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FLIGHT TRANSPORTATION LABORATORY
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Joseph F. Vittek
Editor

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Joseph F. Vittek
Workshop Director
INTRODUCTION

The recent renaming of the NASA Office of Advanced Research and Technology as the Office of Aeronautics and Space Technology emphasizes the new stress being placed on aeronautical research by the Federal government in general, and NASA in particular. Aeronautical research at NASA now engages 5,300 people with an annual budget of $110 million dollars and addresses such problems as:

- Major reductions in aircraft noise, particularly by developing a very quiet short-haul aircraft.
- Improved automated air traffic control
- Encouragement of development of vehicles for both high- and low-density short-haul markets.
- Development of an experimental approach to test and verify not only technical concepts, but also market characteristics, social benefits and the like.

Research and development are essential to the solution of current problems, as they always have been. They are also essential if the full potential of civil aviation is to be realized. However, it must be recognized that neither today's nor tomorrow's problems are solely technological. Solutions will involve not only traditional applications of the physical sciences but also the techniques of economic analysis and the social sciences. Technological advances are subject to a variety of institutional constraints which can be categorized as regulatory, legal, financial, social, attitudinal and the like. All of these factors must be examined and are an essential part of both the problems and their solutions.

Although it is realized that NASA's role in seeking solutions to these problems is essentially technical, it is imperative that the technologist be familiar with the additional constraints that the social and legal systems impose on technical designs. As an example, future aircraft engines must not only provide more thrust, but they must do so economically and quietly.

The purpose of the summer workshop was to provide a
background and insight into these non-technical areas for NASA personnel who will be involved in both the direction and implementation of the technical programs to ensure end products that are acceptable to the market place and the public in general. As was stated in the CARD study:

"... the scope of civil aviation research and development should be expanded to increase emphasis on nonphysical sciences such as economics and sociology."

The workshop consisted of a two-week series of lectures and discussions by leading academic government and industry personnel in the field of flight transportation, covering the interface between technology and the remaining aspects of the air system.

The workshop was held at Waterville Valley, New Hampshire. This site was chosen, because it is away from the normal business setting, thus freeing participants from the daily interruptions of their office routines and offering them a fresh setting in which to immerse themselves in the subject material.

The presentations, as reported here, are not compiled chronologically but rather they are grouped according to major topic and also from the more basic to the more advanced within each topic. This is done so as to give the reader the proper background and continuity (see Table of Contents).
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DEVELOPMENT OF THE AIR TRANSPORT INDUSTRY

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July 10, 1972

Abstract

The presentation will focus on the major developments in the U.S. scheduled air transport industry both domestic and international, together with a brief history of the European air transport system. The role and formulation of the U.S. Civil Aeronautics Board, International Civil Aviation Organization, and International Air Transport Association will also be covered.
The early development of the commercial air transport industry was made possible through government financial support, although this support varied in nature and degree from country to country. In Europe most of the research and development in early aviation was undertaken in one way or another for defense purposes. In the United States, since the transportation of mail had always been the function of the government, public funds were justified to develop the system. Even the "bush-pilots" in Canada were somewhat dependent on government support. In general, this financial aid consisted of air mail payments, grants for offering service on certain routes, outright monetary gifts, aircraft development costs, extremely low interest loans to purchase aircraft and special depreciation allowances. It was assumed that these supports would be temporary and that eventually the industry would become self-supporting.

Prior to the first World War, the United States lagged behind Europe in the development of aircraft, with France considered the pioneer in design and production of early heavier-than-air aircraft. According to one source, at the beginning of the first World War, France had 1400 airplanes, Germany 1000, Russia 800, Great Britain 400, and the United States 23. One explanation for this is the amount of military aviation budget for each of these countries. For example, by 1913 the military aviation budget in France had reached almost 7.5 million dollars, while the figure for the

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1. CAB Publication - Reference 1. Page 204
United States was closer to $125,000.

Although the history of the commercial air transport industry can be traced back to 1905; apart from some of the experimental flights and routes, regularly scheduled air services were not offered until 1918 in the U.S. and 1919 in Europe. In general, the development of the industry focused on the transportation of mail in the United States and passengers in Europe. The U.S. mail service was inaugurated on May 15, 1918 on the New York-Washington route using army equipment and personnel and five months later the air transport part of the service was taken over by the Post Office Department. The fleet consisted mostly of war-surplus aircraft with some new aircraft specially built for the Post Office Department. By December the service was offered in the New York - Chicago market and within two years transcontinental air mail service was in operation between New York and San Francisco with the airplane flying during the day only.

In Europe, after the war, England, France and Germany, all within a few months of each other, started scheduled air services. In Germany Deutsche Luft Reederei began operating a passenger service in February 1919 between Berlin and Weimar via Leipzig; in France Farman Airlines started scheduled operations on the Paris-London and Paris-Brussels routes; and in England, Aircraft Transport and


Travel offered scheduled service in August on the London-Paris route.

The fleets of these early airlines consisted mostly of single and twin-engined bombers which were modified to carry passengers. The British and the French used the early biplanes with capacity ranging from four to twelve seats, while the Germans used the Junker monoplanes. These aircraft had very limited payload capacity, cruising speed and range. By the mid-twenties these early carriers had upgraded the fleets to tri-motors and development was underway for radial air cooled engines which were more powerful and more efficient.

Since the transportation by air crossed national frontiers, a need arose for establishing some principles of international law regarding aerial navigation and a state's sovereignty over its airspace. The Aeronautical Commission of the Peace Conference held in Paris in 1919, established the basic rule of international law regarding commercial aviation. This law stated that every nation has complete and exclusive sovereignty over the airspace above its territory. Although, the United States did not ratify this convention, the Pan American convention signed in Havana in 1928 agreed to most of the principles of the Paris convention. Also in 1919, six European nations, Denmark, England, Germany, Holland, Norway and Sweden, jointly created an organization called the International Air Traffic Association, the predecessor of the present International Air Transport Association. The initial functions of the organization were to clarify international
aviation law and to standardize aviation technology. The main aim of the member airlines was to standardize the conditions and facilities of air travel between their countries.

The mid-1920's represented a period of consolidation in Europe. In many cases the government made consolidation and sometimes partial state ownership a necessary condition for subsidy. For example, Imperial Airways was incorporated in England by merging four separate companies. The Civil Air Transport Subsidies Committee (Hambling Committee) organized in 1923 recommended that the existing four carriers should be merged into one Imperial Airways, partially government owned, which received a total subsidy of one million pounds, spread in decreasing amounts over a ten year period.

Expansion to other countries and continents was largely a result of the European countries expanding operations within their colonial empires. The Belgians, for example, set up services in the Congo in 1920. Since the Treaty of Versailles restricted the Germans from manufacturing aircraft and operating any German international airline, they followed a strategy of setting up local operations in various countries around the world, beginning with South America. The objective was to initially develop local airlines in as many countries as possible and eventually to connect them with a trunk service operating from Germany. Using this strategy, Germany set up local lines in South America,
Eastern and Central Europe, and eventually Persia and China.

Other countries to realize the potential of air transportation were often the ones with poor communication due to natural barriers such as forests, rivers, and mountains, creating a situation for the establishment of air services. For the most part, though, these countries had no aviation industry and exploited some tie with those nations who did in order to obtain aircraft for their air services. In Australia, mail service was started in 1919 on the west coast between Perth and Derby by West Australian Airways. The following year Qantas started the mail service in the east. By the early twenties, similar service was started in Canada, Japan, Latin America, Middle East and South Africa.

In the U.S., while business was not too successful over short distances, great opportunities existed for long-haul transportation of the mail. This was well demonstrated by the time savings produced in an experimental flight from San Francisco to New York taking about 34 hours. By 1924 the transcontinental flight time had further been reduced when the operation had been extended to include night service. The introduction of more reliable and durable engines, radio communication and navigational aids significantly improved the reliability of airline operations. Although there had been a number of early attempts at regular air passenger service in the United States, it was not until 1925 that service
was offered on a year-around basis on the Los Angeles-San Diego route. The 120 mile trip took an hour and a half and cost $17.50 one-way or $26.50 round trip. From here on, the passenger traffic began to grow rapidly and by 1930, the passenger traffic in the United States was about equal to the rest of the world taken together. In Europe, Deutsche Lufthansa was the leading airline in 1930 having carried well over 100,000 passengers. In France in the same year, four airlines put together had carried less than fifty percent of the passenger traffic carried by the German carrier.

The significant passenger traffic growth resulted in the development of larger capacity aircraft. For a long time, however, aircraft speed remained around 100 miles per hour. Although, up until the late twenties, Europe had maintained the lead in aircraft development, the United States took over this leadership in a relatively short period. While the total number of aircraft produced in the United States in the year 1924 amounted to approximately 60, the number increased to about 5,500 during 1929. The U.S. leadership in aircraft development began with the Ford Tri-motor of 1926, continued with the Boeing 247 and received world acknowledgement in 1935 with the DC-3. The DC-3 had a capacity of 21 passengers and a speed of almost two hundred miles per hour. This aircraft revolutionized the air transport industry. Due to its much lower direct operating costs, the carriers were
able to lower the fares and increase traffic. Miller and Sawers show that by the end of 1941, almost 800 DC-3's were delivered and over half of these were delivered to the airlines.

The Post Office Department in the U.S. operated the mail flights until 1927 in spite of the fact that protests were heard from the railroads in the early twenties regarding governmental competition in the transportation of mail. As a result of these protests the Air Mail Act of 1925 (Kelly Act) was passed to encourage commercial aviation and to transfer the air mail transportation operation to private carriers on the basis of competitive bids. Initially the contracts were awarded for four-year periods. Under competitive bidding the most significant contracts were awarded to Boeing Air Transport for the San Francisco-Chicago route and to National Air Transport for the New York-Chicago route. The transcontinental route was linked by about a dozen feeder routes such that almost every major city in the United States was linked on the air mail system.

The problem in the United States during this time period was that the mail revenues were too low to justify capital expense for better equipment. Poor equipment, on the other hand, resulted in poor service which in turn led to even lower revenues. Part of the unwillingness of the carriers to invest in new equipment resulted from the fear of losing mail contracts and the lack of adequate passenger traffic. The carriers needed some government
backing and the public needed assurance that air transportation
was safe, fast and within their means.

There were four major factors which encouraged the develop-
ment of the U.S. air transport industry at this very critical
time. First, the Air Commerce Act of 1926 initiated the
development by the federal government of civil airways, navigational
aids, and provided for the regulation of safety. This Act,
therefore, relieved the private carriers from heavy investments
in ground facilities for air navigation. Second, Charles
Lindbergh's transatlantic flight proved to be very timely in
stimulating the early development of the air passenger market.
Third, the Daniel Guggenheim Fund enabled an experiment to
operate a "model airline" to encourage the development of pas-
senger traffic, which was sometimes considered as a financial
liability. Fourth, the Kelly Act was amended to include pro-
visions whereby the original four year mail contracts could be
extended to ten years, thereby promoting increased investment in
the industry.

During this time period, most of the airlines in the world
were still dependent on government subsidies. Again according to
the research of Miller and Sawers, the French airlines received
the highest amount of government financial support. In 1928
only ten percent or so of the airline revenues came from com-
mmercial operations. In Germany Lufthansa's commercial operations
accounted for roughly 30 percent of the total income. The data on the exact amount of subsidy by country are not readily available. Estimates are available, however, for the development costs of the air mail transportation system in the United States. According to Warner's research, the United States government paid roughly ten million dollars for developing the early transport system. This estimate is based on a total government expenditure of roughly $17.5 million for the nine year period from 1918 to 1927, while Warner estimated the income for this period to be roughly $7.5 million based on the real value of inventory and capital items in hand and the receipts for postage during the nine year period.

In the summer of 1927, Juan Trippe, who was connected with Colonial Airways at the time, learned that the Post Office Department was considering an air mail contract between Key West, Florida and Havana, Cuba. There were two carriers in operation in Florida, Pan American and Florida Airways and neither of these two companies had the necessary financial backing or the equipment to negotiate the contract for the transportation of mail between Cuba and the United States. Although Pan American had acquired a contract from the Cuban government to fly the mail between the U.S. and Cuba, the company did not, however, possess the landing rights.

Trippe flew over to Havana and negotiated an exclusive flying permit between the U.S. and Cuba, ensuring that only Pan Am could operate on this route.

In 1928, the Foreign Air Mail Act was passed authorizing the Postmaster General to award contracts for the transportation of mail by air to foreign countries and territorial possessions of the United States. The carrier selected to offer foreign air mail services was Pan American. Since Pan American had already acquired the necessary landing privileges in other Latin American countries, virtually all of the foreign air mail contracts were awarded to the company at the highest rate permissible under the Act.

Initially the U.S. government did not negotiate the development of the international routes with these Latin American nations. Pan American on its own initiative went ahead and made private agreements with these foreign nations for landing rights in their country and since Pan American was not in a position to offer exchange landing rights, the agreements were made without reciprocal landing rights in the United States. With mail payments authorized by the Foreign Air Mail Act of 1928, and with exclusive landing rights, Pan American showed rapid development.

Although passenger travel was growing fairly rapidly by the end of the twenties, prior to 1929, there was no uniform law regarding the rights of the passengers, ownership of freight, or liability of the carriers. In 1929, an International Diplomatic Conference on Private Air Law was held in Warsaw, Poland
to establish the law regarding the liability of the airlines in international air transportation, towards their passengers and cargo in the event of an accident. The result of this was the Warsaw Convention, which initially limited the carriers' liability to $8,300 for each passenger. The limit on the liability was doubled by the Hague Protocol of 1955 and further increased to $75,000 by the Montreal Agreement of 1966.

In the United States, the Air Mail Act of 1925 was once again amended in 1930 (now called the McNary-Watres, or Watres Act). This Act authorized the exchange of air mail contracts for air mail route certificates with further authority to extend or consolidate routes. Furthermore, the Act authorized payment for the transportation of mail based on space available and distance flown rather than the mail load carried.

It has been said that the Postmaster General, Walter Brown was the chief planner of the Watres Act. He wanted to restructure the industry from a random assortment of short unconnected mail routes to a stable integrated nationwide airline system. He intended to expand passenger services and establish a self-sufficient air transport industry. His plan was to set up three major transcontinental routes coordinated and integrated with several feeder routes. Brown felt that the smaller companies were under capitalized and nearly all of them completely dependent upon the government contracts for their survival. He was con-
vinced that the solution was to eliminate competitive bidding and to use the mail pay to support the carriers whom he considered strong enough to contribute to the development of commercial aviation.

He was able to achieve this by first awarding mail contracts to the lowest bidder who showed a daily operation for a period of at least six months over a route of 250 miles in length and, secondly, through extension or consolidation of routes which in his opinion were in the public interest. The provision providing the substitution of mail contracts for ten-year route certificates had already been in existence. The extension and consolidation provision allowed the establishment of major transcontinental routes. Finally, the form of payment represented an indirect subsidy which enabled the carriers to purchase and operate larger aircraft and develop the passenger market. Mail contracts were not necessarily awarded to the lowest bidder because there was no guarantee that the lowest bidder would be able to survive the cut-throat competition. However, cases when a contract was given to a larger carrier over a smaller carrier the larger carrier was obliged to buy out the smaller carrier at a "fair" price.

Somewhat similar developments were taking place in Europe. For example, the Empire Air Mail Scheme which included provisions that all mail dispatched to or from those parts of the British Commonwealth served by Imperial Airways would automatically be
carried by air. This scheme enabled Imperial to intensify the services and capacity it offered in the knowledge that much of its payload was guaranteed. On this basis, Imperial Airways introduced faster aircraft with more frequent service. This program provided the carrier with substantial subsidy for development in addition to reimbursement for the costs of transporting mail.

During early 1933, charges were made against Brown for collusion, illegal administration and unfair mail awards. A special investigating committee was set and hearings began in September 1933. Although during the investigation it became clear, among other things, that almost all of the mail contracts were awarded to three carriers, some writers claim that the investigation did not probe deeply into the causes of Brown's actions or the sincerity of his national plan. The result of the investigation was that the President cancelled all mail contracts held between the Post Office Department and the private carriers. The Army Air Corps was asked to fly the mail. Severe weather and flying over unknown routes caused some fatal accidents with about a dozen deaths in the first few weeks. As a result of this the transportation of the mail was curtailed and finally came to a standstill in June, 1934.

The Air Mail Act of 1934 set up a threefold control of the air transport industry in the United States. The air mail contracts
were to be awarded by the Post Office Department. The Interstate Commerce Commission was put in charge of setting "fair and reasonable" rates for the transportation of air mail and the Bureau of Air Commerce in the Department of Commerce was made responsible for the regulation of safety. Under this Act, mail contracts were to be awarded on the basis of competitive bidding. Furthermore, the carriers involved in the previous "collusion" charges could not be awarded the contracts, a stipulation which caused the carriers to change their corporate names. In addition, the Act made holding companies illegal and, therefore, separated the historical affiliation between the major airlines and the aircraft manufacturers. Finally, the Act also established a five-man Federal Aviation Commission to study and recommend future aviation policy for the Federal Government. The most important recommendation of this commission was that a single independent agency should be created to regulate civil aviation.

Meanwhile, on the international scene, the determination of landing rights at foreign ports was still the responsibility of the carrier, and Trippe with his position secure in Cuba, had been negotiating exclusive landing rights from the governments of the other Latin-American nations. A decision was made to offer flying boat services based out of Miami and this became the gate-
way to the Caribbean and Latin America. The use of flying boats had two definite advantages: First, whereas airports were scarce, sheltered bodies of water were plentiful; and second, the flying boats seemed to provide a measure of safety in case of a forced landing at sea.

Pan American expanded very aggressively through outright purchase of local airlines or companies if it proved necessary commercially and/or legally. For instance, having won rights to the Caribbean, Pan American proceeded to expand service to the west coast of South America and to Argentina. This was achieved through the formation of Pan American-Grace Airways, Inc., (Panagra) of which Pan American held 50 percent of the stock and W. R. Grace, the steamship company held the other 50 percent of the stock. The firm W. R. Grace and Company ran ships, banks, warehouses, stores, and dominated almost the entire economy on the west coast of South America. From the political and economic points of view, this proved to be a great asset for Pan Am's expansion. There were certain other advantages to the formation of Panagra, for example, the Grace Line steamers provided the radio weather service needed for air transportation. Similar acquisitions of airlines gave Pan American a dominance in Latin America.

Negotiations for the North Atlantic route had begun as early as 1929 resulting in preliminary agreements to offer service twice
a week between the United States and England. However, the British insisted that Pan American could not offer the service until such time when a British carrier could also offer similar service. Since the British did not possess an appropriate commercial aircraft capable of flying the North Atlantic, service was delayed. In the meantime, Trippe involved himself with establishing service on the Pacific. Survey flights were made as early as 1931. While the northern Great Circle route (Seattle-Alaska-Siberia-Japan) required landing permission from Russia and Japan, the central-Pacific route contained fueling points which were American possessions. The mid-Pacific route linked San Francisco and Manila via Hawaii, Midway, Wake and Guam. In October 1935, Pan American received the trans-Pacific mail contract for service from San Francisco to Manila (Philippines). The service was extended to passengers in 1936 and in 1937 the route was expanded to Hong Kong. By 1940, Pan Am had also expanded its trans-Pacific route from Hawaii to New Zealand and Australia.

On the U.S. domestic scene, the air transport industry was passing through a state of ruinous competition. Some carriers were submitting ridiculously low bids to obtain the air mail contracts and routes. Many of the smaller carriers could not bid against the giants, and public investment was beginning to shrink. Legislation was needed to financially stabilize the industry by providing control of competition, assurance of the operation of the carrier, and an end to the confusion of responsibility.
through the establishment of a single regulatory agency.

The Civil Aeronautics Act of 1938 placed the development, regulation and control of air carriers under the jurisdiction of a single independent administrative body later known as the Civil Aeronautics Board. This Act broadened the scope of safety regulation and subjected the airlines to economic regulation. The regulation of the industry was performed with "public interest" and "public convenience and necessity" as main considerations. The major functions of the CAB were to approve passenger fares, freight and mail rates, certificate carriers, monitor competition, and approve mergers and subsidies.

Under the "grandfather" clause of the Civil Aeronautics Act of 1938, 16 remaining airlines were given permanent certificates of convenience and necessity for routes which each of them possessed at the date of adaptation of the Act. The Board also certificated the Railway Express Agency as an indirect air carrier with exemptions from the economic provisions of the Civil Aeronautics Act. The nonscheduled carriers were not required to have certificates of public convenience and necessity and were also exempt from economic regulation by the Board.

Pan American introduced the first regular scheduled mail service on the Atlantic in May 1939, between New York, Lisbon and Marseilles. One month later a similar mail service was offered to England via Newfoundland and Ireland and in July of 1939 passenger service was opened to both countries. The transatlantic crossing took approximately 29 hours using the Boeing 314 flying
boat. The British began a similar service in August. Initially, the passenger fare was set at $375 one way or $675 round trip.

By 1940, the U.S. government's policy towards exchanging landing rights had changed. The landing privileges on international airports were to be negotiated by the Department of State and subject to presidential approval. The CAB was to decide as to which United States carrier should be authorized to operate the negotiated routes. This, in essence, put an end to Pan American's monopoly on negotiating and operating exclusive landing rights.

With the beginning of World War II, Pan American's projected expansion came to a halt. The U.S. government took over the transatlantic operations with Pan American and American Export Airlines being the sole operators. Regular schedules were maintained on the Atlantic and the Pacific. Furthermore, a lot of the aircraft belonging to the U.S. domestic airlines were either purchased or leased by the government. With very few aircraft left in their hands, the carriers were forced into more efficient operations and greater utilization from their fleet on restricted routes which received service. Most of the airlines began to show profit during the war years due, basically, to high load factors, high utilization of equipment and elimination of discount fares such as for round trips and those offered to credit card holders.

During the War normal airline operations were curtailed throughout Europe due to shortage of equipment or enemy action.
Passenger traffic dropped to about a third of the level achieved in 1939. Britain's air transport industry felt a very severe impact. The routes of BOAC had to be restructured completely: the Empire Route had to by-pass Europe and the North Atlantic service was discontinued while the carrier concentrated in keeping open critical lines of communication. The airlines of Allied countries were cooperative in transporting government officials, military personnel and supplies. In Germany Lufthansa's commercial operations were ended abruptly.

The War was responsible for the rapid technical and operational development of transport aircraft. Many refinements were introduced to the aircraft which were in existence prior to the War. Aircraft introduced during the War period such as the DC-4 and the Lockheed Constellation possess higher payload capacity, range and speed. Other areas where refinements were introduced rapidly included radio communication, navigational aids, instrument flying and airport facilities.

Towards the end of the war, many nations were interested in formulating a universal international air transport policy with regard to commercial air rights and in establishing rules governing technical and navigational aspects. In 1944, at the invitation of the United States, 54 nations sent their representatives to the Chicago Conference to formulate universal international air transport policy for international travel and commerce. Due to
the conflicting interests of the various nations present at the conference, an agreement was not reached to provide a means for exchanging commercial rights to fly in and out of independent nations. Basically, there were two conflicting views-- one of relatively complete competitive freedom desired by the U.S. having the aircraft, experience, and finances to dominate such a state of affairs; and the other of rather heavily regulated operations supported by most other nations in their poor economic state following the War and fearing just such a U.S. dominance from which they might never escape. The British wanted to set up an international agency to control capacity, frequency and fares. The routes were to be assigned through bilateral agreements. The Americans, on the other hand, agreed that the routes should be negotiated through bilateral agreements, but the international agency should perform a consultative function only with respect to economic regulation. Instead they suggested, the agency should be restricted to control the technical side of the air transportation.

The outcome of the Conference was an establishment of the International Air Services Transit Agreement and the Provisional International Civil Aviation Organization (PICAO). The former agreement allowed civil aircraft of the signatories to (a) fly across another nation's territory (if the nation was a participant to the agreement) without landing and (b) land for non-commercial purposes. The function of PICAO was to coordinate the activities of the nations signing any agreement made at the Chicago Conference.

5. See Robert Thornton - Reference 5
This organization was also to act as an arbitrator in case of conflicts between the various member states. PICAO, however, did not possess any economic powers to be applied to the international air transport industry.

In 1945, the International Air Transport Association (IATA) was formally established at Havana, Cuba. This organization superseded the original one formed in 1919. Unlike the old organization, the principal function of the new IATA was to control rates on international routes. There are no provisions for controlling capacity or frequency. The extent of capacity was to be negotiated in the bilateral agreements. In addition, some of the functions of the old IATA were still to be performed by the new IATA. The two most important provisions in the functioning of IATA with regard to controlling fares are: (1) a proposed tariff has to be approved unanimously by all the members (2) the approved tariff is still subject to the approval of the aeronautical agency of each of the member nations, which would be affected by the proposed tariff.

Since the Chicago Conference did not result in an agreement to decide on a means of exchanging commercial rights, representatives from Great Britain and the United States met in Bermuda in 1946 to exchange operating rights between the two nations. The Bermuda Agreement resulted in the famous "five freedoms" of the air. The first two freedoms were essentially agreed at the Chicago Conference, namely to fly across and to land for non-
commercial purposes in another nation's territory. The remaining freedoms are: to disembark passengers and cargo in a foreign country which originated in the carrier's home country; to pick up passengers and cargo from a foreign country destined for the carrier's home country; to transport passengers and cargo from one foreign country to another foreign country. The freedom classification is based on the origin and destination of the passenger and the nationality of the airline and not the passenger. For instance, a Canadian in London boarding a flight to Rome is a third freedom on a British carrier, fourth freedom on an Italian carrier and fifth freedom on a U.S., Canadian or a French carrier.

Most countries were in favor of the Bermuda type of agreement for exchanging international traffic rights for commercial civil aviation. The terms of the original Bermuda Agreement between the United Kingdom and the United States are fairly liberal. For example, the agreement did not include provisions for restricting frequencies or number of carriers of either country. Since then, however, the policies of countries have changed. For instance, in 1966, a special bilateral agreement was signed between the U.S. and the U.S.S.R. to provide service between New York and Moscow. This agreement is different in format from the usual Bermuda type, since it contains provisions on the number of frequencies that may be operated between the two countries.
as well as a designation of the carrier which may operate these flights.

In international operations, a country may sometimes designate two or more national carriers to offer parallel services on a given route. The United States has authorized this type of designation on the North Atlantic. London is served, for example, by National, Pan Am, TWA, and Seaboard, the all-cargo carrier. The decision for multi-designation on an international route involves many factors, such as density of the route, the extent of traffic generated by each country, the market share of the carriers of each country, fifth freedom traffic, national interest, etc. While some of these factors are market related and based on simple economics, others are of a political nature and as such very difficult to evaluate.

After the War, Pan American was a strong promoter of the "chosen instrument" concept. Under this concept, all international services were to be operated by a single carrier. Again the concept involves many factors such as prestige, defense, public interest, competition with subsidized carriers, the value of the market, etc. In the United States, the Civil Aeronautics Board, however, favored competition. As early as 1942, American Export Airlines (a shipping company) was awarded a temporary certificate to offer transatlantic service. The Board justified this by saying that an additional carrier would improve the service and serve as a yardstick for comparison of costs. Soon after the war,
Pan American was given further competition when another U.S. carrier, TWA, and a number of foreign flag carriers were authorized to offer scheduled service on the North Atlantic.

With expansion of routes, excess capacity, and heavy investment committed in larger and faster aircraft, the U.S. domestic air transport industry was facing economic crisis in 1948. The scheduled carriers were facing another problem, that of competition from the nonscheduled carriers which came into existence at the end of the War. These nonscheduled operations were started by ex-military personnel who purchased the war-surplus aircraft. The Board exempted these nonscheduled carriers from the economic regulation to carry passengers and/or property in the case of domestic operations and property only in the case of international operations on selected heavy traffic routes. The Board's exemption was based on the assumption that the service provided by these carriers would supplement the scheduled carriers.

In order to improve the economic situation of the industry, the Board authorized high mail rates. This was supplemented by larger passenger traffic growth due to the introduction of lower fares, partly a result of the economics of larger and faster aircraft and partly due to management initiative in introducing differential pricing mechanisms such as coach-type service and family fare plans.
The other line of development in the aviation industry after the War, was the air freight. Although, in the United States the history of air freight dates back to 1930 when many companies made arrangements with the Railway Express Agency to transport packages on regularly scheduled flights, it was not until 1945 that all-freight airlines came into existence. In 1947, the Board permitted ten all-cargo carriers to offer scheduled air freight transportation on a non-certificated basis. By 1949, six of these had declared bankruptcy and the remaining four were issued temporary certificates of public convenience and necessity to perform scheduled service.

There are four other types of U.S. air carriers which need some explanation. First, there were carriers such as Alaska and Hawaiian Airlines which were located in the U.S. overseas territories. Since Hawaii and Alaska did not enter the Union until 1959, and for other reasons of special operating rights with respect to other U.S. airlines, these carriers were not classified under the category of domestic. Even today they are classified as Intra-Alaska or Intra-Hawaii carriers and both carriers possess the Board's permanent route certificates. Secondly, after the War, there was yet another category of carriers called the intra-state carriers. The operations of these carriers were restricted to within state borders and regulated by the state's Public Utilities Commission. These carriers were exempt from the Board's regulations. Third, in 1952, the CAB authorized a group of small
irregular carriers to offer service between communities not served by scheduled airlines to points receiving scheduled airline service. These carriers, called the air-taxi operators or commuter carriers in their scheduled form, offering service with aircraft weighing less than 12,500 pounds were also exempt from the Board's Economic Regulations.

The fourth category of carriers consisted of the helicopter air service operators. The Helicopter Air Service Program started in the United States after the War with subsidies to helicopter carriers in a few major cities for the carriage of mail. Until 1953, the three United States helicopter carriers carried no passengers at all and their sole source of transport revenue was from mail. In the early years the subsidy exceeded overall transport revenues, but as passenger traffic increased, it passed subsidy levels by 1964. The subsidy was completely cut off by the end of 1965 and the major trunk airlines were persuaded to supply financial aid to the helicopter carriers. Since most of the helicopter passengers were airline connecting passengers, the rationale for this action lay in offering better services for the airline passengers with the costs to be borne by the profits of the trunk-line industry.

In Europe, BEA and Sabena made significant inroads in the development of helicopter service. BEA started the scheduled
helicopter passenger service in 1950. Over the years, many routes were tried on an experimental basis and most of these proved to be unprofitable because of excessive costs. Although Sabena was far more successful in its helicopter passenger service, the carrier had to curtail the operations for economy and other non-market reasons. The year 1958 was a boom year when, due largely to the Brussels World Fair, the helicopter services carried over 50,000 passengers and an additional 65,000 sightseeing passengers over Brussels.

By October of 1951, ten domestic trunk carriers had gone off federal subsidy. For those still receiving subsidy, the CAB announced that a separation should be made between service mail payments and subsidy mail payments. For the Big Four trunks -- American, Eastern, TWA, and United, the Board established a domestic service mail rate of 45 cents per ton-mile. Four years later the Board developed a uniform service mail rate structure called "multi-element rate formula." This was a two part rate structure consisting of a line haul charge per mail ton-mile and a terminal charge per pound of mail enplaned, varied according to the class of station served.

In Europe, after the war, the air transport industry grew very rapidly. Most of the route network consisted of pairs of airlines enjoying third and fourth freedom rights and even today

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there are usually only two dominant airlines on any given city-pair. Until about 1950, there was heavy competition between the two carriers. This was considered wasteful rivalry and was gradually eliminated and replaced on many routes by a system of commercial agreements between the airlines, generally known as pool agreements. Pool agreements generally tend to reduce competition and provide the carriers with high equipment and personnel utilization as well as high load factors. Economics can result through more uniform scheduling instead of "bunching" flights at peak demand periods. It is claimed by some that pooling agreements provide the passenger with a more uniform service at a lower price. This is debatable. The terms of the agreement can include sharing of revenue, capacity, costs, and can also include joint marketing studies, promotion and sale, etc. The extent of the agreement varies from carrier to carrier and the agreements are usually tied to the national agreements between the respective countries. According to the Edwards Report, BEA for example, earns roughly 60 percent of its total revenue from commercial agreements. These agreements are not necessarily restricted to intra-European operations. For instance, the "Kangaroo" route which links England with India and Australia is operated through a tripartite agreement between BOAC, Qantas and Air India. The

distribution of revenue is based on a sophisticated formula which takes into account traffic on the various segments as well as the connecting traffic at various points.

These pool agreements generally apply only to the third and fourth freedom traffic. Within Europe fifth freedom traffic is generally limited. There is yet another type of traffic called cabotage. This refers to the transportation of passengers by a foreign carrier between two cities in the territory of one state or its dependencies. For instance, BOAC carrying passengers originating at New York to Los Angeles would be referred to as cabotage traffic. Another example of this would be for Pan Am to carry traffic originating in London to Bermuda. The German internal service operated by foreign carriers is sometimes confused with cabotage traffic; here however, the peace treaty which followed West Germany regaining its sovereignty prohibited Lufthansa from offering service to West Berlin and this service was offered by Air France, BEA and Pan Am. This is not cabotage traffic. However, there were some other routes within West Germany which were operated by the foreign carriers, which was cabotage and is now practically non-existent.

A large number of the scheduled airlines, with the exception of the United States air carriers, are partially or wholly owned by their governments. The extent of government ownership can range from a small percentage as in the case of Finnair (about 6 percent) to a complete control as in the case of BOAC, Qantas,
Air Canada, Air India, etc. Presently, out of the 107 IATA member carriers, 37 are completely privately-owned and forty are completely state-owned. Table 1 shows the extent of state ownership for the IATA member carriers.

The reasons for public ownership vary from political philosophy to market related factors. In England, for example, one reason for nationalization of the airlines was that these carriers were unable to compete with the subsidized foreign carriers. The size of the carrier is usually not the reason for public ownership; it is also important to keep in mind that private ownership, in the case of an international airline still involves government participation for at least two reasons. First, the carrier can prove to be a very useful element of national defense, and second, the carrier needs the government to negotiate bilateral agreements with other nations for landing rights.

Some analysts have attempted to find the relationship between government ownership and profitability. So far there is no conclusive evidence that government ownership leads to inefficient operations, lower profitability, etc. In fact, several government owned airlines have consistently shown profitable operations. In most cases, complete or partial public ownership also does not imply that these carriers exist solely to provide social services, carry the national flag, receive protection from competition and pay very little attention to the cost of providing the service.
## TABLE 1

Extent of State Ownership

**IATA Member Carriers**

<table>
<thead>
<tr>
<th>Number of Carriers</th>
<th>Percent State Ownership</th>
</tr>
</thead>
<tbody>
<tr>
<td>37</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>1 - 49</td>
</tr>
<tr>
<td>13</td>
<td>50 - 89</td>
</tr>
<tr>
<td>8</td>
<td>90 - 99</td>
</tr>
<tr>
<td>40</td>
<td>100</td>
</tr>
</tbody>
</table>

**TOTAL 107**

In many cases the nationalized airlines are eventually expected to pay their own way.

Joint ownerships are quite common in the airline industry. For example, in 1946, TWA acquired a 35 percent common stock interest in the Greek Company, Technical and Aeronautical Exploitations, in exchange for financial and technical assistance. In the same year, BEA held 30 percent interest in Alitalia. There are many reasons for holding financial interests in other airlines. These can range from pure commercial investment reasons to obtaining feeder traffic, developing new routes, and establishing an outlet for retired aircraft.

The establishment of airlines in many of the smaller or less developed countries was strongly influenced by non-economic or non-market factors. In many cases, the airlines were supported by the government for reasons such as national prestige and national defense. On the economic grounds, these international services are usually justified for such reasons as earning foreign exchange and developing tourism. In many cases the development of these airlines was enhanced significantly by the foreign aid through agencies such as the United States Export-Import Bank, ICAO, World Bank, A.I.D., etc. The United States, for instance, has provided low interest loans to purchase United States manufactured aircraft.
the European countries have also provided similar sort of aid in
the past. Besides financial aid, the airlines of these less
developed nations have been given support in areas such as pilot
training, technical services, management consultation, etc. The
benefits gained by the nations providing aid and the airlines
providing support have been mentioned previously.

By the mid-1950's, the airline industry in the United States
could be considered as established. In 1955, the CAB granted
permanent certificates of public convenience and necessity to
the local carriers. Two years later, the CAB was authorized to
guarantee loans to assist carriers to purchase flight equipment.
The amount of loan was limited to 5 million dollars per carrier
and maximum of 90 percent of the loan could be guaranteed. The
following year, new legislation was introduced permitting the
subsidized air carriers to retain profits from the sale of flight
equipment on the conditions that the profits were reinvested in
new equipment within a reasonable period of time.

The Federal Aviation Act of 1958 amended and replaced the
Civil Aeronautics Act of 1938. The safety rule making function
was transferred to the newly created Federal Aviation Agency,
while the regulation of civil aircraft accidents still remained
the responsibility of the Civil Aeronautics Board. Parallel
developments in streamlining the regulatory aspects of air
transportation were taking place in many other countries of the
world. For instance, Britain's Civil Aviation (Licensing) Act of 1960 established the Air Transport Licensing Board to approve applications for operating licenses and regulate domestic fares in the United Kingdom.

The type of regulation applied to the airlines in the United States should not be taken as typical. For instance, the Australian civil air transport policy has been quite unique. Presently the Australian airline industry is basically made up of three airlines: Qantas, a public-owned carrier operating international services only, and two competitive domestic airlines, a private corporation called Ansett Airlines and a government-owned carrier called Trans-Australia Airlines. Under the Civil Aviation Agreement of 1957 and the Airlines Equipment Act of 1958, the government not only controls competition, but exercises a tight control on the commercial management decisions. For example, neither TAA or Ansett can purchase a new aircraft without the specific approval of the government, while each carrier is also supposed to inform the other of its decisions to purchase new equipment. The approval is granted if the regulatory authority considers that the new equipment will not result in excess capacity or produce a competitive edge for one of the carriers. In case of excess capacity, the authority can force the carrier(s) to review their fleets.
Although, research and development of the jet engine was well under way during and even prior to World War II, it was not until 1952 that the public was offered commercial jet service by BOAC (which unfortunately had to be withdrawn shortly after for technical reasons.) In 1956 the Russians introduced the TU-104. The year 1958 is, however, referred to as the "jet revolution" year when Pan American introduced the Boeing 707 on the North Atlantic, in October 1958, three weeks after BOAC introduced the second version of their jet, the DeHavilland Comet 4. For almost a full year there were no other competitors on the North Atlantic with jet aircraft until September and November of 1959 when QANTAS and TWA introduced the Boeing 707's. On the domestic side, National Airlines was the first to offer jet service in the United States, on December 1958, the carrier offered jet service on the New York-Miami route with a B-707 leased from Pan American Airways. A month later American put in a 707 on the transcontinental route, TWA entered the market in March, and United introduced the DC-8 in September of 1959 on this route.

Up to this point, the emphasis has been upon scheduled services, domestic and international, however of increasing importance has been the development of mass travel on non-scheduled or charter services due to the lower fares relative to scheduled services.
The scheduled air services have catered to this demand through excursion fares and other forms of differential pricing, however the lower costs obtainable through non-scheduled air travel have resulted in a tremendous growth in this form of air transportation.

The growth of non-scheduled air carriers started after World War II on both sides of the Atlantic, dependent largely upon the carriage of military cargo and troops for their survival. However before long the European carriers began to vigorously promote civilian commercial operations, in particular the inclusive tour charter.

In an inclusive tour charter, a travel agent produces a "complete package" containing air travel, hotel accommodations, ground transportation, etc. and by arranging schedules to ensure full plane loads, the operators are able to offer packages at a considerably lower price compared to the price of air travel on scheduled carriers. By opening the air travel market to the lower income groups, the charter operators were able to achieve tremendous growth rates.

Prodded by the tremendous demand and realizing the economic importance of tourism, the European States formulated a Multilateral Agreement on Commercial Rights of Non-Scheduled Air Services in Europe at Paris in 1956. This agreement greatly facilitated the growth of inclusive tour travel between the 19 signatories, while attempting to protect their scheduled services.
The low price of the ITC's allowed the lower income workers in Northern Europe to holiday in the sunny South, with air travel to and from the resorts making such a vacation possible within the short time periods available to them. A number of combining factors meant that the United States was much slower in responding to this development and ITC's were not permitted until the mid-sixties while military charters still represent a significant proportion of the supplemental carriers' revenue.

Similar to the scheduled carriers, the United States charter carriers are owned privately. In Europe, although the charter operators are not owned directly by the state, many of them are owned by the national carrier which in turn is partially or wholly owned by the state. This is a critical issue regarding competition not only between charter operators and scheduled airlines in Europe, but between United States scheduled and European scheduled carriers. In the United States, scheduled airlines have not been allowed to own subsidiaries which offer charter services, although they may do so themselves.

Interesting agreements such as these were not always set up in Europe. A different, but interesting agreement was formed by the major airlines in the United States. In 1959, six U.S. carriers, American, Capitol, Eastern, Pan American, TWA and United entered into an agreement called the Air Carrier Mutual Aid Pact.
This agreement provides for financial assistance in case of a strike. The arrangement calls for payment to the struck carrier of any increased "windfall" revenues which they receive as a result of handling the struck carrier's business less the additional expense of handling such increased traffic. In addition, more recently the CAB has allowed some carriers to cooperatively restrict capacity on certain routes.

In general the United States policy reflected free trade. This has been made fairly clear in the various reports on the U.S. international air transport policy released in 1963 and 1970. The policy was essentially non-protectionist, promoting reasonable rates and equal opportunities for U.S. carriers in route exchanges with foreign nations, and opposing arbitrary capacity restrictions. Other significant recommendations were to retain a balance of U.S flag competition on the North Atlantic, have more than one U.S. international air carrier and oppose pooling agreements with foreign carriers.

In Europe, cooperative agreements regarding maintenance and spare parts had begun as early as 1958, with the introduction of jet aircraft. Initially SAS and Swissair signed an agreement to coordinate equipment policy and pool resources in terms of operating workshops and technical organizations. By 1969, the agreement had been extended to include two other carriers, KLM, and UTA, to
form the KSSU group. Under the new program, KLM was to provide airframe maintenance for the B-747 and SAS was responsible for the engine maintenance. This type of cooperation provides the carrier with a small fleet with the advantages of a large fleet.

One other form of cooperative agreement which is significant is the concept of "blocked-space" agreement. Under this concept, a developing carrier with insufficient funds to invest in a large fleet and to minimize the financial risk involved in purchasing aircraft, can block space on another line to be sold under its corporate identity. For example, in 1969 Austrian Airlines entered into a pool agreement with Sabena to offer service on the North Atlantic. Under this scheme, Sabena operated a daily B-707 flight from Vienna to New York via Brussels. Austrian Airlines blocked half of the cargo capacity for its use and paid Sabena half the operating costs of the flight, and a fee for each passenger handled. The flag carrier of Portugal, TAP, had negotiated a similar blocked space agreement with Alitalia in 1966 to offer service between Lisbon and New York.

The mid-sixties not only set the pace for jet operations, but also began to focus on the supersonic aircraft. Pan American, BOAC, and Air France placed firm orders for the Concorde supersonic aircraft. Besides these three international air carriers, a U.S. domestic carrier, Continental Air Lines, also placed an order for three Concorde aircraft. In the meantime, two airframe manufacturers and two engine manufacturers undertook the design studies on the U.S. SST
for the Federal Aviation Agency. The major portion of the cost of research and development was to be borne by the United States Federal Government. Boeing and General Electric were selected to design the United States SST. This team won the competition but the project was abandoned in 1971 for political, environmental, and socio-economic reasons.

The mid-sixties once again witnessed a further streamlining of the transportation planning process in the United States. The Department of Transportation was created to provide total transportation planning, policy guidance and protection of public interest with the aim of achieving an integrated national transportation system based on economic criteria and not modal preferences. Prior to this organization, there were numerous uncoordinated modally oriented transportation agencies with virtually non-existent common goals. These agencies were generally unstructured and without sufficient authority to develop a national transportation system effectively. The Department was given the responsibility of coordinating transportation programs, providing transportation leadership, cooperating and coordinating transportation projects with federal, state, and local government agencies, and identifying prodigious transportation problems.

Parallel efforts took place in Canada, where the National Transportation Act of 1967 created the present Canadian Transport Commission to coordinate the development, regulation and control of the total transportation system; and in the United Kingdom where the Civil Aviation Authority (CAA) came into being in April of this year (1972)
with much the same powers but for aviation only. The functions of these Agencies are somewhat similar to those of the United States Department of Transportation as well as the Civil Aeronautics Board.

In this paper most of the attention has been devoted to the development of the air passenger transportation industry. Although the growth of air cargo has been very significant in the past, its contribution to the total revenue of the carriers is still fairly small. On the average, for all scheduled airlines taken together, approximately ten percent of the revenue is derived from air cargo. According to one report less than one half of a percent of the total cargo moves by air. The same report estimates that if the bulk cargo such as oil, coal minerals, etc, is excluded then the share of cargo transported by air increases to almost four percent. In the past a large part of the air cargo has been emergency cargo. The stable cargo has in the past been restricted to goods of high value, fragility and perishability.

The most crucial factor in air cargo is, of course, the cost. It is now a generally accepted fact that roughly half of the cost of handling cargo is on the ground: loading, unloading, storing, documentation, etc. Recently, effort has been focused on reducing these ground handling costs. For instance, according to one detailed study, a typical international shipment requires the preparation and processing of an average of 46 documents of which nine involve the carrier directly.

8. Interavia - Reference 8.
Efforts to reduce ground handling costs in the past have been in the areas of containerization, computerized documentation systems, etc. Another critical and unfortunately unsolved problem is in the area of rates. So far no carrier or government agency has been able to set rates which take into account adequately, the cost, the value and the market elements of air cargo. The solutions to these problems will expand the air cargo market and its contribution to the total revenue of the air transport industry.

Although direct subsidy is non-existent with major airlines, indirectly the airlines are still aided a great deal by the governments. In most cases, the full cost of navigational and terminal services is still not recovered from the air carriers, but supported by national and regional governments. Since the Chicago Conference of 1944, much work has been done by ICAO to try to coordinate and standardize the charges made for airport and their facilities are open to use by anyone, the governments have had much trouble distinguishing between the services offered to different users. As a consequence, it is debatable whether the airlines have paid their full way on the ground or in the air.

Recently more accurate allocation of airports and navigational costs have become critical issues. In Europe, for example, an organization called Eurocontrol operates navigational facilities in the upper airspace and makes a charge for such services. In the United States the Airport and Airways Development Act of 1970 imposed new and increased aviation user charges to be used for expansion and improvement
of the airport and airway system. In addition, some airports have sought to meet their costs through "head taxes" levied on arriving and/or departing passengers. Recently, an agreement was reached in the United States to prohibit such state and local airport head taxes.

During this relatively short period of roughly sixty years, the progress in the commercial air transport industry has been spectacular. In 1970, over 300 million passengers were carried by the scheduled international and domestic carriers belonging to IATA. Today, the operating revenue of the United States airline industry is about ten billion dollars. We can expect even greater progress with the forthcoming supersonic age and the increasing growth of tourism with its mass travel implications.
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THE ROLE OF THE FEDERAL GOVERNMENT IN THE
DEVELOPMENT OF THE U.S. AIR TRANSPORTATION SYSTEM

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Abstract

A review of the roles of the various federal agencies in the regulation, control, and development of the Air System, with major emphasis on the Department of Transportation (Office of the Secretary, Federal Aviation Administration, and National Transportation Safety Board) and the Civil Aeronautics Board.
The Federal Government plays a central role in the development, finance and operation of the United States Air Transportation System. Figure 1 shows some of the functional relationships between the Government and the other major institutions that are parts of the system. Although local and state governments play a minor role (through the imposition of local taxes or participation in airport ownership and management), the national government is the primary source of political influence and legal control.

Figure 2 shows the government organizations that impact the air system and how they fit into the federal structure. The United States Constitution is the ultimate source of all authority. It allocates governmental functions between the Courts, the Congress and the President. In turn, the legislative and executive branches create and appoint personnel to the independent agencies which are in essence a fourth branch of government—the administrative branch. Each branch interacts with the others, and each plays a particular role.

THE ROLE OF THE COURTS

The Courts are not involved in the day-to-day affairs of the air system. Their major function is the supervision of other governmental bodies through the judicial settlement of disputes as they arise. In addition to the resolution of con-
flicts involving the federal government, the Courts settle liti-
gation between the other institutions that make up the system – the users, manufacturers, airlines, etc. Judicial decisions may have major impact and long range policy implications, but since they only arise when parties bring particular disputes before the Courts, one cannot say that these decisions play a decisive or prominent role in shaping air transportation.

THE ROLE OF THE LEGISLATURE

Under Article I, Section 3 of the Constitution, the Congress has the power to regulate commerce among the states. Therefore, the legislature is the major source of air system policy. However, Congress, like the courts, does not participate in the day-to-day affairs of the system. Rather, through legislation, it establishes policy and delegates the implementation of that policy to executive or independent agencies. Through Congressional hearings, it periodically reviews the impact of its legislation and will make modifications only when necessary.

Perhaps the most important function of Congress is the control of appropriations sought by the operating agencies. In this way, the legislature can exert pressure on both the administrative and executive bodies that are charged with policy implementation.
General Accounting Office (GAO)

The General Accounting Office is an independent agency in the legislative branch of the government established to assist the Congress in controlling the receipt, disbursement and application of public funds. In general, the audit authority of the GAO extends to all departments and agencies of the Federal Government. Through audits, the GAO monitors the ways in which agencies are discharging their financial responsibilities, the efficiency of operations and program management, and whether Government programs are achieving the purposes intended by Congress. This monitoring activity also extends to state and local governments, quasi-governmental bodies and private organizations when they receive or administer federal funds.

By law, federal agencies are required to pay on presentment bills for freight and transportation services furnished by carriers subject to the Interstate Commerce of Federal Aviation Acts. These payments must be made even if not audited. The GAO monitors these transactions, and is responsible for determining the propriety of the rates and classifications billed, recovering overcharges and settling transportation claims brought for or against the government.

THE ROLE OF THE PRESIDENT

Article II, Section 1 of the Constitution vests the execu-
tive power of government in the President. In addition, the President has specific authority and responsibility covering a large range of topics conferred by statute. In general, he is charged with the implementation of federal policy, which he performs both through the Executive Office of the President and the Executive Departments.

The Executive Office

Many special and general purpose agencies are administratively grouped into the Executive Office. They provide various services and functions to assist the President in his administration and executive duties. Several of these agencies can have major impact on the air system.

Council on Environmental Quality -- The Council was established by the National Environmental Policy Act of 1969 to formulate and recommend national policies to promote and improve the quality of the environment. Its recommendations on aircraft noise and pollution could have great influence on the future of air transportation.

Domestic Council -- Through ad hoc project committees set up to deal with both broad program areas and specific problems, the Domestic Council formulates and coordinates domestic policy recommendations to the President. It assesses national needs and coordinates the establishment of national priorities, recommends integrated sets of policy choices and provides a rapid response
to Presidential needs for policy advice on pressing domestic
issues. The Council also maintains a continuous policy review
of on-going programs.

National Aeronautics and Space Council (NASC) -- Created
along with NASA by the National Aeronautics and Space Act of
1958, the NASC is composed of the Vice President, the Secretaries
of State, Defense and Transportation, the Administrator of NASA,
and the Chairman of the Atomic Energy Commission. An Executive
Secretary administers the affairs of the Council assisted by a
small staff.

The functions of NASC are to advise and assist the Presi-
dent regarding policies, plans and programs in aeronautics and
space. The Council develops comprehensive programs for such
activities and fixes the responsibilities of the agencies involved.

Office of Management and Budget (OMB) -- OMB is the Presi-
dent's financial watchdog. It also provides valuable interagency
coordination and review. In the financial area, OMB assists the
President in improving the efficiency and economical conduct of
Government services, and in the preparation and formulation of
the budget and fiscal programs. It supervises and controls the
administration of the budget. OMB also conducts research into
new modes of administrative management.

In the area of interagency review, OMB clears and coordinates
departmental positions on proposed legislation and monitors the
progress of activities so that the work programs of all the executive agencies may be coordinated and so that Congressional appropriations can be expended in the most economical manner with the least overlap and duplication of effort.

OMB also promotes and coordinates Federal and other statistical services, and plans and develops information systems to monitor program performance.

Office of Science and Technology (OST) -- OST assists the President in the development of technical programs and evaluating and coordinating technical activities to assure that science and technology are used most effectively in the general welfare. Specific tasks include the assessment of selected scientific and technical developments and programs and the evaluation of their impact on national policies. OST also maintains close relations with the Nation's scientific and engineering communities so they will continue to participate in the strengthening of the national technology base.

Special Commissions -- Special boards, committees and commissions are created from time to time for special purposes and administratively report to the Executive Office of the President. Some examples are:

Export Administration Review Board
Federal Safety Council
President's Science Advisory Committee
Aviation Advisory Commission
These commissions are composed of experts from industry and
government with full-time staff support. Generally, they under-
take a specific important task, and are dissolved when their work
is completed.

The Executive Departments

The Department of Agriculture -- In addition to its more
traditional duties, the Department locates, operates and admin-
isters airports in the national forest; contracts for aerial ser-
vices such as seeding, spraying and fire fighting; and through
participation in CAB proceedings, the Department seeks to secure
adequate air service for its forests. The Department also oper-
ates inspection and quarantine stations for plants and animals at
airports of entry and assures the humane treatment of animals
moving in interstate commerce by air.

The Department of Commerce -- Through the United States
Travel Service, the Department encourages foreign travel to the
United States, and controls the export of aircraft and related
equipment. It also disseminates technical data abroad and en-
courages U.S. businesses to seek foreign contracts.

Through the Bureau of the Census and the Coast and Geodedic
Survey, the Department provides population and geographic data
essential for airport siting and planning. Through the National
Weather Service, the Department provides the weather information
vital to aircraft operations.
The Department of Defense (DOD) -- The role of the DOD in the development of the air system cannot be minimized. Through technology spin-off, DOD projects have provided the scientific and technical base for many major developments in civil aviation. In addition to the technology spin-offs, it is a prime source of trained aviation personnel who have completed military service.

The DOD is also a customer for air services. It contracts with carriers for the movement of its personnel and equipment and thus provides a major source of income to them, particularly the supplementals. In connection with its purchases of air services, the DOD appears before the CAB in matters relating to military tariffs.

Department of Health, Education and Welfare -- The Department provides quarantine functions at airports of entry to protect against the import of contagious human diseases and to enforce interstate quarantine and health regulations.

Department of Housing and Urban Development (HUD) -- HUD provides funds for regional and urban planning including research on zoning, land-use planning and airport planning. It can finance studies of urban access problems, but research on rapid mass transit to airports is primarily performed by the Urban Mass Transit Administration.

The Department of the Interior -- The Department controls the use of airports in national parks, monuments and recreational
areas. Through participation in CAB proceedings, the Department attempts to ensure adequate service to these areas as well as for the Pacific Trust Territories which it helps administer.

The Department of Justice -- The Department has several functions that directly relate to the air system. First, through the Immigration and Naturalization Service, it maintains offices at airports of entry to monitor the transit of aliens and foreign nationals. Second, Justice enforces nondiscriminatory practices in the air industry by prosecuting violations. Third, Justice provides enforcement when needed for the rules of air safety such as transport of dangerous items and interference with the pilot. Finally, the Justice Department takes an active role in merger proceedings before the Civil Aeronautics Board and enforces anti-trust laws against manufacturers and suppliers. The Civil Aeronautics Act of 1938 exempts the air carriers subject to the Act from the anti-trust laws and substitutes CAB supervision. However, the other institutions in the air system are subject to prosecutions for anti-trust violations.

The Department of Labor -- The major role of the Labor Department is in the enforcement of policies on minimum wages, limitations on hours of work and the employment of minorities. It also provides statistical information on employment and sponsors some limited vocational and training programs.
Department of State -- The State Department is primarily involved in the international aspects of air transportation, particularly as they affect United States manufacturers and carriers. Through the Agency for International Development (AID) it explores the potential for air transportation systems in underdeveloped countries. State promotes international agreements on air traffic control and airspace standards and facilitates cooperation for international weather data collection and dissemination.

The State Department issues passports and visas for travel to and from the United States. Through the Office of the Deputy Assistant Secretary for Transportation and Telecommunications, the Department formulates policy recommendations and negotiates foreign air transportation agreements.

The Treasury Department -- Two bureaus of the Treasury affect the air system. The Bureau of the Customs conducts all customs operations at airports of entry to the United States. The Bureau of Internal Revenue establishes depreciation policies that affect the purchase of aircraft, and sets the policy for taking deductions for business travel. The latter can affect the use of corporate aircraft and the overall volume of travel.

The Postal Service -- The Postal Service is one of the airlines' largest customers. Although mail rates for certified carriers are set by the Civil Aeronautics Board, the Postal Service has a great deal of control over the amount and timing of airmail movements.
In addition, the Postal Service can negotiate contracts with third level carriers to carry mail to small communities not receiving regular certificated air service. These postal contracts are of major importance to the small operator.

THE ROLE OF THE INDEPENDENT AGENCIES

The independent agencies are created by Congress to perform a particular duty defined in the authorizing statute. Normally, members of the agency are appointed by the President with the advice and consent of the Senate, and once appointed, remain in office either for their specified term or until they resign. Although there is removal power, it can only be exercised if the agency member is guilty of major misconduct in office.

So once the agency is established and its members appointed, in theory it is independent of the other branches of government. However, the President can exert great political pressure, and one can assume that members appointed by the President in office may favor his ideas and policies. Likewise, Congress exerts pressures through financial and budget appropriations and through the threat of amending or revoking the statutory authority that originally set up the agency. The Courts also exert some control over agency action by review of decisions on appeal.

The distinction between members of an agency and agency staff must be made clear. All the independent agencies have
staff to perform day-to-day functions and support agency members. In many organizations, the staff may perform research and make policy recommendations. It may even appear as an independent party in agency proceedings. However, recommendations of the staff are not binding on the agency members who make the actual decisions. For example, it is not uncommon for the Civil Aeronautics Board Staff to take positions that are completely contrary to the final decision of the Board members.

**Environmental Protection Agency (EPA)** — To date, the EPA has not had major impact on the air system, deferring most environmental matters involving aviation to the Federal Aviation Administration. However, there are indications that this may not hold true in the future. EPA has a variety of research, monitoring, standard-setting and enforcement activities related to noise and chemical pollution abatement and control. It is logical that these activities will in some way be extended to aviation if a truly systematic attack is to be made on environmental problems. Whether the EPA assumes some of these roles itself, or merely serves as an advisor and consultant to the FAA, it will play an important role in air system development.

**Equal Employment Opportunity Commission (EEOC)** — The Commission has two purposes: (1) to end discrimination based on race, color, religion, sex or national origin in the hiring, promotion, firing, wages, testing, training, apprenticeship and all
other conditions of employment; and (2) to promote voluntary action programs by employers, unions and community organizations to put equal employment opportunity into actual operation. The Commission participates in the investigation and enforcement of actions arising from unlawful discrimination.

Export-Import Bank -- The Bank aids in the financing and export of commodities from the United States to foreign countries. It supplements rather than competes with private financing and plays a major role in the foreign sale of aviation hardware. A more complete description of its functions can be found elsewhere in these proceedings.

Federal Communications Commission (FCC) -- The FCC is charged with the frequency management of telecommunications activities. In particular, it licenses and regulates radio broadcasts for aviation and emergency purposes.

Federal Mediation and Conciliation Service -- The Service assists parties to labor disputes where the industry affects interstate commerce, to settle such disputes through mediation and conciliation. The Service possesses no law enforcement authority, but depends wholly on persuasive techniques. Whenever in its judgement, a dispute threatens to cause a substantial interruption of interstate commerce, the Service can offer its services either on its own incentive or at the request of one or more of the parties. The Service is involved with all industries auxiliary
to the airlines including manufacturers or concessionaries, but
does not take an active role in disputes involving the airlines,
since they are covered by the Railway Labor Act.

**General Services Administration (GSA)** -- The GSA manages the
property (and records) of the government, including the construc-
tion and operation of buildings, procurement and distribution of
supplies, disposal of surplus property, traffic and communica-
tions management, stock piling of strategic and critical materials
and the creation, preservation and disposal of records.

In particular, the GSA manages the government's Transporta-
tion and Communications Service (TCS) which performs traffic
management for civil executive agencies. The TCS represents
these agencies in negotiations with carriers and in hearings of
regulatory bodies. It also develops policies, procedures and
regulations for the procurement and utilization of transportation
services.

**Interstate Commerce Commission (ICC)** -- The ICC participates
with the CAB in establishing air cargo pickup and delivery zones.
It has also developed a policy with the CAB, to limit or prevent
transmodal transportation systems and intermodal ownership and
control of transportation companies.

**National Aeronautics and Space Administration (NASA)** -- NASA's
primary programs in aeronautics are managed by the Office of
Aeronautics and Space Technology and the research centers assigned
to it. The efforts include research and advanced technological development of aircraft and associated electronics. The primary centers are:

- **Ames Research Center** - Research in the configuration, stability, structure and guidance and control of aircraft (and space vehicles).

- **Flight Research Center** - Research in extremely high performance aircraft and spacecraft, including flight operations, flight systems and structural characteristics of the vehicles.

- **Langley Research Center** - Research in structures and materials for subsonic and supersonic flight.

- **Lewis Research Center** - Research in power plants and propulsion.

NASA's work and interest in these areas has expanded rapidly during the past few years and this trend is expected to continue.

**National Labor Relations Board (NLRB)** -- Most of the private institutions involved in the air system are covered by the various provisions of the National Labor Relations Act as amended, with the major exception being the airlines themselves which are covered by the Railway Labor Act. The two major functions of the NLRB are to conduct secret ballot elections among employees to determine whether or not they wish to be represented by a labor organization, and to prevent and remedy unfair labor practices by employers or labor organizations.

Through its regional offices, the NLRB can issue complaints in unfair practice cases, seek settlements of unfair practice
charges, obtain compliance with Board orders and court judgements and petition for injunctions to prevent or remedy unfair practices.

**National Mediation Board** -- The Board was created by a 1934 amendment to the Railway Labor Act. Its jurisdiction was later extended to carriers by air engaged in interstate commerce or under a mail contract. The purposes of the act are to avoid interruption to commerce, to ensure the rights of employees to organize and to provide for the prompt settlement of disputes.

The principle duty of the Board is to mediate differences between the transportation companies and their employees arising from attempts to reach agreements on rates of pay, rules on employee working conditions and the like. The Board also settles disputes among employees concerning what unions should represent them.

**National Science Foundation (NSF)** -- The major role of NSF is to strengthen research and education in the sciences in the United States. Many of the projects undertaken are transportation oriented. Through the award of grants and contracts to universities and other nonprofit institutions, NSF encourages research in vital areas.

**Securities and Exchange Commission (SEC)** -- The SEC guards against fraud in the issuance and sale of securities in interstate commerce or through the mails. It operates primarily by requiring the submission of certain factual data before the stock
can be registered, and periodical data submissions thereafter. It does not guarantee the accuracy of the data filed, but it makes those guilty of fraudulent representations liable for civil or criminal penalties. The SEC also has the power to obtain court orders enjoining acts or practices that could defraud investors or otherwise violate the law.

THE DEPARTMENT OF TRANSPORTATION

There are two federal agencies that merit particular attention: the Department of Transportation (DOT), an executive department of the President; and the Civil Aeronautics Board (CAB), one of the independent agencies.

The DOT is a major institutional factor in the air system. Both through the Office of the Secretary and the Federal Aviation Administration, DOT is involved in policy determination, system analysis and operational problems associated with air service. Through the FAA and the National Transportation Safety Board (which is loosely tied to the DOT for administrative purposes), the Department plays a major role in air safety.

Figure 3 shows the organization of DOT as of 1971. The administrations listed on the bottom line are the operating administrations of the Department. All other functions are collectively said to be in the Office of the Secretary of Transportation (OST).
The Office of the Secretary -- Within OST, the Secretary and the Under Secretary are responsible for overall planning, direction and control of the Department. There are several Assistant Secretaries who play a major role in air system policy development.

Assistant Secretary for Environment and Urban Systems -- Through its concern for environmental matters, the Assistant Secretary's office influences noise and chemical pollution policy and airport planning.

Assistant Secretary for Policy and International Affairs -- The Assistant Secretary is responsible for international and domestic transportation policy, objectives and system planning. He directs programs of international technical cooperation, including technical support to developing countries. A comprehensive transportation data information retrieval system is also being developed in this section of the Department.

Assistant Secretary for Systems Development and Technology -- Scientific and technological research and development in transportation systems, safety, noise abatement and technical policy inspect are under the management of the Assistant Secretary. He also provides overall management for the Transportation Systems Center in Cambridge, Massachusetts which is charged with performing and managing pro-
jects in advanced systems and technological research and
development in all transportation disciplines.

The Federal Aviation Administration (FAA) -- The FAA is
primarily concerned with safety and the operational aspects of
air transportation, as compared with the Civil Aeronautics Board's
economic responsibilities. The Administration is more involved
with the day-to-day aspects of the system than any other govern-
mental body. It is charged with the promotion of safety and
development of the system; achieving efficient use of the air
space; and promoting the national airport system. In addition,
the FAA is responsible for the development and operation of air
traffic control and air navigation systems for both civilian and
military usage.

One of the Administration's most important functions is
safety regulation. It issues and enforces rules, regulations and
standards for aircraft manufacture, maintenance and operation;
for the certification of airmen; and for the certification of
airports used by carriers under CAB economic control. The FAA
also installs and maintains air navigation facilities, communi-
cation equipment and electronics needed for control towers and air
traffic control centers. The safe and efficient management and
utilization of the navigable airspace is one of the Administra-
tion's primary objectives.
The FAA provides a system for the registration and recording of the nationality and ownership of aircraft, engines, propellers and appliances, and performs research and development tasks needed to fulfill its statutory responsibilities. The National Aviation Facilities Experimental Center in Atlantic City, New Jersey is maintained as a facility necessary for the experimental phases of research tests.

In addition to other tasks too numerous to mention, the FAA administers programs to identify the type and costs of airports required for a national airport system and provides funds to assist in airport systems planning and airport master plan development. It also administers the Aviation Trust Fund, making grants for runway and taxiway construction on a matching funds basis with airport operators.

The National Transportation Safety Board (NTSB) -- The NTSB, although administratively attached to the DOT, is autonomous in its functions with its own statutory responsibilities and executive authority. The DOT Act of 1966 specifically states that the Board in the exercise of its functions, powers and duties shall be independent of the Secretary and the other officers of the Department. It is required to directly report to Congress annually on the conduct of its duties and make appropriate recommendations for legislation. The NTSB has responsibility for determining the causes of surface accident as well as air. On
the air side, it investigates accidents (except where it delegates such investigation to the FAA), determines probable cause and reports all facts and circumstances. It also conducts special studies and makes recommendations for aviation safety and accident prevention.

THE CIVIL AERONAUTICS BOARD

Figure 4 shows the organizational structure of the CAB. The Board itself is composed of the five members shown at the top of the chart. All other offices and positions provide staff support to the Board and its activities.

The Board was created by the Civil Aeronautics Act of 1938 and continued by the Federal Aviation Act of 1958. It has broad responsibility for the encouragement and development of civil aviation. Unlike the Interstate Commerce Commission (ICC), the CAB is charged to both regulate the industry and promote its development at the same time. This often leaves the Board in a dilemma as to which goal should be predominant. For example, when a fare increase is requested, the Board must balance the cost to the consumer against the carrier's needs for more capital.

The Board's five members are approved for staggered six-year terms, and no more than three may be from the same political party. The President annually designates one member as Chairman and another as Vice-Chairman. Board activities can be roughly
grouped as follows:

Route Authorizations - The Board through the grant of certificates of public convenience and necessity, authorizes domestic carriers to perform domestic and/or foreign air service between designated points. It also issues permits to foreign carriers to provide air transportation between the United States and foreign countries and authorizes the navigation of foreign aircraft in the United States for other purposes.

Fares - The Board has authority over the tariffs, rates and fares charged for civil air transportation. The carriers initiate the rates and the Board oversees and approves them. The Board also authorizes and pays subsidies for service to communities where traffic does not cover the cost of service.

Inter-Carrier Relationships - The CAB passes on mergers, agreements, acquisitions of control and interlocking relationships involving air carriers. It also supervises unfair competitive practices of carriers or ticket agents.

Reports - The Board requires regular financial and operating reports to be filled by the Carriers. It also specifies the accounting and bookkeeping practices and procedures to be used in preparing the required information.

International - The CAB serves as an advisor to the Department of State in foreign negotiations for new or revised air routes and services.

Board decisions in all domestic areas are subject only to court review, and not that of any executive department or agency. Decisions granting or affecting certificates for overseas and foreign air transportation require Presidential approval.

The Board's Office of Consumer Affairs has recently increased in importance. This office is maintained to assist air travelers, shippers, and others interested in air transportation. It processes
complaints arising from the use of air service and attempts to arrange voluntary solutions between members of the industry and the public.

SUMMARY

There are over 30 federal agencies that can affect the development, operation and control of the air transportation system. Because of the many complex roles the government plays, it is impossible to understand our air system without understanding how intimately private and public institutions are related. What might appear to be a simple management decision may involve complicated regulatory and policy issues that could have major unforeseen impact on the overall operation and efficiency of air transportation. One must understand the complexities of the federal role to truly predict the effects of decisions on the system as a whole.
Schriever & Seifert
"Air Transportation 1975 and Beyond"
An Analysis of Airline Costs

Lecture Notes for MIT Courses

16.73 Airline Management and Marketing

Robert W. Simpson

Flight Transportation Laboratory, MIT

NASA-MIT Summer Workshop on Air Transportation

Waterville Valley, New Hampshire

July 1972
1.0 Introduction

Unlike most forms of public transportation, there is a good body of data describing the costs of providing air transportation services for U.S. domestic airlines. The source of this data is monthly and quarterly reports by US carriers to the CAB using the Uniform System of Accounts and Reports (Form 41). The existence of this data has made it possible for the air transport industry to study the costs of providing service and to introduce new, lower cost methods and equipment in a rational manner.

Historically, costs have been divided into two main categories: Direct Operating Costs, those directly associated with a transport aircraft's operation; and Indirect Operating Costs which are those not directly associated with an aircraft, but rather with an airline and its ground operations.

There are several formula for estimating direct operating costs. A common standard for turbine transports is the ATA 67 formula used by manufacturers to compare transport aircraft (Reference 3).

There is no standard formula for indirect operating costs although they represent roughly one half of the total operating cost and cannot be ignored in any study of air transportation systems. They must be constructed by the analyst for the airline system he is studying using whatever data is available. For new forms of air transportation this is a major difficulty.

The system of accounts used by air carriers to submit their costs to the CAB does not recognize the existence of direct and indirect groupings. It has its own classification scheme which we shall now briefly describe.

U.S. airlines are required to submit to the CAB on a quarterly basis their operating expenses, among other financial statistics, in accordance with the economic regulations of the CAB Uniform
System of Accounts and Reports (Form 41). The accounting provisions are different for route vs. supplemental carriers. Within the route carriers, domestic trunks and locals (Group III) are again distinguished from third level carriers (Groups I and II).

Each cost item in Form 41 is given a four-digit account number. The first two digits designate more general classifications. They are referred to as the functional classification. The last two digits are more detailed breakdowns. They are referred to as the objective classifications. A fifth digit, appended as a decimal, has been assigned for internal control by the CAB. It subdivides the objective classifications.

We include in here, for reference purposes, brief excerpts of the official definitions of the Functional classifications. Full descriptions of the Functional and Objective classifications can be found in Reference 4.

5100 Flying Operations

This function shall include expenses incurred directly in the in-flight operation of aircraft and expenses attaching to the holding of aircraft and aircraft operational personnel in readiness for assignment to an in-flight status.

5200 Direct Maintenance

This function shall include the costs of labor, materials and outside services consumed directly in periodic maintenance operations and the maintenance and repair of property and equipment of all types and classes, regardless of the location at which incurred.
5300 Maintenance Burden.

This function shall include all overhead or general expenses used directly in the activities involved in periodic maintenance operations and the maintenance and repair of property and equipment of all types and classes, including the cost of direct labor, materials and outside services used in the maintenance and repair of property and equipment.

5500 Passenger Service.

This function shall include all expenses chargeable directly to activities contributing to the comfort, safety and convenience of passengers while in flight and when flights are interrupted.

6100 Aircraft Servicing.

This function shall include the compensation of ground personnel and other expenses incurred on the ground incident to the protection and control of the in-flight movement of aircraft; scheduling or preparing aircraft operational crews for flight assignment; landing and parking aircraft; visual inspection, routine checking, servicing and fueling of aircraft; and other expenses incurred on the ground incident to readying for arrival and take-off aircraft.
6200 Traffic Servicing.

This function shall include the compensation of ground personnel and other expenses incurred on the ground incident to handling traffic of all types and classed on the ground subsequent to the issuance of documents establishing the air carrier's responsibility to provide air transportation. Expenses attributable to the operation of airport traffic offices shall also be included in this subfunction; expenses attributable to reservations centers shall be excluded. It shall include expenses incurred in both enplaning and deplaning traffic as well as expenses incurred in preparation for enplanement and all expenses subsequent to deplanement.

6300 Servicing Administration.

This function shall include expenses of a general nature incurred in performing supervisory or administrative activities relating solely and in common to functions 6100 Aircraft Servicing and 6200 Traffic Servicing.

6500 Reservations and Sales.

This function shall include expenses incident to direct sales solicitation, documenting sales, controlling and arranging or confirming aircraft space sold, and in developing tariffs and schedules for publication. It shall also include expenses attributable to the operation of city traffic offices.
6600 Advertising and Publicity.

This function shall include expenses incurred in creating public preference for the air carrier and its services; stimulating development of the air transport market; and promoting the air carrier or developing air transportation generally.

6800 General and Administrative.

This function shall include expenses of a general corporate nature and expenses incurred in performing activities which contribute to more than a single operating function such as general financial accounting activities and other general operational administration which are not directly applicable to a particular function.

7000 Depreciation and Amortization.

This function shall include all charges to expense to record losses suffered through current exhaustion of the serviceability of property and equipment due to wear and tear from use and the action of time and the elements, which are not replaced by current repairs, as well as losses in serviceability occasioned by obsolescence, supersession, discoveries, change in popular demand or action by public authority. It shall also include charges for the amortization of capitalized developmental and preoperating costs, and other intangible assets applicable to the performance of air transportation.
2.0 The Art of Cost Estimation

Before we describe in greater detail a classification system for airline costs, it is necessary to make a few observations on the nature of cost estimation. It is very much dependent upon the judgement of the cost analyst who must correctly apply the available data according to a given purpose or objective. To be correct, the cost analyst must understand the operations of the airline, and how the activities of the airline are measured, as well as how the costs are incurred and recorded.

The data source is usually a cost accounting process. This provides data on the cumulated expenses in various categories over a time period like a quarter, or year, and must be correlated by the analyst with cumulated measures of airline activity which he deems to be causing this expense. Different analysts will correlate a given cost with different measures of activity, or the same analyst may even use different activity measures in analyzing costs for different purposes.

2.1 Cost Functions

Here we shall attempt to provide an analytical framework for cost estimation to show some of its difficulties. We shall introduce the abstract concept of a cost function.

Cost functions attempt to relate the cost of some operation to the various component activities related to the operation. We may denote a cost function as $C_i(x,t)$

where $C_i$ is the cost function for operation $i$, (dollars)

$t$ is time variable

$x$ is a vector of activity variables $\left( x_1, x_2, x_3, \ldots x_n \right)$

Thus a cost function provides a time history of the cost of operation $i$ as a function of the activities which are deemed to cause it. We rarely know with any confidence such an analytical expression for any cost function.
Typical measures of activity for airline operations are listed below:

- **P** - passengers originated (or enplaned)
- **D** - aircraft departures
- **RH** - revenue aircraft block hours
- **RM** - revenue aircraft miles
- **RPM** - revenue passenger miles
- **ASM** - available seat miles
- **RTM** - revenue ton miles
- **ATM** - available ton miles
- **R** - revenue dollars

These are cumulative measures for the airline system over some time period similar to the cumulated expense and one expects that any cost function would be monotonic if expressed in terms of these measures (i.e. the cumulated cost never decreases as the cumulative measures of activity increase.)

However, analysts commonly use ratios to "average" these cumulative measures, as an index of activity levels. Some of the common ratios are listed below:

- \( \bar{P} = \frac{P}{D} \) = average passengers per departure
- \( \bar{D} = \frac{RM}{D} \) = average aircraft stage length, or hop length
- \( \bar{d} = \frac{RPM}{P} \) = average passenger trip length (or hop length).
- \( \bar{T_b} = \frac{RH}{D} \) = average aircraft block time
- \( \bar{r} = \frac{R}{P} \) = average ticket price per passenger
- \( \bar{LF} = \frac{RPM}{ASM} \) = average passenger load factor
- \( \bar{LF} = \frac{RTM}{ATM} \) = Average overall ton-mile load factor

Cost functions will generally be "joint" functions of the activity variables, i.e. more than one variable is causing the expense in a certain category. Analysts generally find it necessary to represent
the cost as a "separable" function, or to ignore the "jointness" and represent the costs as a function of a single activity variable. Thus, our general cost function is separated into components,

$$C_i(x_1, x_2) = C_i^1(x_1) + C_i^2(x_2)$$

where commonly only one component is said to exist.

The art of cost estimation occurs precisely at this point. The cost analyst must choose the form of the cost function he believes to exist. Having done so, he returns to the "science" of econometrics to use linear or non-linear multiple regression techniques to determine the coefficients and parameter which give a "best fit", or "best correlation" between the observed cost data, and the observed activity data. The analyst postulates cause and effect, and a circumstance of a good correlation does not verify his postulate, although this is often hopefully stated by inexperienced analysts. A result of good correlation is necessary, but not sufficient to verify this postulate.

2.2 Marginal and Unit Costs

If we assume that we have a single component cost function, we can plot it against its activity variable as shown by figure 1. In this case, we may take the ratio of the cost to its activity at any point to form a "unit cost". Its value corresponds to the slope of the line from the origin to the cost curve as shown in figure 1, and obviously varies as the scale of operations changes, i.e. the unit cost is a function of x.

$$\text{Unit Cost} = c(x) = \frac{C(x)}{x}$$

There is another cost corresponding to the actual slope of the cost curve at any point. This is called the "marginal cost" and is also a function of the activity variable x.

$$\text{Marginal Cost} = c'(x) = \frac{\partial C(x)}{\partial x}$$
Figure 1  A SINGLE COMPONENT COST FUNCTION

COST FUNCTION, $C_i(X)$

SLOPE OF CURVE = MARGINAL COST AT $X_1$

SLOPE OF RAY FROM ORIGIN = UNIT COST AT $X_1$

COST, $C_i$

$\text{ACTIVITY, } X \text{ (UNITS)}$
In general marginal costs do not equal unit costs.

The marginal costs also exist for a general cost function, and if known, would tell us the rate of change of cost as any activity variable is changed. If the general cost function is separable, then unit costs can exist for each component of the cost function. Notice that the unit costs represent an "average cost per unit", and thus are sometimes called average costs. We shall avoid that usage here, and refer to them as unit costs.

In a similar manner, costs may be plotted against time as shown in figure 2. The unit cost becomes the "long term" cost, while "short term" rates of expense may be determined by taking the slopes over shorter periods of time. Given a time frame for a cost analysis, the analyst regards short term costs as "variable" costs, and long term costs as "fixed" costs. The distinction of variable and fixed costs may also apply to other activity measures used in a given cost analysis, where only a certain portion of the costs are considered to be variable. Yet another cost concept is the distinction made between "sunk" and "recoverable" costs, where a large expense or investment made at some point in time is classified as to whether or not it could be recovered in some fashion.
Figure 2 VARIATION OF COST OVER TIME

OPERATING COST
$C_i$

CUMULATIVE EXPENDITURES

EXPENSES ARE INCURRED IN
WEEKLY
MONTHLY
QUARTERLY
YEARLY

CYCLES

MONTH
1 2 3 4
TIME, t (WEEKS)
3.0 Categorization of Airline Costs

We shall follow the categories of costs developed in reference 1, where:

a) Direct Operating Costs are designated Flight Operating Costs
b) Indirect Operating Costs are divided into two categories;
   1) Ground Operating Costs
   2) System Operating Costs
c) System Non-operating Costs are also identified.

Table 1 shows the major categories of this new cost structure. Instead of just direct and indirect categories, there are now four major categories. Table 2 gives a detailed breakdown of the operating cost categories showing a percentage of total operating costs for US domestic trunk airlines for each category and sub-category. Table 2 also indicates the time frame for the expense and some arbitrary allocations of the cost. A brief explanation of this cost categorization is given below:

a) Flight Operating Costs

These are usually known as direct operating costs, and are defined here to coincide with the definition used in reference 2, so that document can be used as a source of data. There is one exception where rental and flight insurance costs listed under Direct Flying Operations are transferred to a category called Flight Equipment Ownership. Flight Operating Costs are usually allocated against the flying hours of the airline fleet. Note that cabin crew expenses and interest costs of debt associated with aircraft ownership are not included, even though they are major cost items. On the other hand, a maintenance burden is included covering general administrative and overhead expenses for the airline maintenance shops.

b) Ground Operating Costs

This is a new group of costs which might be called direct ground operating costs. These costs are incurred at the station in handling passengers and aircraft, and are directly incurred
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<th>A. Flight Operating Costs - (FC)</th>
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<td>A.1 Direct Flying Operations</td>
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<td>A.2 Flight Maintenance</td>
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<td>A.3 Flight Equipment Ownership</td>
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<th>B. Ground Operating Costs - (GC)</th>
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<td>B.3 Aircraft Servicing</td>
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<th>C. System Operating Costs - (SC)</th>
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<td>C.1 System Promotional Costs</td>
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<td>C.2 System Administrative Costs</td>
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<td>C.3 Ground Maintenance</td>
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<td>C.4 Ground Equipment Ownership</td>
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| D. Total Operating Costs - (TOC) | Sum of A + B + C            |

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<th>E. System Non-Operating Costs - (SNC)</th>
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<tr>
<td>E.1 Interest and Debt Expense</td>
<td></td>
</tr>
<tr>
<td>E.2 Taxes</td>
<td></td>
</tr>
</tbody>
</table>
TABLE 2 - BREAKDOWN OF AIRLINE OPERATING COSTS

A = Allocation Frame
X = Expenditure Frame

<table>
<thead>
<tr>
<th>Allocation Transform</th>
<th>% TOC</th>
<th>Time Frame for Expenditure</th>
</tr>
</thead>
<tbody>
<tr>
<td>$/ $/ $/ $/ $/ $/</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A. FLIGHT OPERATING COSTS

1. Direct Flying Operations
   - Flt. Crew Hrs./Mo. 13.5
   - Fuel, Oil 13.0
   - Other

2. Flight Maintenance
   - Direct Airframe + Other Hrs./Dep. 4.6
   - Direct Engines Hrs./Dep. 4.4
   - Burden Hrs./Year 6.5

3. Flight Equipment Ownership
   - Depreciation Airframe + Other Hrs./Year 0.4
   - Depreciation Engines 1.7
   - Obsolescence & Deterioration 0.4
   - Flt. Equipment Rental 3.2
   - Flt. Insurance 0.4

B. GROUND OPERATING COSTS

1. Reservations & Sales
   - Personnel Pax./Mo. 3.2
   - Commissions (Rev./Pax. - 1) 3.9
   - Other 1.2

2. Traffic Servicing
   - Personnel Pax./Mo. 5.5
   - Rentals Pax./Year 0.7
   - Other 1.1

3. Aircraft Servicing
   - Personnel Dep./Mo. 4.0
   - Landing Fees 2.0
   - Other 1.2

C. SYSTEM OPERATING COSTS

1. Promotional Costs
   - Passenger Flight Service Rev./Pax. 10.2
   - Advertising & Publicity Rev./Mo. 2.4

2. Administrative Costs
   - Rev./Mo. 4.3

3. Ground Maintenance
   - Rev./Year 1.9

4. Ground Equipment Ownership
   - Rev./Year 1.9
in providing the complete transportation service. They are best allocated against passengers enplaned, and aircraft departures although other allocations may be useful. Station administrative costs are not listed here, but included as a system administrative expense later.

c) System Operating Costs

These costs are the old indirect operating costs remaining after ground operating costs are removed. They are not directly associated with supplying the transportation service, and are more of the nature of a system overhead expense. For example, Promotional costs are those spent to increase system revenues, and includes the onboard passenger service expenses of food and cabin crew. Administrative expenses are those of a general management of corporate nature for the complete airline system (except maintenance administration). The maintenance and ownership of ground property and equipment are minor categories included for completeness. System Operating costs may be allocated in an overhead manner against dollars of revenue.

d) Total Operating Costs

The sum of the above costs is called total operating cost.

e) System Non-Operating Costs

This is a new group of costs not normally considered by the old DOC-IOC breakdown. They are not associated with the operations of the company, but rather with its corporate existence. The interest expenses associated with corporate debt are substantial, and since most of the airline debt can be associated with new flight equipment, can be related to Flight Equipment Ownership for some analysis purposes. The taxation expenses are associated with corporate profit declaration, and is difficult to separate from the corporation.

The following sections will describe these cost categories in more detail.
4.0 Flight Operating Costs - FC

This grouping of costs is more generally known as "Direct Operating Costs". We shall use the basic definitions of the CAB source document (reference 2) with some minor rearrangements as described previously. These costs are long term, average costs for operating an aircraft. For shorter term operations, various categories of the costs should be dropped. For example, ownership costs, and maintenance burden costs are commonly deleted since they are long term costs spread over several years.

As indicated by Table 2, Flight Operating Costs are roughly 55% of total operating costs.

4.1 Flight Operating Costs per Block Hour, FC_{HR}

The basic cost measure for transport aircraft is the flight operating cost per block hour, FC_{HR}. It is a constant, independent of trip distance for a given aircraft and airline, and therefore provides a simple, useful description for comparing different aircraft in airline service.

Another simple measure which is not widely used, but which is useful for comparing aircraft of different capacity is the flight operating cost per seat-hour, FC_{SHR}

\[
FC_{SHR} = \frac{FC_{HR}}{Sa}
\]

where \( Sa \) = available seats

A set of typical values of these measures for US transport aircraft is given in Table 3. Notice that FC_{SHR} varies between 4 to 6 $/seat hour for both jet and turboprop transports, and that the helicopter costs are much higher.

A more detailed breakdown of these hourly costs is shown in Table 4 for the Boeing 727-100 in domestic service in 1969. The total cost
### TABLE 3

Operating Costs Per Hour, Costs Per Seat Hour 1969

<table>
<thead>
<tr>
<th>Aircraft Type</th>
<th>Fleet Size</th>
<th>Cost/Hr. ($)</th>
<th>Seats *</th>
<th>Cost/Seat Hr. ($)</th>
<th>Average Stage (miles)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>A) Domestic Trunks</strong></td>
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<tr>
<td>B707-100</td>
<td>17</td>
<td>810.59</td>
<td>128</td>
<td>6.33</td>
<td>884</td>
</tr>
<tr>
<td>B707-100B</td>
<td>91</td>
<td>774.87</td>
<td>128</td>
<td>6.05</td>
<td>1156</td>
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<tr>
<td>B720</td>
<td>45.1</td>
<td>701.02</td>
<td>120.7</td>
<td>5.85</td>
<td>827</td>
</tr>
<tr>
<td>B720B</td>
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<td>669.98</td>
<td>116</td>
<td>5.76</td>
<td>721</td>
</tr>
<tr>
<td>DC8-20</td>
<td>43.7</td>
<td>728.60</td>
<td>132.8</td>
<td>5.48</td>
<td>1180</td>
</tr>
<tr>
<td>DC8-50</td>
<td>43.3</td>
<td>691.00</td>
<td>134.5</td>
<td>5.14</td>
<td>936</td>
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<tr>
<td>DC8-61</td>
<td>35.5</td>
<td>754.76</td>
<td>196.2</td>
<td>3.85</td>
<td>1033</td>
</tr>
<tr>
<td>B727-100</td>
<td>275</td>
<td>564.46</td>
<td>95.6</td>
<td>5.90</td>
<td>508</td>
</tr>
<tr>
<td>B727-200</td>
<td>144.2</td>
<td>684.55</td>
<td>125.3</td>
<td>5.45</td>
<td>517</td>
</tr>
<tr>
<td>DC-9-30</td>
<td>132.4</td>
<td>439.63</td>
<td>89.3</td>
<td>4.93</td>
<td>298</td>
</tr>
<tr>
<td>DC-9-10</td>
<td>67.4</td>
<td>444.59</td>
<td>68.4</td>
<td>6.55</td>
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<tr>
<td>BAC-111-400</td>
<td>25.9</td>
<td>554.70</td>
<td>64</td>
<td>8.65</td>
<td>214</td>
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<td>Electra</td>
<td>40</td>
<td>526.85</td>
<td>82.7</td>
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<tr>
<td>B-737</td>
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<td>457.56</td>
<td>96.2</td>
<td>4.75</td>
<td>231</td>
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<tr>
<td><strong>B) Local Service</strong></td>
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<td>DC-9-30</td>
<td>50.7</td>
<td>396.64</td>
<td>96.5</td>
<td>4.10</td>
<td>230</td>
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<tr>
<td>CV-580</td>
<td>103.3</td>
<td>256.7</td>
<td>50.7</td>
<td>5.07</td>
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<tr>
<td>FH-227</td>
<td>47.1</td>
<td>227.26</td>
<td>44.6</td>
<td>5.09</td>
<td>109</td>
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<tr>
<td><strong>C) Helicopters</strong></td>
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<td></td>
<td></td>
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<td></td>
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<tr>
<td>S-61</td>
<td>8</td>
<td>340.7</td>
<td>23.5</td>
<td>14.50</td>
<td>18</td>
</tr>
<tr>
<td>V-107 (1968)</td>
<td>4.3</td>
<td>575.3</td>
<td>24.6</td>
<td>23.60</td>
<td>13</td>
</tr>
<tr>
<td><strong>C) STOL</strong></td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>DHC-5 Twin Otter (Est.)</td>
<td>100.00</td>
<td>19</td>
<td>5.25</td>
<td>-</td>
<td></td>
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</tbody>
</table>

*Seats are averaged over aircraft miles performed in 1969.*
**Table 4**

*Flight Operating Costs per Block Hour for Boeing 727-100*

<table>
<thead>
<tr>
<th>Category</th>
<th>Year 1</th>
<th>Year 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1. Direct Flying Operations</strong></td>
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<td></td>
</tr>
<tr>
<td>- Flt. Crew</td>
<td>144.91</td>
<td>144.91</td>
</tr>
<tr>
<td>- Fuel Oil</td>
<td>138.72</td>
<td>138.72</td>
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<tr>
<td><strong>2. Flight Maintenance</strong></td>
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<td></td>
</tr>
<tr>
<td>- Direct Airframe &amp; Other</td>
<td>48.85</td>
<td>48.85</td>
</tr>
<tr>
<td>- Direct Engine</td>
<td>43.00</td>
<td>43.00</td>
</tr>
<tr>
<td>- Burden</td>
<td>66.30</td>
<td></td>
</tr>
<tr>
<td><strong>3. Flight Equipment Ownership</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Depreciation Airframe &amp; Other</td>
<td>69.77</td>
<td></td>
</tr>
<tr>
<td>- Depreciation Engines</td>
<td>14.46</td>
<td></td>
</tr>
<tr>
<td>- Obsolescence and Deterioration</td>
<td>1.78</td>
<td></td>
</tr>
<tr>
<td>- Flight Equipment Rental</td>
<td>26.75</td>
<td></td>
</tr>
<tr>
<td>- Flight Insurance</td>
<td>9.39</td>
<td></td>
</tr>
<tr>
<td><strong>4. Long-Term Average Costs</strong></td>
<td>564.46</td>
<td></td>
</tr>
<tr>
<td><strong>5. Short-Term Average Costs (less Burden, Ownership Costs)</strong></td>
<td>375.48</td>
<td></td>
</tr>
</tbody>
</table>

of 564 $/hour is distributed roughly equally between crew, fuel, maintenance, and ownership. Thus, the sub-category, "Direct Operation," made up of fuel and crew accounts for roughly 50%, while the other two sub-categories are each 25%. If maintenance burden, and ownership costs are dropped, a short term or monthly operating cost of 375 $/hour is obtained. A breakdown of hourly costs for the first six months of 1971 is given in Table 5 for various types of current transports and individual airlines. The costs vary quite widely.

For the Boeing 727, they range from 593 to 856 $/block hour with an average of 665 $/block hour for this period. This range is due to factors such as wage rates, fuel cost variations, varying maintenance programs, and varying depreciation scheduled. The variation is significant enough to invalidate the use of any standard formula such as the ATA67 DOC formula when studying the operations of a particular airline system, or for return on investment calculations.

In recent years there has been a marked rate of increase of Flight Operating costs due to inflationary factors. Reference 5 is a good source of the trends in operating cost for jet transport aircraft in domestic service. Table 6 is extracted from it to show the effects of inflation on the flight operating costs for the Boeing 727. With this rate of growth in costs, it is necessary to also specify the year in studying the operations of the industry, or a given airline system.

The hourly operating cost $FC_{HR}$ for a transport aircraft must be related to its hourly productivity, $P_{HR}$ as measured in available seat miles per hour, or available ton miles per hour. A plot of $FC_{HR}$ against available ton miles per hour is shown in figure 3 for aircraft in domestic trunk and local airline service for the year 1968. The flattening of the trend curve indicates a relative improvement in flight operating costs as productivity increases.

If we divide the hourly operating costs by the productivity measured in available ton-miles per hour, we obtain a value of DOC, direct operating cost in terms of dollars per available ton mile. A
## TABLE 5
First Six Months of 1971

<table>
<thead>
<tr>
<th>(Dollars per Block Hr.)</th>
<th>Total Block Hours</th>
<th>DIRECT EXPENSES (Dollars per Block Hr.)</th>
<th>Total Aircraft Burden Expense</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boeing 727</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>United</td>
<td>214,550</td>
<td>356</td>
<td>76</td>
</tr>
<tr>
<td>Eastern</td>
<td>186,328</td>
<td>349</td>
<td>99</td>
</tr>
<tr>
<td>American</td>
<td>157,712</td>
<td>349</td>
<td>98</td>
</tr>
<tr>
<td>TransWorld</td>
<td>101,153</td>
<td>353</td>
<td>80</td>
</tr>
<tr>
<td>National</td>
<td>61,419</td>
<td>310</td>
<td>97</td>
</tr>
<tr>
<td>Braniff</td>
<td>59,041</td>
<td>329</td>
<td>103</td>
</tr>
<tr>
<td>Northwestern</td>
<td>56,529</td>
<td>340</td>
<td>68</td>
</tr>
<tr>
<td>Continental</td>
<td>36,523</td>
<td>345</td>
<td>106</td>
</tr>
<tr>
<td>Northeast</td>
<td>34,010</td>
<td>347</td>
<td>115</td>
</tr>
<tr>
<td>Pan American</td>
<td>29,225</td>
<td>392</td>
<td>123</td>
</tr>
<tr>
<td>Western</td>
<td>9,159</td>
<td>346</td>
<td>95</td>
</tr>
<tr>
<td>Alaska</td>
<td>8,527</td>
<td>428</td>
<td>162</td>
</tr>
<tr>
<td>Airlift</td>
<td>5,194</td>
<td>376</td>
<td>154</td>
</tr>
<tr>
<td>Frontier</td>
<td>5,056</td>
<td>361</td>
<td>168</td>
</tr>
<tr>
<td>Allegheny</td>
<td>3,355</td>
<td>457</td>
<td>64</td>
</tr>
<tr>
<td><strong>727 Average</strong></td>
<td><strong>971,693</strong></td>
<td><strong>349</strong></td>
<td><strong>93</strong></td>
</tr>
<tr>
<td>Douglas DC-9</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delta</td>
<td>143,573</td>
<td>235</td>
<td>55</td>
</tr>
<tr>
<td>Eastern</td>
<td>132,576</td>
<td>270</td>
<td>74</td>
</tr>
<tr>
<td>Allegheny</td>
<td>46,901</td>
<td>271</td>
<td>71</td>
</tr>
<tr>
<td>Air West</td>
<td>31,307</td>
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<tr>
<td>Continental</td>
<td>30,427</td>
<td>221</td>
<td>89</td>
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<tr>
<td>Southern</td>
<td>29,350</td>
<td>236</td>
<td>94</td>
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<tr>
<td>Grumman</td>
<td>24,344</td>
<td>241</td>
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<td>22,610</td>
<td>291</td>
<td>80</td>
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<td>Texas Int'l.</td>
<td>22,410</td>
<td>236</td>
<td>92</td>
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<td>North Central</td>
<td>21,403</td>
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<td>75</td>
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<tr>
<td>Northeast</td>
<td>19,071</td>
<td>263</td>
<td>92</td>
</tr>
<tr>
<td>Hawaiian</td>
<td>8,515</td>
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</tr>
<tr>
<td>Caribbean</td>
<td>3,529</td>
<td>418</td>
<td>150</td>
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<tr>
<td><strong>DC-9 Average</strong></td>
<td><strong>531,616</strong></td>
<td><strong>255</strong></td>
<td><strong>76</strong></td>
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<tr>
<td>Boeing 737</td>
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<tr>
<td>United</td>
<td>72,953</td>
<td>339</td>
<td>62</td>
</tr>
<tr>
<td>Western</td>
<td>40,688</td>
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<td>110</td>
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<tr>
<td>Piedmont</td>
<td>17,820</td>
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<td>78</td>
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<tr>
<td>Frontier</td>
<td>15,588</td>
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<td>Wien Consol.</td>
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<td><strong>86</strong></td>
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<tr>
<td>BAC 111</td>
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<td>90</td>
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<tr>
<td><strong>111 Average</strong></td>
<td><strong>48,288</strong></td>
<td><strong>247</strong></td>
<td><strong>82</strong></td>
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Table 5 (continued)

(Dollars per Block Hr.)

<table>
<thead>
<tr>
<th>DIRECT EXPENSES</th>
<th>Total</th>
<th>Flying Operations</th>
<th>Direct Maint.</th>
<th>Deprec. &amp; Rentals</th>
<th>Total</th>
<th>Maint. Burden</th>
<th>Total Aircraft Expense</th>
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<tbody>
<tr>
<td>Boeing 747</td>
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<td>647</td>
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<td>1785</td>
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<td>239</td>
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<td>1517</td>
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<td>695</td>
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<td>377</td>
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<td>1673</td>
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<td>3299</td>
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<td>3350</td>
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<td>1627</td>
<td>148</td>
<td>1775</td>
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<td>312</td>
<td>687</td>
<td>2050</td>
<td>48</td>
<td>2098</td>
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<td>747 Average</td>
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<td>226</td>
<td>626</td>
<td>1610</td>
<td>137</td>
<td>1747</td>
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<td>Douglas DC-8</td>
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<td>698</td>
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<td>808</td>
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<td>185</td>
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<td>701</td>
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<td>707</td>
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<tr>
<td>800 Average</td>
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<td>398</td>
<td>134</td>
<td>121</td>
<td>653</td>
<td>143</td>
<td>796</td>
</tr>
</tbody>
</table>

1 Data for Trans Caribbean included with American.
plot of this value is shown in figure 4, and clearly demonstrates the superiority of the more productive aircraft in terms of unit costs.

4.2 Flight Operating Costs per Trip

The hourly cost, FC\(_{HR}\) is a basic and convenient cost measure for transport aircraft. A more precise formulation for analytic purposes is provided by the trip cost measures; FC\(_{AT}\), flight operating cost per aircraft trip, and FC\(_{ST}\), flight operating cost per seat trip.

Flight Cost per aircraft trip, FC\(_{AT}\) always turns out to be a linear function of distance, d.

\[
FC_{AT} = c_1 + c_2 \cdot d
\]

so that knowledge of the two coefficients \(c_1\) and \(c_2\) is sufficient to accurately describe the cost performance of any transport aircraft. Because the variation of fuel costs is not proportional to block time, and since fuel costs may vary with the particular climb-cruise schedule used for a given aircraft, it is not possible to simply multiply the hourly costs by the block time to obtain a precise measure of trip costs.

For purposes of determining minimum cost flight plans, where varying climb-cruise profiles and schedules may be used, it is sometimes useful to represent trip costs in the following form:

\[
FC_{AT} = \text{Time Costs} + \text{Fuel Costs}
\]

where the time costs are computed using a short term hourly cost for crew, maintenance, and perhaps ownership, and fuel costs are computed for a given mission profile.

It is useful to also define the trip costs per available seat FC\(_{ST}\). Since Sa, the available seats is not constant after design range, this cost measure will have a linear form up to design range, and a non-linear variation after design range. The traditional DOC curves can be derived from FC\(_{ST}\) by dividing by the trip distance. The variation
Figure 3  FLIGHT OPERATING COST PER HOUR VERSUS HOURLY PRODUCTIVITY

SOURCE — CAB, AIRCRAFT OPERATING COST AND PERFORMANCE REPORT DOMESTIC SERVICE, 1968
Figure 4  FLIGHT OPERATING COSTS PER AVAILABLE TON MILE VERSUS HOURLY PRODUCTIVITY

SOURCE - CAB AIRCRAFT OPERATING COST AND PERFORMANCE REPORT DOMESTIC SERVICE, 1968
Table 6

Trends in Flight Operating Cost per Block Hour, B-727 Domestic

<table>
<thead>
<tr>
<th>Year</th>
<th>Flying Operations</th>
<th>Maintenance</th>
<th>Ownership</th>
<th>Total FC/Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Crew</td>
<td>Fuel</td>
<td>$</td>
<td>$</td>
</tr>
<tr>
<td>1964</td>
<td>108</td>
<td>121</td>
<td>121</td>
<td>161</td>
</tr>
<tr>
<td>1965</td>
<td>121</td>
<td>129</td>
<td>147</td>
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</tr>
<tr>
<td>1966</td>
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<td>171</td>
<td>138</td>
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<tr>
<td>1967</td>
<td>123</td>
<td>130</td>
<td>159</td>
<td>121</td>
</tr>
<tr>
<td>1968</td>
<td>133</td>
<td>132</td>
<td>152</td>
<td>121</td>
</tr>
<tr>
<td>1969</td>
<td>140</td>
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<tr>
<td>1970</td>
<td>160</td>
<td>146</td>
<td>168</td>
<td>147</td>
</tr>
</tbody>
</table>
of these cost curves with trip distance is shown in Figure 5 for the B727 in domestic service in 1969. Notice the strong variation in the unit costs measure, DOC, before it flattens out around full design range.

4.3 Average Flight Costs

Suppose we have an aircraft operating over a given set of trips (or hops, or stages) within an airline system. We want to compute measures of average flight operating costs over this set of trips.

If there are \( N \) trips with \( n(x) \) trips at a particular distance, \( x \), then we may denote a probability density function, \( f(x) = \frac{n(x)}{N} \) to describe the distribution of trip distances within the set of trips.

The average trip distance, \( \bar{d} \), is given by

\[
\bar{d} = \int_0^\infty x \cdot f(x) \, dx
\]

where \( 1.0 = \int_0^\infty f(x) \, dx \).

Now, the flight operating costs per trip can be expressed as a linear function of trip distance, \( x \)

\[
F_{CA} = c_1 + c_2 \cdot x
\]

The average flight cost per trip, \( \overline{F_{CA}} \), becomes

\[
\overline{F_{CA}} = \int_0^\infty (c_1 + c_2 x) \cdot f(x) \, dx
\]

\[
= c_1 + c_2 \cdot \bar{d}
\]

i.e., the average flight cost per trip is exactly the flight cost at the average trip distance.

Now, the total flight operating cost over the set of trips, \( FC \) is given by:

\[
FC = N \overline{F_{CA}}
\]

and the total mileage of the set of trips, \( M \);
Figure 5  VARIATION OF FLIGHT OPERATING COSTS WITH TRIP DISTANCE

TRACT/CRAFT TRIP, FCAT

COST/SEAT TRIP, FCS

COST/SEAT MILE, DOC

B-727-100, DOMESTIC AVERAGE, 1969

DESIGN RANGE
\[ M = N \cdot \bar{d} \]

so that the average flight operating cost per seat mile (if we assume that \( S \) seats are available on all trips) becomes:

\[
\text{DOC}_{AV} = \frac{\text{FC}}{M} = \frac{N \cdot \text{FC}_{AT}}{N \cdot \bar{d} \cdot S} = \frac{c_1 + c_2 \cdot \bar{d}}{\bar{d} \cdot S}
\]

\[
= \frac{1}{S} \left[ \frac{c_1}{\bar{d}} + c_2 \right]
\]

\[
= \text{DOC} \left( \bar{d} \right)
\]

i.e., the average direct operating cost over the set of trips is exactly the direct operating cost at the average distance.

These two properties are a result of the linear form of trip costs with trip distance.

Notice, however, that if we average DOC values over a set of trips, we do not get the value of \( \text{DOC}_{AV} \) since DOC(x) is non-linear in x;

\[
\overline{\text{DOC}} = \frac{1}{S} \int_0^\infty \left[ \frac{c_1}{x} + c_2 \right] \cdot f(x) \cdot dx
\]

so \( \overline{\text{DOC}} \neq \text{DOC}(\bar{d}) \neq \text{DOC}_{AV} \)

The value \( \overline{\text{DOC}} \) is a useless quantity, and it is a mistake to compute it. The useful quantity is \( \text{DOC}(\bar{d}) \), the direct operating cost at the average trip distance.
5.0 Ground Operating Costs

This group of operating costs are incurred on the ground in preparation and termination of the trip. They are zero-distance, or "terminal" costs as opposed to "line-haul" costs, although it may be argued that there is more preparation for a longer haul trip.

As indicated by Table 2, Ground Operating Costs are roughly 25% of total operating costs, broken down into roughly equal categories of 8% each for reservations and sales, traffic servicing, and aircraft servicing. A particular airline would use its own costs over the system, or perhaps for each station in its system. Notice that these costs are relatively independent of the type of aircraft.

5.1 Measures of Airline Activity

Statistics on measures of activity for domestic airlines for the last quarter of 1970 are given in Table 7. Some selected activity indices are also presented.

While more detailed cost allocations may often be made using various appropriate measures of airline activity, here we shall allocate ground operating costs against passengers originated, and aircraft departures performed for the complete domestic industry. There may be significant variation from these unit costs for a particular airline or station.

5.2 Ground Operating Costs per Passenger, GCₚ

For reservations and sales, the unit cost for the last quarter of 1970 is 4.96 $/passenger originated. For traffic servicing, it is 4.80 $/passenger originated. The total is defined as ground operating cost per passenger,

\[ GCₚ = 9.76 \text{ $/passenger} \]

5.3 Ground Operating Costs per Aircraft Departure, GC₃

The costs per aircraft departure cover the arrival of the plane (and its landing fees), its servicing, and its start up and departure. Dividing the costs reported for the last quarter of 1970 by the number of departures gives a unit cost value

\[ GC₃ = 178.30 \text{ $/aircraft departure} \]
TABLE 7. ACTIVITY MEASURES, DOMESTIC AIRLINE INDUSTRY
(last quarter, 1970)

Activity Measures

\[ \text{RPM} = 22.76 \times 10^9 \text{ revenue passenger miles} \]
\[ \text{P} = 29.0 \times 10^6 \text{ revenue passenger originated} \]
\[ \text{RTM} = 2.97 \times 10^9 \text{ revenue ton miles} \]
\[ \text{RH} = 0.993 \times 10^6 \text{ revenue aircraft block hours} \]
\[ \text{D} = 0.720 \times 10^6 \text{ revenue aircraft departures} \]
\[ \text{R} = 1.50 \times 10^9 \text{ revenue dollars} \]

Indices of Activity

\[ \bar{d} = 784 \text{ (s. miles) - average passenger trip length} \]
\[ \bar{p} = 40.3 \text{ (passengers) - average passengers per departure} \]
\[ \bar{r} = 51.7 \text{ (dollars) - average ticket price} \]
\[ \bar{t}_b = 1.37 \text{ (hours) - average block hours per departure} \]
\[ \bar{r}_a = 2083 \text{ (dollars) - average aircraft revenue per departure} \]
6.0 System Operating Costs

This group of costs is a system wide set of costs of an overhead nature. It is roughly 20% of total operating costs as may be seen from Table 2. Promotional costs are roughly one half of this group, with the remainder split equally between general and administrative and the costs of owning and maintaining ground equipment.

While these costs may be allocated against a variety of airline activity measures, here we shall simply allocate against the revenue dollar as an overhead costs. Again, note that these costs are independent of the types of aircraft used in the airline system.

6.1 System Operating Costs, $C$

Using the data for the domestic industry for the last quarter of 1970 once again, we obtain the following costs in terms of dollars per dollar of revenue:

Promotional Costs -
  Passenger Service - 0.112
  Advertising - 0.025
  TOTAL 0.137

General and Administrative - 0.043

Ground Equipment
  Maintenance - 0.015
  Ownership - 0.019
  TOTAL 0.034

Combining these expenses, we form an overall system cost $C$,

\[ SC = 0.220 \] $/\text{revenue dollar}$
7.0 Trip Costs

We now combine the Flight Operating Costs and the Ground Costs and the Ground Costs per aircraft departure to form a cost per aircraft trip, $T_{C_{AT}}$:

$$T_{C_{AT}} = F_{C_{AT}} + G_{C_{D}}$$

Also, we shall define the trip costs per available seat;

$$T_{C_{ST}} = F_{C_{ST}} + \frac{G_{C_{D}}}{S_{a}}$$

$$= F_{C_{ST}} + G_{C_{ST}}$$

where $G_{C_{ST}}$ = ground operating costs per seat departure.

These trip cost measures combine the aircraft related costs; Flight Operating Costs, and Aircraft Servicing costs. The trip cost per available seat, $T_{C_{ST}}$, is useful for comparison with fares or yields in a later section.

For example, if we use the industry averages for 1970 for a Boeing 727-100;

$$F_{C_{ST}} = 2.85 + .0121d \quad $/seat trip$$

$$G_{C_{ST}} = \frac{178.30}{96} = 1.86 \quad $/seat departure$$

Therefore, $T_{C_{ST}} = 4.71 + .0121d$

The variation of trip costs with distance is shown by figure 6. Notice that the ground operating costs are small compared to flight operating costs, and that the cost levels seem very low, e.g. the cost per seat for a 1000 mile trip is only $16.80.$
Figure 6 VARIATION OF TRIP COST/SEAT WITH TRIP DISTANCE

B-727-100
DOMESTIC SERVICE
1970

TRIP COST PER SEAT
$ TCST

FLIGHT OPERATING COSTS

GROUND OPERATING COSTS

TRIP DISTANCE (S. MILES)
8.0 Fares, Yields, and Net Yields

We shall now turn our attention to the variation of airline trip income per passenger with trip distance.

8.1 Domestic Airline Fare Structure, $F$

Unlike other forms of common carrier passenger transportation (except perhaps taxis) the domestic airline fare structure has a zero distance charge as airlines have attempted to recover the cost of these ground operations. Over the past twenty years, thus zero distance intercept has grown from zero to 9 dollars with a recent CAB examiner's recommendation that it be raised still further to 12 dollars.

In 1967, a CAB regression of coach fares versus trip distance found an extremely good fit for the following formula:

Coach Fares, $F_c = 6.40 + .057d$ dollars

In 1969, at the insistence of the CAB on basing fares on airport to airport distances, the following formula was adopted for coach fares as part of a general industry fare increase:

\[
F_p = 9.00 + .060d_1 \\
+ .056d_2 \\
+ .052d_3 \\
+ .050d_4 \\
+ .048d_5
\]

where \(0 \leq d_1 \leq 500\) s.miles

\[
501 \leq d_1 + d_2 \leq 1000 \\
1001 \leq d_1 + d_2 + d_3 \leq 1500 \\
1501 \leq d_1 + d_2 + d_3 + d_4 \leq 2000 \\
2001 \leq d_1 + d_2 + d_3 + d_4 + d_5
\]

As part of this decision, first class fares, $F_f$ were to be 1.25 times the coach fares. There was an 8% government tax applied, and then fares were rounded up to the nearest dollar.

In 1971, a further general increase of 6% in coach fares was allowed, with first class being set at 1.3 times coach fare, and night coach
Fig. 7 CURRENT FARE FORMULAE, US DOMESTIC FARES, 1971-72

LESS 8% FEDERAL TAX WITHOUT ROUNDUP TO NEAREST DOLLAR

JET DAY COACH FARE = 9.54 + 6.36 CENTS/MILE (0-500)
+ 5.96 “ (501-1000)
+ 5.51 “ (1001-1500)
+ 5.30 “ (1501-2000)
+ 5.09 “ (2000+)

JET FIRST CLASS FARE = 1.3 × COACH
JET NIGHT COACH FARE = 0.8 × COACH
fares at 0.8 times coach fare. The round up rule was retained. Figure 7 shows the current fare formulae versus distance for the basic fares before the 8% tax and rounding up to the nearest dollar. The domestic fare investigation has ended and a further change is expected before the end of 1972.

8.2 Yield per Passenger, \( Y_p \)

While the fare structure seems to determine airline revenues very explicitly, the actual airline revenue for a given city pair is the result of the traffic which moves at a mix of regular fares (coach, first class, night coach), and a variety of discount fares (\( \frac{1}{2} \) fare student, military standby, Family Plan, excursion fares, etc). A value for yield on a route is obtained by the airline by dividing the actual revenues from the route by the number of tickets sold, i.e., yield is the average ticket price (exclusive of tax).

Thus, the yield values need not fit an explicit distance formula like the fares, and indeed may vary over month of the year for a given route. However, there is generally a good linear variation with trip distance. We shall represent this by a yield formula,

\[
Y_p = y_1 + y_2 \cdot d
\]

The value of \( Y_p \) generally has been below the level for standard coach fares in recent years, where a great number of travellers have begun to use the discount fares. It may be as much as 15% below coach in tourist markets.

Thus, as well as forecasting the number of travellers in a given market, an estimate must be made of the breakdown of traffic moving at different fares to forecast the yield, and the future expected airline revenue.

8.3 Net Yield, \( \text{NY}_p \)

We shall define net yield here by combining the yield with the ground operating costs per passenger and the system operating costs per dollar of revenue:

\[
\text{NY}_p = (1 - SC) \cdot Y_p - GC_p
\]
Figure 8  YIELDS AND COSTS VERSUS TRIP DISTANCE

![Graph showing yields and costs versus trip distance. The graph includes lines for yield, net yield, system and ground operating costs, and trip cost/seat for B-727-100.]
Since the system costs, SC, have been treated as an overhead cost, they further decrease the yield values before we subtract off the cost per passenger for reservations and sales, and traffic servicing. The value of net yield then represents a net income per passenger to be compared with the trip cost per seat from the flight and ground operations of the aircraft.

For example, if we assume a yield formula for 1970,

$$Y_p = 9.00 + 0.055d$$

with \( SC = 0.23 \)

and \( GC_p = 9.76 \$/passenger. \)

Then, net yield per passenger becomes

$$NY_p = -2.63 + 0.0423D \text{ dollars/passenger}$$

Notice the negative value of net yield per passenger for distances less than 60 miles! Ground operating costs are higher than the zero distance intercept of the assumed yield formula (or the coach fare formula). The relationship of yield, and net yield per passenger to trip cost per seat is shown against trip distance in figure 8. Notice that net yield per passenger and trip cost per seat cross around 250 miles, and that there is a large excess of net yield over trip costs as trip distance approaches full design range.
9.0 Trip Income and Breakeven Load Factor

We are now in a position to compare the net yield per passenger and trip cost per seat to determine income per aircraft trip, income per seat trip, and the breakeven load or load factor for an aircraft trip.

9.1 Income per Aircraft Trip

If the number of passengers on a given aircraft trip is denoted by $P_{AT}$, then the income per aircraft trip, $I_{AT}$, is given by;

$$I_{AT} = \frac{NY}{p} \cdot P_{AT} - TC_{AT}$$

If the number of passengers required to breakeven is denoted by $P_{ATB}$, then when $I_{AT} = 0$,

$$P_{ATB} = \frac{TC_{AT}}{NY_{p}}$$

9.2 Breakeven Load Factor

If we denote the load factor, $LF$, as the ratio of passenger load to $S$, seats available at less than design range.

$$LF = \frac{P_{AT}}{S}$$

Then the breakeven load factor, $LF_{B}$

$$LF_{B} = \frac{P_{ATB}}{S} = \frac{TC_{ST}}{NY_{p}}$$

i.e., the breakeven load factor equals the ratio of trip cost per seat to net yield per passenger.

A plot of breakeven load factors for the B-727-100 in domestic service in 1970 is shown in figure 9. Because of the crossover of net yield per passenger and trip cost per seat, there usually is a large variation in $LF_{B}$ with trip distance. It is over 100% at distances less than 250 miles, and reduces to 35% or less at long ranges. Notice that since we have defined load factor based on total seats, it does not break upwards after design range.
Figure 9 VARIATION OF BREAKEVEN LOAD FACTOR WITH TRIP DISTANCE

- BREAKEVEN LOAD FACTOR
- DESIGN RANGE

8-727-100, DOMESTIC SERVICE, 1970
LONG TERM, AVERAGE COSTS

TRIP DISTANCE (S. MILES)
Because the variation of net yield and trip cost are linear with distance, the average breakeven load factor for a set of trips is the breakeven load factor at the average trip distance. Thus, for the B-727-100 in domestic service in 1970, the average stage distance was 500 miles where the breakeven load factor was 58%.

9.3 Income Per Seat Trip

We can also define the income per seat trip, $I_{ST}$ as a very simple function of the actual load factor and breakeven load factor;

$$I_{ST} = \frac{I_{AT}}{S} = \frac{1}{S} (NY_p \cdot P_{AT} - TC_{AT})$$

$$= \frac{NY_p \cdot P_{AT}}{S} - TC_{ST}$$

$$= \frac{NY_p \cdot LF}{S} - NY_p \cdot LF_B$$

$$= NY_p \cdot (LF - LF_B)$$

Therefore, the income per seat trip is some fraction of the net yield per passenger, where the fraction is the difference between actual and breakeven load factor. This fraction shows the leverage of every point in achieved average load factor in increasing the airline trip income.
References


4. Uniform System of Accounts and Reports for Certified Air Carriers, US Civil Aeronautics Board


6. Direct Exhibits of Bureau of Economics, Phase 9, Fare Structure, Domestic Passenger Fare Investigation, November 1970, CAB.
The ATA-67 Formula for Direct Operating Cost

H.B. Faulkner

INTRODUCTION

The ATA formulas for direct operating cost were developed for the purpose of comparing different aircraft, existing or not, on the same route or the same aircraft on different routes. Such characteristics of the airline as crew pay, maintenance procedures, and depreciation schedules are kept constant. The formulas should be used for comparison only; they cannot reliably predict the actual operating cost of an airplane in service with a specific airline.

The 1967 ATA Formula is designed for turbine powered transport aircraft only. It covers only direct operating costs, which do not include such items as stewardesses and interest on investment. The formula is based on the characteristics of U.S. international and domestic airlines, and therefore it should not be applied to foreign or third level carriers. In particular, third level carriers would be likely to have smaller, unpressurized aircraft, shorter routes, and different labor rates.

In air transportation systems analysis the 1967 ATA Formula is usually used with appropriate exceptions or modifications, such as: different maintenance labor rate, total maintenance multiplied by a factor, maintenance burden deleted, different depreciation schedule, or different spares percentages. For situations outside the scope of the ATA Formula, other formulas are used, such as the Lockheed/New York Airways Formula (Reference 1) for VTOL or an updated version of the 1960 ATA formula for reciprocating power.
EFFECT OF MODIFICATIONS FOR NOISE ABATEMENT

The principal direct effect would be on depreciation. The cost of the modification would be spread over the remainder of the useful life of the aircraft or the depreciation period.

Other effects could occur through lower cruise speed, higher fuel consumption, or increased maintenance.
CONVERSIONS

The formula gives results in \$/aircraft mile. Knowing block speed, stage length, and the number of passenger seats, any of the following conversions can be made.

\$
/\text{hour} = \$/\text{aircraft mile} \times \text{block speed}
\$
/\text{seat mile} = \$/\text{aircraft mile} \times \frac{100}{\text{number of seats}}
\$
/\text{seat trip} = \$/\text{aircraft mile} \times \frac{\text{stage length}}{\text{number of seats}}
\$
/\text{seat hour} = \$/\text{aircraft mile} \times \frac{\text{block speed}}{\text{number of seats}}
\$
/\text{trip} = \$/\text{aircraft mile} \times \text{stage length}
The following data are needed to exercise the ATA Formula.
The Formula itself is provided in the appendix.

**INPUTS**

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>S</td>
<td>number of seats</td>
</tr>
<tr>
<td>D</td>
<td>stage length, statute miles</td>
</tr>
<tr>
<td>$T_{cl}$</td>
<td>time to climb, hr.</td>
</tr>
<tr>
<td>$T_d$</td>
<td>time to descend, hr.</td>
</tr>
<tr>
<td>$D_{cl}$</td>
<td>distance to climb, mi.</td>
</tr>
<tr>
<td>$D_d$</td>
<td>distance to descend, mi.</td>
</tr>
<tr>
<td>$V_{cr}$</td>
<td>cruise speed, mph</td>
</tr>
<tr>
<td>$F_{gm}$</td>
<td>ground maneuver fuel, lbs.</td>
</tr>
<tr>
<td>$F_{cl}$</td>
<td>climb fuel, lbs</td>
</tr>
<tr>
<td>$F_{cr}$</td>
<td>cruise fuel, lbs</td>
</tr>
<tr>
<td>$F_{am}$</td>
<td>air maneuver fuel, lbs.</td>
</tr>
<tr>
<td>$F_d$</td>
<td>descent fuel, lbs.</td>
</tr>
<tr>
<td>$TOGW_{max}$</td>
<td>maximum takeoff gross weight, lbs.</td>
</tr>
<tr>
<td>$N_e$</td>
<td>number of engines</td>
</tr>
<tr>
<td>$U$</td>
<td>utilization, hours per year</td>
</tr>
<tr>
<td>$C_t$</td>
<td>total purchase cost of aircraft without spares, $</td>
</tr>
<tr>
<td>$W_a$</td>
<td>weight of airframe, lbs.</td>
</tr>
<tr>
<td>$C_a$</td>
<td>purchase cost of airframe, $</td>
</tr>
<tr>
<td>$T$</td>
<td>takeoff thrust of one engine, lbs.</td>
</tr>
<tr>
<td>$C_e$</td>
<td>purchase cost of one engine,$</td>
</tr>
</tbody>
</table>
EXAMPLE

We now proceed through an example, the Boeing 737-200 as it was used on the average in 1970 (Reference 2). The following table gives the inputs to the formula. Notice that the state length is short, the block speed is low, and the utilization is low. The formula shows how to calculate block speed if that is unknown. Here we assume the full payload can be carried so we do not need to calculate reserve fuel as shown in the formula. We will show calculations for all quantities although some of them can be read from charts included with the formula.

Input

<table>
<thead>
<tr>
<th>Input</th>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$S$</td>
<td>number of seats</td>
<td>93</td>
</tr>
<tr>
<td>$D$</td>
<td>stage length</td>
<td>262 statute miles</td>
</tr>
<tr>
<td>$V_b$</td>
<td>block speed</td>
<td>289 mph</td>
</tr>
<tr>
<td>$F_b$</td>
<td>block fuel</td>
<td>5440 lbs.</td>
</tr>
<tr>
<td>$\text{TOGW}_{\text{max}}$</td>
<td>maximum takeoff gross weight</td>
<td>114,500 lbs</td>
</tr>
<tr>
<td>$N_e$</td>
<td>number of engines</td>
<td>2</td>
</tr>
<tr>
<td>$U$</td>
<td>utilization</td>
<td>1865 hr/yr</td>
</tr>
<tr>
<td>$C_t$</td>
<td>total aircraft cost</td>
<td>$5.20 \times 10^6$</td>
</tr>
<tr>
<td>$W_a$</td>
<td>airframe weight</td>
<td>53,217 lbs</td>
</tr>
<tr>
<td>$C_a$</td>
<td>airframe cost</td>
<td>$4.68 \times 10^6$</td>
</tr>
<tr>
<td>$T$</td>
<td>total takeoff thrust of one engine</td>
<td>14,500 lbs.</td>
</tr>
<tr>
<td>$C_e$</td>
<td>cost of one engine</td>
<td>$261,000$</td>
</tr>
</tbody>
</table>
Flight Crew

Two Man Crew:

\[
C_{am} = 0.05 \left( \frac{TOGW}{1000} \right) + 100.0 \frac{1}{V_b}
\]

\[
= 0.05 \left( \frac{114,500}{1000} \right) + 100.0 \frac{1}{289}
\]

\[
= 5.72 + 100.0 \frac{1}{289}
\]

\[
= 0.366 $/mi
\]

The cost components of the formula naturally are incurred as cost per hour, cost per trip, or cost per year, which are then converted to cost per mile. The cost of flight crew is incurred as cost per hour and is converted by dividing by block speed. Note that the cost depends on gross weight and number of crew.

Fuel and Oil

\[
C_{am} = 1.02 \left( \frac{F_b \times C}{ft} + N_e \times 0.135 \times C \times t_b \right) \div D
\]

\[
= 1.02 \left( \frac{(5440 \times 0.0149) + (2 \times 0.135 \times 0.926 \times 0.906)}{262} \right)
\]

\[
= 1.02 \frac{81.2 + 0.27}{262}
\]

\[
= 0.317 $/mi
\]

The cost of fuel and oil is incurred as cost per trip and converted to cost per mile by dividing by stage length. Note that the cost of oil is insignificant.
Hull Insurance

\[
C_{am} = \frac{0.02 \times C_t}{U \times V_b}
\]

\[
= \frac{0.02 \times 5.2 \times 10^6}{1865 \times 289}
\]

\[
= 0.193 \$/mi
\]

Insurance is an annual expense and is converted to cost per mile by dividing by utilization and block speed.

Maintenance

Airframe Labor

\[
K_{FC_a} = 0.05 \left( \frac{W_a}{1000} + 6 - \frac{630}{53,217 + 120} \right)
\]

\[
= 2.66 + 6 - 3.63
\]

\[
= 6.97 \text{ hr/cycle}
\]

\[
K_{FH_a} = 0.59 \text{ } K_{FC_a} = 0.59 \times 6.97 = 4.11 \text{ hr/flight hr.}
\]

\[
C_{am} = \frac{(K_{FH_a} + K_{FC_a})}{V_b} \quad (4.00) \quad (1)
\]

\[
= \frac{4.11 \times 0.722 + 6.97}{289 \times 0.906}
\]

\[
= 0.152 \$/mi.
\]
All maintenance expense is incurred as a cost per trip and is converted to cost per mile by dividing by stage length (block speed times block time). Maintenance labor costs are based on the labor man hours per flight hour and the labor man hours per flight cycle. Airframe labor is non-linear function of airframe weight.

**Maintenance**

**Airframe Material:**

\[
C_{FH_a} = \frac{3.08 C_a}{10^6} = \frac{3.08 \times 4.68 \times 10^6}{10^6} = 14.4
\]

\[
C_{FC_a} = \frac{6.24 C_a}{10^6} = \frac{6.24 \times 4.68 \times 10^6}{10^6} = 29.2
\]

\[
C_{am} = \frac{C_{FH_a} T_f + C_{FC_a}}{V_b T_b} = \frac{14.4 \times .722 + 29.2}{289 \times .906} = 0.151 \text{s/mi.}
\]

Maintenance material cost is based on material cost per flight hour and material cost per flight cycle. These costs are proportional to airframe cost.
Maintenance

Engine Labor:

\[ K_{FH_e} = \left( 0.6 + \frac{0.027T}{10^3} \right) N_e \]
\[ = \left( 0.6 + \frac{0.027 \times 14,500}{10^3} \right)^2 \]
\[ = (0.6 + 0.392)^2 \]
\[ = 1.98 \]

\[ K_{FC_e} = \left( 0.3 + \frac{0.03T}{10^3} \right) N_e \]
\[ = \left( 0.3 + \frac{0.03 \times 14,500}{10^3} \right)^2 \]
\[ = (0.3 + 0.435)^2 \]
\[ = 1.47 \]

\[ C_{am} = \frac{K_{FH_e} t_f + K_{FC_e}}{V_b t_b} \]

\[ = 1.98 \times 0.722 + 1.47 \]
\[ = \frac{289 \times 0.906}{289} \]
\[ = 0.111 \text{$/mi.} \]

Note that increasing the number of engines without changing the thrust increases the engine labor cost. However, this can be partially offset by reducing the thrust requirement from the engine out case.
Maintenance

Engine Material:

\[ C_{FH_e} = 2.5 \ N_e \left( \frac{C_e}{10^5} \right) \]

\[ = 2.5 \times 2 \times \left( \frac{261,000}{10^5} \right) \]

\[ = 13.1 \]

\[ C_{FC_e} = 2.0 \ N_e \left( \frac{C_e}{10^5} \right) \]

\[ = 2.0 \times 2 \times \left( \frac{261,000}{10^5} \right) \]

\[ = 10.4 \]

\[ C_{am} = \frac{C_{FH_e} t_f + C_{FC_e}}{V_b t_b} \]

\[ = \frac{13.1 \times 0.722 + 10.4}{289 \times 0.906} \]

\[ = 0.076 \$\text{/mi} \]

Engine material cost is proportional to the total cost of the engines.
Maintenance

Burden:

\[ C_{am} = 1.8 \times (\text{Airframe Labor} + \text{Engine Labor}) \]

\[ = 1.8 \times (0.152 + 0.111) \]

\[ = 0.474 \, \$/\text{mi} \]

Maintenance burden is the cost of owning and maintaining the ground facilities for aircraft maintenance. It is proportional to the sum of airframe and engine labor costs.
Depreciation

\[ C_t = 5.20 \times 10^6 = \text{total aircraft cost without spares} \]

\[ .10 (C_t - N_e C_e) = .10 C = .10 \times 4.68 \times 10^6 = .468 \times 10^6 \]

= 10% airframe spares cost

\[ .40 N_e C_e = .40 \times 2 \times 261,000 = .209 \times 10^6 \]

= 40% engine spares cost

\[ C_{am} = \frac{1}{V_b} \left[ \frac{C_t + .10 (C_t - N_e C_e) + .40 N_e C_e}{D_a \times U} \right] \]

\[ = \frac{1}{289} \left[ \frac{5.20 \times 10^6 + .468 \times 10^6 + .209 \times 10^6}{12 \times 1865} \right] \]

\[ = \frac{1}{289} \left[ \frac{5.88 \times 10^6}{12 \times 1865} \right] \]

\[ = 0.910 \$/\text{mi} \]

Depreciation is an annual expense which is converted to cost per mile by dividing by utilization and block speed.
Summary

<table>
<thead>
<tr>
<th></th>
<th>$/mi.</th>
<th>$/hr.</th>
<th>$/s.mi.</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crew</td>
<td>.366</td>
<td>106</td>
<td>.394</td>
<td>13.3</td>
</tr>
<tr>
<td>Fuel and Oil</td>
<td>.317</td>
<td>92</td>
<td>.341</td>
<td>11.5</td>
</tr>
<tr>
<td>Hull Insurance</td>
<td>.193</td>
<td>56</td>
<td>.208</td>
<td>7.0</td>
</tr>
<tr>
<td>Total Flying Operations</td>
<td>.876</td>
<td>254</td>
<td>.943</td>
<td>31.8</td>
</tr>
<tr>
<td>Airframe Labor</td>
<td>.152</td>
<td>44</td>
<td>.164</td>
<td>5.5</td>
</tr>
<tr>
<td>Airframe Material</td>
<td>.151</td>
<td>44</td>
<td>.163</td>
<td>5.5</td>
</tr>
<tr>
<td>Engine Labor</td>
<td>.111</td>
<td>32</td>
<td>.119</td>
<td>4.0</td>
</tr>
<tr>
<td>Engine Material</td>
<td>.076</td>
<td>22</td>
<td>.082</td>
<td>2.8</td>
</tr>
<tr>
<td>Total Direct Maintenance</td>
<td>.490</td>
<td>142</td>
<td>.528</td>
<td>17.8</td>
</tr>
<tr>
<td>Maintenance Burden</td>
<td>.474</td>
<td>137</td>
<td>.510</td>
<td>17.2</td>
</tr>
<tr>
<td>Total Maintenance</td>
<td>.964</td>
<td>279</td>
<td>1.038</td>
<td>35.0</td>
</tr>
<tr>
<td>Depreciation</td>
<td>.910</td>
<td>263</td>
<td>.980</td>
<td>33.2</td>
</tr>
<tr>
<td>Total</td>
<td>2.750</td>
<td>796</td>
<td>2.961</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Notice that total flying operations, total maintenance, and depreciation are each about a third of the cost. Maintenance burden, rather than flight crew or fuel, is the largest single item.
Comparison with the Real World

737-200 $/hr.

Actual Figures are for the year 1970. (Reference 2)

<table>
<thead>
<tr>
<th></th>
<th>1967 ATA</th>
<th>United</th>
<th>Western</th>
<th>Frontier</th>
<th>Piedmont</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crew</td>
<td>106</td>
<td>183</td>
<td>119</td>
<td>112</td>
<td>107</td>
</tr>
<tr>
<td>Fuel and Oil</td>
<td>92</td>
<td>101</td>
<td>113</td>
<td>101</td>
<td>104</td>
</tr>
<tr>
<td>Insurance</td>
<td>56</td>
<td>12</td>
<td>4</td>
<td>24</td>
<td>18</td>
</tr>
<tr>
<td>Flying Operations</td>
<td>254</td>
<td>296</td>
<td>236</td>
<td>237</td>
<td>229</td>
</tr>
<tr>
<td>Airframe</td>
<td>88</td>
<td>51</td>
<td>47</td>
<td>62</td>
<td>46</td>
</tr>
<tr>
<td>Engine</td>
<td>54</td>
<td>25</td>
<td>45</td>
<td>37</td>
<td>36</td>
</tr>
<tr>
<td>Burden</td>
<td>137</td>
<td>70</td>
<td>37</td>
<td>38</td>
<td>43</td>
</tr>
<tr>
<td>Total Maintenance</td>
<td>279</td>
<td>146</td>
<td>129</td>
<td>137</td>
<td>125</td>
</tr>
<tr>
<td>Depreciation</td>
<td>263</td>
<td>99</td>
<td>104</td>
<td>129</td>
<td>89</td>
</tr>
<tr>
<td>Total</td>
<td>796</td>
<td>541</td>
<td>470</td>
<td>503</td>
<td>443</td>
</tr>
</tbody>
</table>
The formula predicts flying operations expense fairly well except insurance is high. Also United Airlines has a three man crew on the 737-200, whereas we assumed two men for the formula.

The formula is very high on maintenance. This seems to be because the formula is based on long haul aircraft, which may have high cycle costs. The example is a short haul aircraft, which has been designed to have low cycle costs. The maintenance burden is correspondingly high.

Depreciation is also high because more recent (1971-82) purchase costs were used as input to the formula and because the airlines are using different depreciation schedules from the one assumed by the formula.

The total figures show that the direct operating cost does vary significantly from airline to airline. The total cost from the formula is high and indicates the danger of using the formula to predict the absolute true cost in airline service.
REFERENCES


2. CAB, Aircraft Operating Cost and Performance Report, Volume V, August 1971
Technology for Design of Transport Aircraft

Lecture Notes for MIT Courses

Sem. 1.61 Freshman Seminar in Air Transportation
and
Graduate Course 1.201, Transportation Systems Analysis

Robert W. Simpson
Flight Transportation Laboratory, MIT

Revised for NASA/MIT Summer Workshop on Air Transportation
Waterville Valley, New Hampshire
July 1972
Technology for the Design of Transport Aircraft

A) Measures of Performance

The common measures of performance for a transport aircraft are listed below:

1. Cruise Performance - Payload (passengers) versus Range (s. miles)
2. Cost Performance - ($/block hour, $/available seat mile)
3. Runway Performance - takeoff and landing distances (feet)
4. Speed Performance - max. cruise speed (mph)
5. Noise Performance - noise footprint size, or peak noise (PNdb)

For a long range transport aircraft, the designer maximizes cruise and cost performance subject to constraints specified for takeoff and landing, speed, and noise performance. If the designer optimizes takeoff and landing performance as for STOL or VTOL transport aircraft, then cruise performance will be less than optimal, and these aircraft will only perform well over short cruise ranges. Introduction of noise constraints into the design of transport aircraft requires good knowledge of the noise generation characteristics of engines and other propulsive devices as a function of size and technology, and like all constraints will cause less than optimal cruise and takeoff and landing performance.

The designer's problem is to create an aircraft design which is matched to some design mission stated in terms of desired or required levels of these measures of performance.

Here we shall discuss the design parameters which determine cruise performance for a conventional subsonic jet transport, and fix other design considerations. We shall assume the aircraft burns climb fuel to reach cruising altitude, and ask ourselves how far the aircraft can carry a given payload at cruising altitude. This simple analysis brings out the major factors in establishing the cruise performance. We shall see how the current state of aeronautical technology determines the current size of transport aircraft, (and therefore its operating cost) and how different sizes of transport are needed to provide the cost optimal vehicle for different
given payload-range objectives.

B) Technology

We have three areas of aeronautical technology, aerodynamics, structures, and propulsion, which keep improving, and which cause newer aircraft to be superior as time goes on. In discussing cruise performance, we will use a single measure for the level of technology in each area.

<table>
<thead>
<tr>
<th>Areas of Technology</th>
<th>Measure of Technology Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Aerodynamics</td>
<td>( V(L/D) = \text{speed} \times (\text{lift/drag ratio in cruise}) )</td>
</tr>
<tr>
<td>2. Structures</td>
<td>( \frac{W_E}{W_G} = \text{empty weight fraction} ) ( = (\text{operating empty weight/gross weight}) )</td>
</tr>
<tr>
<td>3. Propulsion</td>
<td>( \text{SFC} = \text{Cruise specific fuel consumption} ) ( (\text{lbs. of fuel per hour/lbs. of thrust}) )</td>
</tr>
</tbody>
</table>

B.1 Aerodynamics Technology

The lift/drag ratio, \( L/D \), in cruise for present subsonic aircraft is a number like 16-17, i.e. for every 16 lbs of weight, there is a requirement for 1 lb of thrust. The steady state forces on the aircraft are shown in Figure 1. The aircraft weight \( W_G \) equals the lift \( L \). Dividing the lift by the \( L/D \) ratio gives the drag \( D \), which requires an equal thrust, \( T \).

While \( L/D \) ratios of up to 40 can be obtained for sailplanes at low speeds by using large span, high aspect ratio wings and good airfoil sections, the objective for transport aircraft turns out to be the maximization of the product of speed and \( L/D \), i.e. to achieve good \( L/D \) values at higher speeds. This objective must be compromised by aerodynamic requirements for takeoff and landing performance which demand a larger wing area than otherwise would be used for cruise.

A plot of values of \( V(L/B) \) is given by Figure 2 which shows the
Figure 1  STEADY STATE FORCES IN CRUISE

LIFT $L = \text{WEIGHT } W_G$
THRUST $T = \text{DRAG, } D$

$CRUISE \text{ SPEED } V, \text{ MPH}$
Figure 2  TREND OF V (L/D) FOR TRANSPORT AIRCRAFT
steady improvement for transport aircraft over the past 35 years. These improvements have been developments like laminar flow airfoils, thinner wings, swept wings, higher wing loadings in cruise because of better high lift devices, etc. The supercritical wing section (SCW) and perhaps laminar flow control (LFC) wing are developments which have promise of continuing improvement.

Notice that although the SST has L/D values of only 8, its speed on the order of 1800 mph gives very high values for $V(L/D)$.

B.2 Structures Technology

Here we use the "empty weight fraction" as a measure of structures technology although it contains other than the weight of the aircraft structure.

We shall use the following, non-standard breakdown of the weight of a transport aircraft:

We define \( W_G \) = takeoff gross weight
\( W_{Gi} \) = initial cruise weight
\( W_{Gf} \) = final cruise weight

The total fuel load is divided into:

\( W_F \) = total fuel weight
\( W_{FC} \) = fuel burn in climb
\( W_{FB} \) = fuel burn in cruise
\( W_{FR} \) = weight of fuel reserve

Then
\[
W = W_G - W_{FC} = W_G - W_{FB} = W_{Gi} - W_{FB}
\]
For simplicity, we shall ignore fuel burn in descent, and range during climb, and shall be computing only range in cruise. We shall assume that $W_{FC} = W_{FR} = 5\%$ of $W_G$.

We define the operating weight empty, $W_E$, as made up of:

$$W_E = W_S + W_{FE} + W_{PP} + (W_{FR})$$

where $W_S =$ weight of aircraft structure

$W_{FE} =$ weight of furnishings and equipment (pilots, seats, galley, toilets, radios, etc.)

$W_{PP} =$ weight of power plant

$W_{FR} =$ weight of reserve fuel.

Notice that for convenience, we include the reserve fuel in the "operating weight empty" although that is not standard practice.

We define the useful load, $W_U$, as the difference between the initial cruise weight, $W_{Gi}$ and $W_E$

$$W_U = W_{Gi} - W_E = W_G - W_{FC} - W_E$$

The useful load will consist of some combination of payload, $W_p$ and fuel burn in cruise $W_{FB}$. We are going to examine the effects of range requirements on the payload fraction, $W_p/W_G$, which can be achieved. As range is increased, more of the useful load must be devoted to fuel, thereby decreasing the payload fraction.

Typical values of the "empty weight fraction" (without reserve fuel) for current aircraft are given by Table 1. Notice that the empty weight fraction is roughly 50\%, and that lower values are obtained for long haul, large size aircraft, where emphasis is placed upon achieving a low value, and where some economy of scale
## TABLE 1. Typical Values of Basic Empty Weight/Max Gross Weight

<table>
<thead>
<tr>
<th>Passenger Aircraft</th>
<th>Empty Weight Fraction</th>
<th>Max. Gross Weight</th>
<th>Range</th>
<th>St Miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>747</td>
<td>.491</td>
<td>710.0</td>
<td>5,790</td>
<td></td>
</tr>
<tr>
<td>DC-10-10</td>
<td>.474</td>
<td>555.</td>
<td>5,400</td>
<td></td>
</tr>
<tr>
<td>L-1011</td>
<td>.550</td>
<td>426.</td>
<td>2,878</td>
<td></td>
</tr>
<tr>
<td>DC-8-63</td>
<td>.437</td>
<td>350.</td>
<td>4,500</td>
<td></td>
</tr>
<tr>
<td>707-320B</td>
<td>.423</td>
<td>327.</td>
<td>6,160</td>
<td></td>
</tr>
<tr>
<td>727-200D</td>
<td>.552</td>
<td>175.</td>
<td>1,543</td>
<td></td>
</tr>
<tr>
<td>Trident-3B</td>
<td>.554</td>
<td>150.</td>
<td>2,430</td>
<td></td>
</tr>
<tr>
<td>Mercure</td>
<td>.557</td>
<td>114.6</td>
<td>1,100</td>
<td></td>
</tr>
<tr>
<td>DC-9-40</td>
<td>.488</td>
<td>114.0</td>
<td>1,192</td>
<td></td>
</tr>
<tr>
<td>737-200F</td>
<td>.538</td>
<td>109.0</td>
<td>2,135</td>
<td></td>
</tr>
<tr>
<td>BAC-111-475</td>
<td>.532</td>
<td>97.5</td>
<td>1,682</td>
<td></td>
</tr>
<tr>
<td>F-28-2000</td>
<td>.557</td>
<td>65.0</td>
<td>1,301</td>
<td></td>
</tr>
<tr>
<td>VFW 614</td>
<td>.656</td>
<td>41.0</td>
<td>1,553</td>
<td></td>
</tr>
<tr>
<td>VAK-40</td>
<td>.570</td>
<td>36.4</td>
<td>807</td>
<td></td>
</tr>
<tr>
<td>Falcon 20T</td>
<td>.607</td>
<td>29.1</td>
<td>641</td>
<td></td>
</tr>
<tr>
<td>DHC-6</td>
<td>.560</td>
<td>12.5</td>
<td>745</td>
<td></td>
</tr>
<tr>
<td>Concorde SST</td>
<td>.44</td>
<td>885.</td>
<td>4,020</td>
<td></td>
</tr>
<tr>
<td>S-61 helicopter</td>
<td>.62</td>
<td>19.00</td>
<td>275</td>
<td></td>
</tr>
</tbody>
</table>

### Freighters

<table>
<thead>
<tr>
<th>Aircraft</th>
<th>Empty Weight Fraction</th>
<th>Max. Gross Weight</th>
<th>Range</th>
<th>St Miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>747F</td>
<td>.428</td>
<td>775.0</td>
<td>2,880</td>
<td></td>
</tr>
<tr>
<td>CSA</td>
<td>.425</td>
<td>764.5</td>
<td>3,500</td>
<td></td>
</tr>
<tr>
<td>707-320C</td>
<td>.402</td>
<td>332.0</td>
<td>3,925</td>
<td></td>
</tr>
<tr>
<td>L-100-30(C130)</td>
<td>.468</td>
<td>155.0</td>
<td>2,800</td>
<td></td>
</tr>
</tbody>
</table>

(Source: Jane's 1971-72)
may occur for fixed equipment like radios, galley, etc.

The major portion of the empty weight fraction is the structures weight, \( W_s \), which is usually 30% of the gross weight. A diagram of the value of the "structures weight fraction" is shown by Figure 3. Since the construction of the DC-3 there has been very few basic changes in structural technology. However, there is considerable promise currently of new developments which use composite materials, and different construction techniques to provide extremely light weight and rigid structures. These are expensive now, but future development work may reduce their costs.

B.3 Propulsion

The specific fuel consumption is given in terms of rate of fuel burned per lb. of thrust for the engine. Here we want the cruise SFC values at cruise altitude and speed. For the early jets, SFE had a value of roughly 1.0 in cruise, which meant that a 10,000 lb. thrust engine would consume 10,000 lbs. of fuel in one hour. For present fan engines, SFC is roughly 0.6, so that only 6,000 lbs of fuel per hour would be consumed by current engines.

Another common measure of propulsion technology is the thrust to weight ratio of the engines, but here we have made it a part of the operating weight fraction as a measure for structures technology.

The most remarkable improvement over the last decade has been the improvement in cruise SFC for the engines used by subsonic transport aircraft. This is illustrated in Table 2 and Figure 4 which show the almost 50% reduction in fuel consumption by current
Table 2. Specific Fuel Consumption for Current Transport Engines

<table>
<thead>
<tr>
<th>Engine</th>
<th>Bypass Ratio</th>
<th>Takeoff Conditions</th>
<th>Cruise Conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Static</td>
<td>Mach</td>
</tr>
<tr>
<td>JT3-C</td>
<td>0</td>
<td>13,500</td>
<td>0.77</td>
</tr>
<tr>
<td>CONWAY</td>
<td>0.6</td>
<td>20,400</td>
<td>0.62</td>
</tr>
<tr>
<td>SPEY</td>
<td>1.0</td>
<td>9,850</td>
<td>0.54</td>
</tr>
<tr>
<td>JT8-D</td>
<td>1.03</td>
<td>14,880</td>
<td>0.57</td>
</tr>
<tr>
<td>JT3-D</td>
<td>1.4</td>
<td>18,000</td>
<td>0.52</td>
</tr>
<tr>
<td>TFE-731</td>
<td>2.55</td>
<td>3,500</td>
<td>0.49</td>
</tr>
<tr>
<td>M-45</td>
<td>2.8</td>
<td>7,760</td>
<td>0.45</td>
</tr>
<tr>
<td>CF-6-6</td>
<td>6.25</td>
<td>40,000</td>
<td>0.34</td>
</tr>
<tr>
<td>ASTAFAN</td>
<td>6.5</td>
<td>1,5622</td>
<td>0.38</td>
</tr>
</tbody>
</table>
Figure 3  TREND FOR STRUCTURES WEIGHT FRACTION FOR TRANSPORT AIRCRAFT

CONVENTIONAL ALUMINUM ALLOY STRUCTURE

POSSIBLE EFFECT OF NEW COMPOSITE MATERIALS
Figure 4  TRENDS IN PROPULSION - SFC

- TURBOJETS
- FAN ENGINES
- BPR = 5 ENGINES

Cruise SFC


YEAR
high bypass ratio fan engines over the initial pure jet engines. This improvement is due to better propulsive efficiencies from the fan, improved component efficiencies for engine components like compressors, turbines, combustors, etc., and higher cycle temperatures due to improved materials and technology in the design and construction of the turbine blades.

C) Determination of Range-Payload Performance

C.1 Short Range Aircraft

Where the fuel burn, $W_{FB}$, is a small fraction of $W_G$, we can assume that $W_G$ remains constant during cruise, or $W_{Gi} \approx W_{Gf} \approx W_G$.

If we define $R = \text{cruising range (s. miles)}$

$$m = \text{mileage factor, (s. miles per lb. of fuel)}$$

Then $R = m \cdot W_{FB}$

We can express $m$ in terms of $V$, $T$, and SFC

$$m = \frac{V}{T(SFC)} = \frac{s.\text{miles/hr}}{\text{lbs of fuel/hr}} = \frac{s.\text{miles}}{\text{lb. fuel}}$$

But from Figure 1, $\frac{T}{W_G} = \frac{D}{L}$, or $T = \frac{W_G}{(L/D)}$

$$\Rightarrow \quad m = \frac{V}{SFC} \cdot \frac{(L/D)}{W_G}$$

Substituting $m$ in (1)

$$R = \frac{V(L/D)}{SFC} \cdot \left[ \frac{W_{FB}}{W_G} \right] = r \cdot \left[ \frac{W_{FB}}{W_G} \right]$$

where $r$ is called "specific range" (s. miles)

and $\frac{W_{FB}}{W_G}$ is called "fuel burn fraction"
Note: r has the dimensions of s. miles

e.g. if L/D = 16, SFC = 0.6 lbs. of fuel/hr. per lb. of thrust

\[ V = 550 \text{ mph} \]

Then \[ r = \frac{550 \times 16}{0.6} = 14,700 \text{ s. miles} \]

We shall use these assumed values in later examples.

a) If no payload is carried, then \( W_P = 0, W_U = W_{FB} = W_{Gi} - W_E \),

then the maximum cruise range, \( R_{\text{max}} \)

\[
R_{\text{max}} = r \left[ \frac{W_{FB}}{W_G} \right] = r \left[ \frac{W_U}{W_G} \right] = r \left[ \frac{W_{Gi} - W_E}{W_{Gi}} \right]
\]

\[
= r \left( 1 - \frac{W_E}{W_{Gi}} \right)
\]

So, our structures technology parameter is a strong determinant of the maximum range for a fuelled aircraft. If the "empty weight fraction" can be reduced, it increases the "fuel fraction", or "useful load fraction", and thereby the maximum range.

b) If payload is carried, then \( W_{FB} = W_{Gi} - W_E - W_P \) \( W_S = W_E - W_P \)

and for any given payload

\[
R = r \left[ \frac{W_{FB}}{W_G} \right] \approx r \left[ \frac{(W_G - W_E - W_P)}{W_G} \right]
\]

\[
= R_{\text{max}} - r \cdot \left[ \frac{W_P}{W_G} \right]
\]

from (3)

where \( \frac{W_P}{W_G} \) is called the "payload fraction".

We can plot the payload fraction against R in Figure 5.
Figure 5  PAYLOAD FRACTION versus RANGE

PAYLOAD FRACTION  \( \frac{W_U}{W_G} \)

SLOPE = \( \frac{1}{r} \)

\( R_{\text{max}} (r_1) \)

R, CRUISE RANGE  (Statute Miles)
where \( \frac{W_P}{W_G} = \frac{1}{r} \cdot (R_{\text{max}} - R) \) (4)

At \( R = 0 \), \( \frac{W_P}{W_G} = \frac{R_{\text{max}}}{r} = \frac{W_U}{W_G} \) from equation (3)

For this short range case the variation of payload fraction is linear in \( R \), decreasing to zero at \( R_{\text{max}} \). As \( r \) is improved, the payload fraction at any range improves, and \( R_{\text{max}} \) increases. As \( \frac{W_E}{W_G} \) is decreased, \( \frac{W_U}{W_G} \) is increased which gives higher payload fractions for all ranges.

This simple analysis has been for the short range case where \( W_j \) may be considered as remaining constant over the cruise, or the fuel burn fraction is small for the short range mission.

C.2 Long Range Aircraft

For a long range aircraft, the change in \( W_g \) during the flight cannot be ignored (\( W_g = \) instantaneous gross weight)

\( \text{e.g. a B-707-300 on a NY to Paris trip} \)

\( W_{Gi} \) out of NY \( \approx 315000 \) lbs

\( W_{Gf} \) at Paris \( \approx 230000 \) lbs

so final weight is 2/3 of initial weight.

Equation 2 still applies over a small increment of cruise so we resort to the calculus which produces a different, more precise formula called the "Breguet Range Equation". Equation (2) becomes

\[ q_R = \frac{r}{w_g} \cdot d W_{FB} \]
where \( dR \) = increment of range

\[ dW_{FB} = -dW_g = \text{increment of fuel burn} \]

\[ = \text{decrease in } W_g \]

\[ dR = r \cdot \left[ \frac{-dW_g}{W_g} \right] \]

If the value of \( W_g \) at start of cruise is \( W_{gi} \), at end of cruise is \( W_{gf} \), then we have to integrate from \( W_{gi} \) to \( W_{gf} \) to get the exact formula for \( R \)

\[ R = r \cdot \int_{W_{gi}}^{W_{gf}} \frac{-dW_g}{W_g} = r \cdot \int_{W_{gi}}^{W_{gf}} \frac{dW_g}{W_g} = r \cdot \ln \left[ \frac{W_{gi}}{W_{gf}} \right] \]  \hspace{1cm} (2a)

If we compare to Equation (2) we see that the specific range is now modified by a logarithmic expression involving the initial and final cruise gross weights;

\[ \frac{W_{FB}}{W_g} \sim \frac{W_{FB}}{W_{gf}} \text{ is now replaced by } \ln \left[ \frac{W_{gf} + W_{FB}}{W_{gf}} \right] = \ln \left[ 1 + \frac{W_{FB}}{W_{gf}} \right] \]

a) \text{If no payload is carried, then } W_p = 0, W_U = W_{FB} = W_{gi} - W_E \text{ then the maximum range becomes,}

\[ R_{max} = r \cdot \ln \left[ \frac{W_{gi}}{W_{gf}} \right] = r \ln \left[ \frac{W_{Gi}}{W_E} \right] = r \ln \left[ \frac{1}{W_E/W_{Gi}} \right] \]  \hspace{1cm} (3a)

As before, if \( W_E/W_{Gi} \) is reduced, \( R_{max} \) will be increased. However since \( W_g \) now decreases as fuel is burned, \( R_{max} \) is greater in (3a) than from the sample case (3).

For example if \( r = 14,700 \) as before, and \( \frac{W_{FC}}{W_g} = .05 \), and
we assume $\frac{W_E}{W_G} = 0.60$, $\frac{W_E}{W_{Gi}} = \frac{0.60}{0.95} = 0.632$

or $\frac{W_{FB}}{W_G} = 0.35$, $\frac{W_{FB}}{W_{Gi}} = \frac{0.35}{0.45} = 0.370$

From (3), $R_{max} = 14,700 \times (0.37) = 5450$ s. miles in cruise

From (3a), $R_{max} = 14,700 \ln \frac{1}{0.632} = 14,700 \ln (1.58) = 6770$ s. miles

The correct formula makes a 1320 s. mile difference in $R_{max}$.

b) If payload is carried, then $W_{FB} = W_{Gi} - W_E - W_P$, and the payload becomes

$$R = r \ln \left( \frac{W_{Gi}}{W_{Wf}} \right) = r \ln \left( \frac{W_{Gi}}{W_E + W_P} \right) = r \ln \left( \frac{1}{\frac{W_E/W_{Gi} + W_P/W_{Gi}}{1}} \right)$$

If we unlog this expression

$$\frac{W_E}{W_{Gi}}, \frac{W_P}{W_{Gi}} = e^{-R/r}$$

or payload fraction, $\frac{W_P}{W_{Gi}} = e^{-R/r} - \frac{W_E}{W_{Gi}}$  \hspace{1cm} (4a)

At $R = 0$, $\frac{W_P}{W_{Gi}} = 1 - \frac{W_E}{W_{Gi}} = \frac{W_U}{W_{Gi}}$ as before for short range case

At $R = R_{max}$, $\frac{W_P}{W_{Gi}} = 0$

As shown in Figure 6, the payload fraction curve is now a shallow exponential. Near maximum range, the payload fraction becomes very small, and very sensitive to errors in estimating technology measures.
Figure 6  PAYLOAD FRACTION versus RANGE

PAYLOAD FRACTION $W_p/W_G_i$

SLOPE $= -1/r \ e^{R/r}$

BREGUET CURVE

$W_U/W_G_i$

$R$, RANGE (STATUTE MILES)
D. Weight-Range Diagram

We can now show the weight breakdown versus design range for a conventional subsonic jet at a given level of aircraft technology. From Figure 7, we see that the payload fraction is strongly dependent on design range.

For a long range aircraft, the payload fraction will be very small, and aircraft payload-range performance will be very sensitive to the values of $r$ and $W_{E}/W_{G}$ which can be achieved. For example, if $W_{P}/W_{G}$ is 10% for some design range, then every lb. saved in empty weight converts directly to payload, and saves 10 lbs. in design gross weight.

However, for a short range aircraft where $W_{P}/W_{G}$ may be 33%, then every lb. saved in empty weight still converts directly to payload, but saves only 3 lbs. in design gross weight.

Therefore, a critical decision in the design of any transport aircraft is the choice of the full payload-design range point. Once this is selected, we have a good idea of the required aircraft gross weight for a given level of aircraft technology, and consequently, as we shall see, its probable purchase cost and operating cost.

For our example technology, we can compute payload fractions at design ranges from 6000 to 500 s. miles. Table 3 gives the result of applying equation (3a), and quotes typical gross weights for a 50,000 lb. and 100,000 lb. payload, or roughly a 250 and 500 passenger vehicle.
Figure 7  WEIGHT BREAKDOWN versus RANGE

CLIMB FUEL BURN

CRUISE FUEL BURN, $W_{FB}/W_G$

PAYLOAD, $W_P/W_G$

RESERVE FUEL

WEIGHT FOR FURNISHINGS, EQUIPMENT, ENGINES

STRUCTURES WEIGHT

$W_U = 35\% \text{ OF } W_G$

$W_E = 60\% \text{ OF } W_G$

DESIGN RANGE (STATUTE MILES)
### TABLE 3. SIZING TRANSPORT AIRCRAFT

<table>
<thead>
<tr>
<th>Cruise Design Range (s. miles)</th>
<th>Payload Fraction ((W_p/W_G))</th>
<th>(W_G/W_P) (lbs. per payload)</th>
<th>Gross Weight 250 pax</th>
<th>Gross Weight 500 pax</th>
</tr>
</thead>
<tbody>
<tr>
<td>6000</td>
<td>.04</td>
<td>25</td>
<td>(1.25 \times 10^6)</td>
<td>(2.5 \times 10^6)</td>
</tr>
<tr>
<td>5000</td>
<td>.075</td>
<td>13.3</td>
<td>666,000</td>
<td>1.33 ( \times 10^6)</td>
</tr>
<tr>
<td>4000</td>
<td>.122</td>
<td>8.20</td>
<td>410,000</td>
<td>820,000</td>
</tr>
<tr>
<td>3000</td>
<td>.177</td>
<td>5.65</td>
<td>282,000</td>
<td>565,000</td>
</tr>
<tr>
<td>2000</td>
<td>.230</td>
<td>4.35</td>
<td>217,500</td>
<td>435,000</td>
</tr>
<tr>
<td>1000</td>
<td>.284</td>
<td>3.52</td>
<td>176,000</td>
<td>352,000</td>
</tr>
<tr>
<td>500</td>
<td>.317</td>
<td>3.15</td>
<td>158,000</td>
<td>315,000</td>
</tr>
</tbody>
</table>
E) Payload-Range Diagrams

Having chosen the design range point for a given payload weight, there are two volume decisions which subsequently must be made. First, a fuselage volume must be selected to comfortably house a number of passengers corresponding to the payload, or a cargo load of a given density, or container configuration. Secondly, a fuel tank volume must be selected.

The fuselage volume restriction prevents the addition of passengers or cargo on trips of shorter than design range where the fuel load can be reduced. The fuel volume restriction prevents extending the ranges on trips where less than full payload is being carried. These volume restrictions are shown in Figure 8.

Point A is the design range for full payload. Point B is a point where the fuel tanks are completely filled and a reduced payload is carried. Along the line AB the aircraft operates at full gross weight, and trades off payload and fuel load. Point C is the zero payload range, and the aircraft takeoff weight is reduced from the maximum gross weight as we move along the line BC. Any payload-range point inside the shaded area can be handled by the aircraft by operating at reduced gross weights.

By choosing different volumes, the designer establishes points A and B, and can provide quite different range-payload performance for transport aircraft of constant gross weight as exemplified by the exponential curve which is now dimensional on Y-axis.
Figure 8 VOLUME RESTRICTIONS ON RANGE-PAYLOAD PERFORMANCE

PAYLOAD, $W_p$ (LB)

DESIGN RANGE FOR FULL PAYLOAD

CABIN VOLUME RESTRICTION

FUEL TANK VOLUME RESTRICTION

ZERO PAYLOAD RANGE

RANGE (STATUTE MILES)
We now have derived one of the two basic diagrams describing transport aircraft performance. It is called the "payload-range" diagram. Payload-range diagrams for various current jet transports are shown in Figure 9. Since smaller aircraft are cheaper to own and operate, airlines buy several kinds of aircraft even at a given level of technology to match their fleet capabilities to their traffic loads on routes of varying distances. Traffic load points should be kept near the outer boundaries of the range-payload diagrams for profitability. This will be shown later using the second basic diagram, the direct operating cost-range curve.

As technology improves, a smaller gross weight airplane can be constructed to provide the same payload-range capability at lower costs. For long range aircraft, these technology improvements can provide spectacular changes in gross weight. For example, if the present cruise engines of SFC = 0.60 did not exist, a transport aircraft of the general size of the B-747 (i.e. the second aircraft in Table 3, Range = 4000 miles, Payload = 100,000 lbs) would increase in gross weight from 820,000 lbs to 1.67 million lbs. if the cruise SFC were only 0.8. One can safely say that the C-5A, B-747, DC-10, L-1011, etc. would not have been built if it were not for the development of this better engine technology. The construction of new engines of smaller thrust will similarly cause new smaller transports to be built in future years to replace the present DC-9 and B-727.
Figure 9  PAYLOAD-RANGE DIAGRAMS FOR CURRENT TRANSPORT AIRCRAFT

REF: FLIGHT, NOV 65, 68, 71
ISA STD, NO RESERVES

B-747B
DC-10-30
B-707-320B
B-727-200
DC-8-30
DHC-6

PAYLOAD x 1000 LB

RANGE x 1000 STATUTE MILES
F) Direct Operating Cost

F.1 Effects of Size and Range on Operating Cost

We shall now discuss the second basic diagram describing transport aircraft performance, the direct operating cost curve, or DOC curve. The direct operating costs are made up of crew, fuel, maintenance, and depreciation costs directly associated with operating the aircraft. A fuller discussion of total airline costs is the subject of a separate lecture. In this section we shall make some observations on the effects of aircraft size and range (as determined by technology) on these operating costs.

We shall use a single cost measure, $F_{CHR}$, the flight operating costs per block hour to show the effects of size as measured by the gross weight, $W_G$, and range as measured by the full payload-design range. Figure 10 shows a typical result of FTL computer design studies for CTOL jet transports. For a level of technology described as 1970 technology, it shows a linear variation of hourly costs with gross weight (or payload size) for a given design range. However, there is also a variation with design range, so that a set of linear rays far out from a zero weight point of 100 $/block hour. The hourly costs for current transport aircraft are shown in Figure 10. The rays correspond to a level of technology used in the DC-10 and B-747 aircraft, and good agreement is shown for those aircraft.

The positive intercept at zero gross weight causes an economy of scale as aircraft size is increased for a given design range. We will show this by introducing another basic cost measure, $F_{SHR}$, the flight operating cost per seat hour. The variation of $F_{SHR}$ as payload is increased (shown for a design range of 1000 s. miles) is given by Figure 11(a). Obviously, there is a significant economy of scale as payload increases from 50 passengers (5.40 $/seat hour) to 200 passengers (3.64 $/seat hour). Note that the gains are not significant after that size, but there clearly are benefits from introducing
Figure 10  OPERATING COSTS PER BLOCK HOUR versus GROSS WEIGHT AND RANGE

FLIGHT OPERATING COSTS $/BLOCK HR ($/BLOCK HR)

RANGE = 1000 (S. MILES)

FTL DESIGN STUDIES
ATA-67: 4000 HRS/YR, 1/2 YR?
1.25 × LABOR
TECHNOLOGY: BPR = 5, SFC0 = 0.33
M = 0.84 AT 25000 FT
FIELD LENGTH, 800 FT

NOTE: EXISTING AIRCRAFT COSTS FROM CAB,
"AIRCRAFT OPERATING COSTS, 1971"
U.S. DOMESTIC AVERAGE, 1970

AIRCRAFT GROSS WEIGHT (1000 LBS)

AIRCRAFT GROSS WEIGTH (1000 LBS)
Figure 11 EFFECT OF PAYLOAD SIZE ON FLIGHT COSTS PER SEAT HOUR

1970 TECHNOLOGY

\[ r = 14,000 \text{ STATUTE MILES} \]
\[ W_p W_G = 0.28 \]
Figure 11a  EFFECT OF PAYLOAD SIZE ON FLIGHT COSTS PER SEAT HOUR

-FLIGHT OPERATING COSTS PER SEAT-HOUR
FC

DESIGN RANGE = 1000 STATUTE MILES

1970 TECHNOLOGY
BPR = 5, SFC₀ = 0.33
M = 0.84 AT 25,000 FEET
FIELD LENGTH = 8000

ATA-6:
4000 HRS/YEAR, 12 YEARS
.25 × LABOP
220 LBS PER PASSENGER

SEATS
Figure 11b  EFFECT OF DESIGN RANGE ON FLIGHT COSTS PER SEAT HOUR

CAPACITY (SEATS) 40

FC$_{SHR}$
$\$/\text{SEAT HR}$

DESIGN RANGE (Statute Miles)
larger size aircraft whenever traffic loads warrant their usage.

The variation of $F_{CSHR}$ with design range at constant payload is shown by Figure 11(b). Here as range is increased, there is an exponential growth in $F_{CSHR}$, so that for a given payload size, there are benefits from using the shortest design range vehicle which will perform the task. Figure 11(b) shows the effect of size and range simultaneously, (a crossplot of the 1000 mile design range points actually produce Figure 11(a).) Notice that a smaller, but lesser design range vehicle can be cheaper than a larger, but longer design range vehicle. The cheapest vehicle is the one designed for exactly the payload and range of the transportation task to be performed. Using a larger vehicle is cheaper per seat, but not cheaper per passenger.

F.2 Derivation of DOC Direct Operating Costs ($/available seat mile)

For a given aircraft, we can compute the operating cost per hour, $F_{CHR}$. From this basic cost measure, we can derive the DOC curve in terms of cents per available seat mile versus range. We shall now show this derivation.

First, we must know the variation of block time with range. This is shown in Figure 12 as a linear form, where the slope of the curve is inversely proportional to cruise speed, $V_{CR}$ and the zero distance intercept accounts for taxi time, takeoff and landing times, circling the airport for landing and takeoff, and any delays due to ATC congestion. This curve can be obtained by plotting scheduled times versus trip distance, and Figure 12 shows a typical result.
Figure 12  BLOCK TIMES FOR DOMESTIC SERVICE

OFFICIAL AIRLINE GUIDE
B-727 SCHEDULED SERVICE

BLOCK TIME
$T_b$
(minutes)

SLOPE = $1/V_{CR} = 0.11 \, d$

26 MINUTES

TRIP DISTANCE
Figure 13  BLOCK SPEED VARIATION WITH TRIP DISTANCE

BLOCK SPEED $V_b$

$V_{CR}$

TRIP DISTANCE
Figure 14  VARIATION OF PRODUCTIVITY WITH TRIP DISTANCE

PRODUCTIVITY $P_{HR}$ (seat-miles/hour)

TRIP DISTANCE

SEATS UNAVAILABLE DUE TO PAYLOAD-RANGE LIMITATIONS

DESIGN RANGE
If we compute block speed, $V_b$, as trip distance divided by block time, we get the asymptotic curve shown in Figure 13 where at longer ranges, the blockspeed begins to approach the cruise speed.

If we define $P_{HR} = \text{productivity per hour in terms of seat-miles per hour}$ where $S_a = \text{available seats for a given trip}$, then a curve shown in Figure 14 is obtained. It is proportional to the $V_b$ curve up to the full payload design range point where the number of available seats begins to be reduced causing the aircraft productivity to decrease after that point.

Now if we divide the hourly cost by the hourly productivity, we obtain the second basic diagram for transport aircraft, the DOC curve (Direct Operating Cost).

$$\text{DOC} = \frac{FC_{HR}}{P_{HR}} = \frac{\$ \text{/hour}}{\text{seat miles/hour}} = \$\text{/available seat mile}$$

Since $FC_{HR}$ is a constant, this curve is the inverse of the $P_{HR}$ curve and produces the form shown in Figure 15, where DOC is high for short trips, decreases towards the design range point, and increases thereafter.

If we consider different payloads and ranges for the DOC curve, we see that a 50 seat vehicle is more expensive than a 100 seat vehicle, and a vehicle designed for 1000 miles will be cheaper than one designed for 2000 miles as stated previously.
Figure 15  VARIATION OF DOC WITH TRIP DISTANCE

DOC
cents/available
seat-mile

TRIP DISTANCE

50 SEAT AIRCRAFT

100 SEAT AIRCRAFT

DESIGN RANGE
Figure 16  VARIATION OF FLIGHT TRIP COST WITH TRIP DISTANCE

\[ \text{FC}_\text{AT} \]
FLIGHT-COST PER AIRCRAFT TRIP $.$

100 SEATS

50 SEATS

TRIP DISTANCE

1000  2000
Figure 17  VARIATION OF FLIGHT TRIP COST/SEAT WITH TRIP DISTANCE

FC<sub>ST</sub>
FLIGHT COST
PER SEAT TRIP
$

100 SEATS

50 SEATS

TRIP DISTANCE
These curves may cross so that a smaller, shorter range vehicle is cheaper at certain ranges than a larger, longer range vehicle.

Because of this hyperbolic shape, it is easier to work with trip cost measures which have a linear form with distance since they are proportional to block time. We define two trip cost measures here:

\[ \text{FC}_{\text{AT}} = \frac{\text{flight cost per airplane trip}}{\text{distance}} = c_1 + c_2 d \approx FC_{\text{HR}} \cdot T_b \]

where \( c_1 \) and \( c_2 \) are known cost coefficients

\[ \text{FC}_{\text{ST}} = \frac{\text{flight cost per seat trip}}{\text{distance}} = \frac{\text{FC}_{\text{AT}}}{S_a} \]

where \( S_a \) = available seats

The form of \( \text{EC}_{\text{AT}} \) and \( \text{FC}_{\text{ST}} \) with distance is shown in Figures 16 and 17. After design range, where \( S_a \) is decreasing \( \text{FC}_{\text{ST}} \) becomes non-linear.

Generally, these trip cost measures are easier to understand and more useful than the DOC curve with its hyperbolic shape. One needs only to compute \( c_1 \) and \( c_2 \) for a given airplane and cruise schedule, and know the variation of available seats with trip distances.

It must be emphasized that because of the strong variation in DOC with trip distance, any value quoted for DOC is meaningless unless accompanied by a value for trip distance. This point is often forgotten by economists, laymen, and inexperienced systems analysts.
G) **Profitable Load Diagrams**

The two basic diagrams, range-payload and DOC, may be combined to form a "profitable load" diagram if certain major assumptions are made:

1) It is necessary to assume a variation of revenue yield with distance. While a fare formula may be known, yield for a given route is an average net contribution in terms of dollars per passenger computed by taking into account the mix of standard and discount fares, sales commissions, taxes, and perhaps short term, variable indirect operating costs per passenger arising from ticketing, reservations, passenger handling, etc. Here we assume Y is linear with trip distance.

2) It is necessary to assume a variation of total costs, TC with distance, or to ignore allocation of overhead costs and produce a short term profit (or contribution to overhead) diagram. Here we shall assume that short term total operating seats per seat trip, TC\textsubscript{ST} have the same linear form as the flight costs, FC\textsubscript{ST}.

The usual relationship of Y and TC\textsubscript{ST} is shown on Figure 18 where the linear forms cross at some short range. The result is a hyperbolic form for breakeven load decreasing to very low values at design range as shown in Figure 19. As with DOC, any value quoted for breakeven load factor must be accompanied
Figure 18  VARIATION OF TOTAL COSTS AND YIELD WITH TRIP DISTANCE

\[ Y, \text{ YIELD} \]
\[ TC_{ST} \]
\[ \text{TOTAL COST/SEAT TRIP} \]
\[ $ \]

\[ Y - \text{YIELD PER PASSENGER} \]
\[ TC_{ST} - \text{TOTAL COST/SEAT} \]

DESIGN RANGE

TRIP DISTANCE
Figure 19  TYPICAL VARIATION OF BREAKEVEN LOAD WITH DISTANCE

$L_B$  
BREAKEVEN LOAD  
PASSENGERS

DESIGN RANGE

TRIP DISTANCE

100
50
0
by a quoted value for trip distance.

The payload-range and breakeven load curves can now be combined to form a "profitable" load diagram as shown in Figure 20. The shaded areas represent points where a "profit" can be made using the aircraft to carry a given load over this trip distance. If the areas overlap, it is preferable to choose an aircraft where the point lies close to the upper boundary of payload-range limits since it is more profitable. E.g., choose the medium range aircraft for point PQ in Figure 20.

Notice that the profitable load diagram cannot be uniquely associated with a particular aircraft because of its assumptions. It must be associated with an airline and a set of routes since the indirect costs are specific to the airline, and the yield values are specific to a set of routes or city pairs. Thus when profitable load diagrams are shown, these additional data should be quoted.

Notice also that the hyperbolic form of the breakeven load curve is due to the differing slopes of the yield and total cost curves with trip distance. If yields, or fares were proportional to cost over distance, then the breakeven load would be constant with trip distance. Recent fare changes have moved fares much into line with costs by raising the zero distance intercept for coach fares.
Figure 20  PROFITABLE LOAD DIAGRAMS

TRAFFIC LOAD (PASSENGERS)

DISTANCE PQ

TRIP DISTANCE

TRAFFIC ON ROUTE PQ

AREA OF PROFITABILITY

LARGE, LONG RANGE AIRCRAFT

MEDIUM, LONG RANGE AIRCRAFT

SMALL, SHORT RANGE AIRCRAFT
from $6.00 to $12.00. This provides much lower breakeven loads for shorter distance trips.

H) The Price of Transport Aircraft

As mentioned earlier, the purchase price and therefore depreciation costs are proportional to aircraft size. To demonstrate this Figure 21 shows a plot of current prices against aircraft operating empty weight. A good fit is given by the curve,

$$ P_a = 1.9 \times 10^6 + 66.6E $$

where $P_a$ = fully equipped market price

$W_E$ = basic operating weight empty

This correlation does not mean that $W_E$ is the causative factor in determining the price which a manufacturer will decide to establish for his new product. Competition from existing aircraft, the expected size of the production run, etc. are factors which he considers closely. It is merely interesting to note the correlation with empty weight.

Notice also, that the DEC-6, a simple STOL transport from Canada, and the YAK-40, a new entry in world markets from Russia, are well below the minimum price for conventional transport aircraft from the Western world.
A set of data on prices for current new and used jet transports taken from the weekly editions of Esso's "Aviation News Digest" is given by Table 4. There is considerable variation in unit prices which may be due to various amounts of aircraft spares included with the purchase.
Figure 21  THE PRICE OF CURRENT TRANSPORT AIRCRAFT

PRICE
(New Fully Equipped April, 1972)
($ MIL)

OPERATING WEIGHT EMPTY, $E_{E} (1000 LBS)

SOURCE: FLIGHT MAGAZINE, APRIL 20, 1972
### Table 4. Acquisition Prices for New Long-Range Transport Aircraft

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Economics shares with engineering a concern with solving problems: problems like how to produce shoes efficiently or how to control pollution—or how to design an efficient transportation system. However, the economic approach to solving problems differs from the engineering approach in one crucial way: In an economic context every problem has a solution. Economists achieve this miracle by defining their goals in such a way that doing without something is the correct "solution" if it is too expensive or impossible to obtain it. Thus if pollution can be eliminated only at a prohibitive cost, economists will seek the optimal amount of pollution. If Lockheed loses money no matter what it does, the economic solution is for Lockheed to go out of business.

Formally, the economic approach involves maximizing an objective function that reflects both goals and costs. This idea is sometimes stated incorrectly as, for example, "getting the most pollution control for the least amount of money." A correct statement in words is somewhat cumbersome: The goal is to control pollution at whatever level in a cost-minimizing manner, and to choose the level of pollution control that is most worthwhile considering its minimum cost. Similarly, economists look at the behavior of a consumer as solving a problem in the allocation of time and money. The goal for a consumer is to spend whatever money is earned in the manner that maximizes his satisfaction, or "utility," and to earn that amount of money that is most satisfying considering the disagreeableness of working harder and the satisfaction to be obtained from what the earnings from extra work will buy. Considering for the moment a
choice between just two goods, say wine and cheese, we can associate any pair of quantities of the two goods with a point in the first quadrant of a graph with Cartesian co-ordinates. Thus point A may represent 2 glasses of wine and 4 ounces of cheese. The other combinations of wine and cheese that would be equally satisfying to a consumer will, under reasonable assumptions, be on a curve through A that is convex to the origin. Economists call such a curve an "indifference curve." Combinations that are preferred over A lie on indifference curves farther from the origin. If the prices of wine and cheese are given, the other combinations that can be bought for the same amount of money as A will be on a straight line through A (the budget line), the slope of which is determined by the relative prices of wine and cheese. If A is preferred to all other combinations that can be bought with the same amount of money, then the indifference curve through A must be tangent to the budget line at A. Thus a graphical depiction of a process of consumer maximization involves finding where the boundary of attainable points is tangent to an indifference curve. In a more formal formulation a continuous variable called "utility" is assumed to depend on the quantities of wine and cheese in such a way that each indifference curve corresponds to a different level of utility, with higher levels of utility associated with indifference curves further from the origin. The consumer's problem is then one of maximizing

\[ U = f(q_w, q_c) \]
subject to the constraint that

\[ I = p_w q_w + p_c q_c \]  \hspace{1cm} (2)

i.e., that expenditure be equal to income. To solve this kind of problem economists use Lagrangian constrained maximization techniques. Generalization to more than two commodities is straightforward.

A demand curve can then be derived by finding the quantities of a good that solve the maximization problem as one varies the price of that commodity, holding income and the prices of all other goods constant. Or, more directly, one can say that a demand curve expresses the quantity of a good that a utility-maximizing person will want to buy as a function of the price, assuming that income and all other prices are fixed at given levels, and assuming that the person has no way of affecting the price he pays. For reasons of consistency with historical diagrams, economists always put quantity on the horizontal axes of their graphs and price on the vertical axes, even though they usually think of quantity as the dependent variable. Market demand at any price is obtained by summing the quantities demanded by all persons in the market at that price. Economists are often concerned with the "elasticity of demand," by which they mean

\[ \frac{dq}{dp} \cdot \frac{d}{q} \]  \hspace{1cm} (3)

the limit of the ratio of percentage changes in quantity to percentage changes in price along the demand curve.

A supply curve is derived by applying the idea of profit maximization of firms. Technology determines a relationship between inputs and output.
Economists call that relationship a "production function," but we won't delve into it. Suffice it to say that the production function and the prices of inputs determine a "total cost function," \( C(q) \) which gives the minimum cost at which any quantity of output can be produced. The profit, \( \pi \), that a firm makes can be considered the difference between revenues and costs, each of which depend on the quantity of output:

\[
\pi = R(q) - C(q)
\]

(3)

If a firm cannot affect the price at which it sells its output (as in the economists' model of perfect competition), then revenue is simply the product of quantity and that inflexible price:

\[
\pi = p \cdot q - C(q)
\]

(4)

The condition for profit maximization can be obtained by differentiating with respect to \( q \) and setting that derivative equal to 0:

\[
\frac{d\pi}{dq} = p - \frac{dC}{dq} = 0.
\]

(5)

Thus

\[
\frac{dC}{dq} = p.
\]

(6)

Economists refer to the derivative of total cost with respect to quantity as "marginal cost," that is, the cost of producing one addition unit. Similarly, the derivative of revenue with respect to quantity is called marginal revenue. Profit maximization involves equating marginal revenue and marginal cost, which, in the cost of a competitive firm means choosing that output where marginal cost is equal to the price received. This is efficient because it means that the prices by which consumers choose how much to buy correspond to the costs of producing what they buy.
There is a second-order condition of profit maximization: Marginal cost must be rising. And one further condition: revenue must be greater than "variable costs," that is the costs that could be avoided by not producing. This condition may also be stated as the condition that price be greater than average variable cost. All three conditions are summarized in the statement that a competitive firm's supply curve is that part of its marginal cost curve that is greater than average variable cost and rising.

A market supply curve is obtained by summing the quantities that all firms would supply at each price. If all firms have the same cost functions, then in the long run, when all costs are variable, a competitive market will supply unlimited quantities at a price that just covers costs. Profit, exclusive of an ordinary return to capital and entrepreneurial effort, is exactly zero.

The competitive result may be contrasted with the profit maximizing outcome when a firm can affect the price of its output by varying the quantity it produces. Then (2) may be written as

$$\pi = p(q) \cdot q - C(q).$$  \hspace{1cm} (7)

Differentiating and setting the result to zero,

$$\frac{d\pi}{dq} = \frac{dp}{dq} \cdot q + p \frac{dC}{dq} = 0.$$  \hspace{1cm} (8)

Rearranging,

$$\frac{dC}{dq} = p + \frac{dp}{dq} \cdot q,$$  \hspace{1cm} (9)

or

$$\frac{dC}{dq} = p \left( 1 + \frac{1}{\frac{dp}{dq} \cdot \frac{p}{q}} \right).$$  \hspace{1cm} (10)
In words, a profit-maximizing producer who can affect the price of his product will choose a level of output where marginal cost is equal to price multiplied by one plus the reciprocal of the elasticity of demand. Since the elasticity of demand is negative, this means that marginal cost will be less than price, so that consumers will be economizing on this output inefficiently, treating it as if it were more valuable than it is in terms of resources used in production.

A regulated firm might have no control over the price of its product, but it could affect both revenues and costs through such variables as advertising and frequency of service. An economic analysis would predict that regulated firms would maximize with respect to the variables they did control, setting them at levels where their marginal contributions to revenues equaled their marginal contributions to costs, with appropriate second-order conditions.
For further reading


Kelvin Lancaster, *Introduction to Modern Microeconomics* (Rand McNally)—

a more theoretical treatment.


a mathematical treatment.
BASIC TRANSPORTATION ECONOMICS

Monday, July 10, 1972

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Introduction

Under the terms of this workshop, the lectures are to be published basically in the original form which you heard in the class. In the matter of revision, I have made only small adjustments in order to preserve the flavor of the original lecture. I mention this partly because lectures, like sermons, do not make books. No matter how resonant and uplifting they sound, at least to the lecturer during presentation, they remain unimpressive in print. With this caveat in mind, the reader is introduced to the session titled "Basic Transportation Economics."

The Scope of Transportation

Transportation economics is the application of economic principles to the examination of issues in various modes of transportation. It is usually not treated as a separate discipline but rather as a mix of general transportation and applied microeconomic theory.

The occasion of this lecture seems an appropriate moment to evaluate the general state of transportation as a profession, science, art, or however one may view it. In making this evaluation, it would be helpful to observe the significant areas of transportation and to indicate to you where economics fits in. As a starting point, one might classify transportation into five general areas: (1) transportation engineering, (2) transportation planning, (3) transportation policy, (4) transportation regulation and law, and (5) transportation economics.

The first of these areas is transportation engineering, in which
there are the two sub-areas: "hardware" and "software." Hardware pertains to analysis in the actual production of transportation equipment and invokes the use of traditional engineering principles. The software area, which involves the application of analytic tools and techniques to transportation problems, would include systems analysis, demand modelling, and computer programming applications.

The second area of transportation is transportation planning, which develops a decision-making apparatus to handle the social, political, and environmental aspects of a multitude of current and future problems at urban, regional, and national levels. The third area refers to transportation policy, the "piece de sustenance" of all transportation analysts. Issues of transportation policy can range widely from the question of labor featherbedding to SST investment to subsidy for mass transit systems. To this area I have added logistics and physical distribution management, that is, the management of the movement of physical goods from points of origin to points of destination.

The fourth area of transportation regulation and law will comprise a substantial portion of this seminar and its activities concerning the air sector will be explained accordingly. This brings us to the fifth area of transportation economics, the use of economic analysis in transportation.

**Transportation Economics**

Economics evolved in the eighteenth and nineteenth centuries as an attempt to explain and to justify a market system. The
coordinating and controlling mechanisms in those centuries were the competitive markets and the systems of prices that emerged from the bargains between freely contracting buyers and sellers. The rationalization of the competitive market is still in large measure relevant to most advanced economies today. For all the great modifications to which market economies have been subjected in practice during the twentieth century and for all the qualifications that must be attached the case for such an economy, the competitive market model is still an important measure (in some ways--essential) descriptive both of reality and of the aggregate conception of what an ideal economic system should be.

Yet there are at least two large sectors of the U.S. economy that the competitive market model cannot even purport to describe. These are the huge and growing public sector, where the allocation of resources is determined mainly by political decisions, and the regulated sector in which the organization and management are mostly private but the central economic decisions are subject to direct governmental regulation. In general, industries which fall under the aegis of the various independent regulatory commissions may be classified into communications, banking and finance, energy, public utilities, and transportation. In these instances the primary guarantor of acceptable activity is conceived to be not competition or self-restraint but direct governmental prescription of major aspects of their structure and economic performance. Transportation industries are distinguished from other sectors of the economy by four principal components of this regulation: control of entry, fare and rate fixing, the prescription
of quality and conditions of service, and the imposition of an obligation to serve all users under reasonable conditions. Transportation economics then is an analysis of the economics of that regulation—its characteristics and consequences, the principles that govern it, and the principles by which it ought to be governed.

If you read today the classic treatise of two centuries ago by Adam Smith on the Wealth of Nations, you would note that he submitted three general propositions which have provided the basis of economic analysis over the decades. These three propositions in paraphrase form are the following:

First, that the wealth of a nation is the product of its labor; Second, that the greatest improvements in the product of labor result from the division of labor; and Third, that the division of labor is limited by the extent of market.

Now to these three propositions I would add a fourth which many economists, especially regional economists, have argued: the extent of the market is controlled by the cost of transportation. If you interpret these four propositions in a syllogistic fashion, you could argue the linkage between transportation cost and the wealth of a nation. If the nation's wealth can be measured by the national income accounts, GNP statistics reflect quite clearly the importance of the transportation sector.

In terms of economic analysis one must distinguish between the different modes of transportation because the institutional arrangement,
managerial practices, and market structure are very different in the air, rail, water, motor and pipeline industries. The analysis must indicate the distinctions between passenger and freight traffic, between intercity and urban movements, and between domestic and international transportation. Even in the case of a single mode, the analyst must define the scope of his study very carefully. As an example, the analysis for evaluating TACV would be very different from examining AMTRAK or previous intercity rail passenger service with conventional technology because neither the immediate nor long-run effects of TACV are known.

Especially since each economic analysis requires stringent assumptions about the constancy of all variables except the ones under focus, it is essential for the analyst to specify each time the location, environment, and time period to which his analysis is applicable. In technical terms, this feature is referred to as "ceteris paribus"—everything else being equal—and the analysis is known as one of partial equilibrium.

In terms of the above scope of an analysis of transportation economics, one also must keep in mind that there are several components to the total transportation picture involving the actual users of transportation, the firms (carriers) which are providing the services, the extent of government agency participation, and the impacts on nonusers (or what is often referred to as the public interest elements). An economic analysis conducted solely at the user level in urban transportation might suggest different policy implications than an analysis at the firm or agency level since firms and users often have
different interests and are striving for different objectives. Many riders in the Boston corridor may be interested in free transit but the MBTA cannot offer commuter services at zero fares unless large subsidies were involved. The cross-effects on nonusers as a result of the income transfers necessary to pay for these subsidies and the increasing role of governmental involvement would complicate the analysis.

Market Structure, Conduct, and Performance

How are these components best treated simultaneously? In terms of most effectively solving the total picture by using the airline industry as an example: first, we look at how the firms or agencies are structured in offering the air transportation service to the public, namely, how are they organized, how large are they, how do they compete? Why do we have trunk line carriers? Why are there supplementals? Why do we have local air carriers? Why cargo carriers? In terms of an economic analysis of the air transport industry, market structure refers to the degree of competition, the size distribution of firms, absolute size, types of competition, and barriers to entry. In general, market structure pertains to the ways in which airline firms are organized and the resulting structure of firms from such organizations. Just as the credibility of a demand or cost analysis depends on the specification of a location and time period, so does the merit of a market structure analysis require the specification of relevant markets (routes) and types of service.

2 The total picture of transportation can be portrayed in Figure 1.
INGREDIENTS AND SCOPE OF TRANSPORTATION ECONOMICS

ANALYSIS BY MODE

Passengers:
- International
- Domestic
  - Intercity
  - Urban

Commodities (Freight):
- International
- Domestic

(1) Air
(2) Rail
(3) Motor
  (a) Auto
  (b) Bus
  (c) Truck
(4) Water
  (a) Inland
  (b) Ocean
(5) Pipeline
(6) New Technology

Figure 1

The Total Picture of Transportation Economics
Along the line of the structural elements, a second feature to examine relates to what is called in legal terms market conduct or simply conduct. Market conduct pertains to the ways in which firms or agencies in air transportation behave in relation to the statutory or other legal requirements within the context of their market structure. Issues of certification, route structure, and fares fall into this category.

Related specifically to the conduct area are the ways in which firms and agencies behave with respect to economic yardsticks. This third area refers to what is called economic or market performance. Measures of economic performance would include rates of return on investment, profit rates, number of innovations, returns on research and development, and rates of return on stockholder equity.

From all of this emerges a really basic question: What is the relationship between market structure and market performance? The degree of such a relationship has been an often debated and well documented topic, with proponents ranging from one extreme to the other. Suffice it to say that, if the testimony of many participants in airline merger cases is an indicator, it appears that at least in the airline industry changes in market structure induce changes in market performance. If the C.A.B. in the future regards its adjudicating role in merger cases seriously, then substantial research must be undertaken linking the forecasts of expected changes in economic performance to changes in market structure resulting from merger activities.
Production Functions, Costs, and Demand

How does one go about measuring these variables? Say we want to examine profit to the firm as a measure of performance. From an empirical point of view, we need to have estimates of revenues and costs. In order to forecast revenues, we must estimate a demand function; and to estimate costs, we need some estimate of the underlying production function.

What then is a production function? A production function is merely a behavioral relationship between the inputs required to provide transportation services and the output which is derived (see Figure 2). A very difficult question in terms of transportation, particularly airline transportation, is what is output? This is especially difficult when you encounter the empirical problems of trying to measure output (whether it be seat-miles, departing seats, revenue-seat-miles, number of movements, etc.). For purposes of illustration, let us assume that the input side can be classified by three items: capital, labor, and fuel. The production function then associates this combination of inputs with producing a certain level of output. Again both the location and time period must be carefully specified.

There are numerous types of production functions that can be tested empirically but the most frequently applied type is the multiplicative production function, which could be represented from Figure 3 in the following way: output (Z) is derived from a joint combination of capital (K), labor (L), and fuel (F). The result is a logarithmic production function. Taking natural logs on both sides of the equation yields a log linear equation where the exponents become coefficients and represent the elasticities of output with respect to each of these inputs.
PRODUCTION FUNCTIONS:

TWO VERSIONS

(1) \( Z = F(X_1, X_2, \ldots, X_n) \)

inputs

(2) \( Z = F(C, L, V, T, E, D) \)

characteristics

Where \( Z \) represents output

\( X_1, X_2, \ldots, X_n \) represent capital, labor, fuel, etc. and the characteristics can be depicted by cost, level of service, volume, technology, environment, etc.

Figure 2
Two Methods of Specifying Production Functions
Z = F(K, L, F)
Z = AK^\alpha L^\beta F^\gamma
\alpha + \beta + \gamma > 1

TC = rK + wL + mF + FC

OBJECTIVE:
minimize \phi = rK + wL + mF + FC + (Z - AK^\alpha L^\beta F^\gamma)

Figure 3
A Multiplicative Production Function
with Three Inputs
For example, in Figure 3, $\alpha$ represents the elasticity of output with respect to capital, $\beta$ the elasticity of output with respect to labor, and $\gamma$ the elasticity of output with respect to fuel. The sum of these exponents is a measure of the returns to scale. If the sum equals one, constant returns to scale result, that is, a 10% increase in capital, labor and fuel simultaneously would yield a 10% increase in output or volume ($Z$). If the sum exceeds one, increasing returns to scale results; if the exponents sum to less than one, then decreasing returns to scale occur (for the same 10% increase in inputs, a less than 10% increase in output would occur).

The use of production functions is becoming the most frequently used procedure for identifying the growth component attributable to progress in all industries, including air transportation. In view of the productivities of the physical inputs in some base period, we can estimate the increase in input that would have occurred since the base period if, given the level of technological knowledge of that period, the increase of output had been brought about merely by the growth of the quantity of physical inputs. The difference between the output growth actually observed and the so calculated hypothetical growth (i.e., the residual) may be regarded as an excellent measure of productivity change. Quite obviously, this measure requires estimates of both inputs and outputs and of the behavioral linkage between the two in the form of the coefficients of the production function.

There are at least three principal reasons for suggesting a production function approach to the development of improved productivity
measures in air transportation. One is the general desirability for accuracy, precision, and clarity to facilitate scientific analysis. A second and related reason concerns a particular objective: if we know a priori why we want to measure performance in air transportation, we can then decide what kinds of measures of inputs and outputs are appropriate. Statistical testing then becomes the means by which this appropriateness is determined.

A third reason for being concerned with the production function approach relates to the infrastructure of general cost analysis and to the estimation of cost functions. The statistical estimate of cost functions has been in the strict sense an empirically evasive effort despite the literature being replete with different sorts of estimation attempts. The chief reason for a paucity of meaningful estimates is that rarely are the cost functions related to the behavioral properties of the production functions. In the past researchers in their haste to relate cost to output forgot that in theory and in practice one cannot say anything about the properties of cost functions unless something is known about the underlying properties of the productions from which cost functions can only be derived.

On the assumption that the prices of these inputs are known, that is, the price of capital, the price of labor, and the price of fuel \( r, w, \) and \( m \) in Figure 3), one can specify a general cost function which can be derived from the production function. Notice that the cost function \( TC \) contains a term for fixed cost \( FC \) in addition to the variable prices above. Another way of expressing a total cost function
is to relate costs directly to output (see Figure 4, Equation 1). From this traditional cost function (a cubic expression) can be derived a complete set of relationships involving average and marginal costs. These relationships are useful in an airline's determination of short run cost minimization. From Figure 5, notice that the marginal cost curve intersects both the average total cost curve and the average variable cost curve at their minimum points. From the total cost curve, the average cost curve which Professor Tideman drew is total cost divided by Z and the result is a U-shaped curve. The partial derivative of total cost (TC) with respect to Z yields marginal cost. It says neither anything about demand, nor anything about revenues, which must be treated as separate behavioral analyses in order to test for profit maximization conditions.

On the demand side, single equation estimates usually specify a relationship between the quantity demanded of air service and variables such as population, income, and fares. Some analysts would prefer to combine the population and income variables into a single variable called income per capita. A shift in population will cause a direct change in the quantity demanded of air service. A change in the fares will affect the change in quantity demanded but in a negative fashion. When fares increase, by the law of demand, generally the volume will go down, assuming again ceteris paribus.

Several sessions in this workshop will be devoted to issues of demand. In these sessions we will observe a variety of techniques used for forecasting demand including trend analysis, market research
approaches, and econometric methods.

The specification of demand is crucial since at any particular time, average fare multiplied by the number of passengers using the services will yield revenues. Keeping in mind that the airline company is pursuing some one or more managerial objectives, like profit maximization, an accurate assessment of revenues is required to offset cost in order to generate profits. Profits are maximized when total revenues exceed total costs by the largest amount for some \( Z \) or, as Professor Tideman has demonstrated, when marginal costs equal marginal revenues. These two conditions will occur simultaneously.

In many situations airline companies will be pursuing objectives other than profit maximization yet the foundations for any alternative hypothesis still require an accurate assessment of costs and revenues. In fact, the need for extremely accurate estimates becomes much more compelling as one considers additional alternative objectives. A separate analysis of some of these objectives is the topic of a later session in this workshop. The importance of cost and demand functions will become apparent to you in the topics of other sessions which will focus on issues of competition, regulation, fare levels, excess capacity, growth, and long run survival.

**Summary**

Transportation economics is an integral part of all transportation activities. We have observed the scope of transportation and the niche which transportation economics occupies in that scope. To the extent
(1) \[ TC = a_0 + a_1Z - a_2Z^2 + a_3Z^3 = TFC + TVC \]
(total cost)

(2) \[ TFC = a_0 \]
(total fixed cost)

(3) \[ TVC = a_1Z - a_2Z^2 + a_3Z^3 \]
(total variable cost)

(4) \[ ATC = \frac{TC}{Z} = \frac{a_1}{Z} + a_1 - a_2Z + a_3Z^2 \]
(average total cost)

(5) \[ AFC = \frac{TFC}{Z} \]
(average fixed cost)

(6) \[ AVC = \frac{TVC}{Z} = ATC - AFC \]
(average variable cost)

(7) \[ MC = \frac{\partial (TC)}{\partial Z} = a_1 - 2a_2Z + 3a_3Z^2 \]
(marginal cost)

Figure 4
Cost Functions
SHORT RUN OPTIMIZATION: \( MC = ATC \)

\[
MC = \frac{d(TC)}{dZ} = \frac{d(TVC)}{dZ}
\]

\[
\frac{d(ATC)}{dZ} = 0 \Rightarrow MC = ATC
\]

Figure 5

Cost Minimization
that there exists a need for more refined, detailed, and careful analyses, we have examined the contributions of the market structure—conduct-performance methodology and the specification of production, cost and demand functions.
The primary purpose of this presentation is to describe the concept of economic efficiency, its application to the pricing of air transport services, and its relevance as a policy objective. The first two sections discuss economic efficiency in general terms, whereas the third applies this norm to several airline pricing problems. The final section emphasizes the importance of industry behavior as a parameter in policy analysis.

*Presented at a Summer Workshop on "Air Transportation Systems Analysis and Economics," conducted by the Flight Transportation Laboratory of the Massachusetts Institute of Technology, and sponsored by the Office of Aeronautics and Space Technology, National Aeronautics and Space Administration (July 13, 1972). Portions of this presentation are excerpted from a study on airline regulation the author and George W. Douglas are preparing for the Brookings Institution. The standard disclaimer applies.
I. The Nature and Relevance of Economic Efficiency

A market is said to be "efficient" (in economic terms) when there is no other feasible means of production, no other combinations of qualities and quantities of outputs, and no other distribution of outputs which would make actual and potential producers and consumers as a group better off. If for some reason a market is not efficient, then by definition there exists some change which could improve the economic "welfare" of the market's participants: that is, there are potential modifications in production and/or distribution which could increase the utility (or "enjoyment") of at least one consumer (and/or producer) without decreasing the utility of anyone else.

More specifically, economic efficiency in airline service means that, given production and cost relationships, the quality and quantity of service output is one which satisfies consumers (and furthermore compensates producers) as well as any other. If the airline market is not efficient, then on balance someone could gain from a change. For example, airline customers as a group might prefer less quality and a commensurate lower fare (the lower quality requiring less cost and thus profits -- or return to carrier investment -- remaining unchanged). Or, carriers might be able to improve the existing production process, thus raising profits, increasing service quality, and/or lowering fares.

Of course, economic efficiency may not be the only rational public policy objective of an industry such as the airlines. In particular, for over 30 years it has been public policy to consider other goals in commercial aviation.
including: (a) "the promotion, encouragement, and development of civil aeronautics," (b) "the promotion of safety in air commerce," and (c) meeting "the present and future needs of the foreign and domestic commerce of the United States, of the Postal Service, and of the national defense." While generally these and other goals mentioned in the Civil Aeronautics Board's "Declaration of Policy" are at least compatible with economic efficiency, depending on one's interpretation, in extreme form they can become overriding. For example, an efficient service is a reasonably safe one, but to "... assure the highest degree of safety..." (emphasis mine) would mean no service at all. Moreover, an efficient airline market is one which "promotes and encourages" air service to the extent consistent with optimizing resource use, but promotion beyond that means a less efficient market. Finally, to tailor air service to the special dictates of the Postal Service (PS) and/or the Department of Defense (DOD) probably would mean significant efficiency losses. However, provided PS and DOD "demands" for air service are weighed like those of other users, economic efficiency may obtain.

There are many other public policy goals for the airline industry that could be mentioned. For example, the stability of rates and service. As we

2. Other goals implied by Section 102 of the FA Act likewise, depending on interpretation, are at least consistent with economic efficiency. Examples include: (a) recognition and preservation of inherent advantages of air transport, (b) coordination of services, (c) competition, (d) sound economic conditions, (e) adequate, economical and efficient service, (f) reasonable charges, (g) absence of price discrimination, and (h) limitations on predatory competition.
shall see below, for the market mechanism to function properly, prices (and service) will change from one time period to the next; thus, to some extent, "stability" may conflict with economic efficiency. Another role the industry conceivably may take is furthering the economic development of sparsely populated regions of the country. While undoubtedly this was a successful role for the railroads in developing the West, there is little hard evidence that commercial air service has a significant impact on community development, and, even if it did, one could speculate that development in one area is at the sacrifice of another. It would appear therefore that an undue emphasis on an economic development role for the airlines can conflict with economic efficiency.

Finally, another, very important public policy goal is "equity." For example, the institution of charging children less than adults is so ingrained that to suggest something different ruffles most people's sensitivities. Yet, from an economic efficiency standpoint (vis-à-vis profit or revenue maximizing price discrimination) there is little or no "justification" for children's discounts except in extraordinary circumstances. Another example, which incidentally, shows changing attitudes toward equity, is airline discounts for "youth" and the elderly. Because of backlash to student agitation in the late 1960's, people generally have become less inclined toward permitting youth-fare discounts, whereas discounts for the elderly are more in favor. However, a special discount for businessmen, aged 30-40, would doubtless be strongly opposed.
In summary, achieving economic efficiency in a market would appear to be a worthwhile, if not paramount, objective. There are many other public policy goals for the airlines, and for the most part these are at least consistent with economic efficiency, depending, of course, on one's interpretation. However, in some cases economic efficiency cannot obtain if certain other goals are given too great a weight. In light of this, perhaps the most important role of an economist is to indicate something of the economic efficiency "costs" of pursuing non-economic objectives.

II. Optimal Pricing, Quantity, and Service Quality

If we can assume that other industries are characterized by economic efficiency, then we may perform a "partial analysis" on a single industry such as the airlines. If this assumption does not hold, then one may have to resort to that analytical framework called the "economics of the second best." For the purposes of this presentation we shall assume that economic efficiency does obtain elsewhere and further that there are no real (as opposed to pecuniary) externalities. In such a setting the prices paid for resources attracted into the industry in question reflect the true opportunity costs of their use elsewhere. For example, the price paid by the airlines for an aircraft reflects the value of those resources used in making the aircraft (labor, working capital, metal, etc.) had they been utilized in producing something.

else (e.g., automobiles). By assuming that there are no externalities, we rule out changes in air service having any positive or negative impact on the rest of the economy not transmitted through the price mechanism. For example, increased air travel may lessen auto travel and thus (for a time at least) lower the value of General Motors stock, reduce the rate of advance in United Auto Workers' incomes, and decrease the pay received by executives with special expertise in auto production and sales. This, however, is a pecuniary externality, and has no effect on optimal resource allocation. On the other hand, increased air travel may augment air pollution over auto plants and raise costs of production. This is an example of a real externality, but for the moment we presume that these are unimportant.

**Technical Efficiency**

One requirement for economic efficiency in any industry is "technical efficiency," and by that we mean achieving any output at lowest cost. Given a production function of the form

\[ X = f(a, b, c, \ldots), \]

there is a least-cost combination of inputs a, b, c, etc. which for any level (and quality) of output \( X' \), yields the lowest total cost to the firm. This technically efficient combination, of course, depends on the nature of the

---

1. This distinction between technical efficiency and "allocative efficiency" is somewhat arbitrary since the well-known efficiency conditions for production are closely akin to the allocative efficiency conditions in consumption. Nevertheless, it is a useful distinction and we will adopt it in this presentation.
production function and the prices paid for the inputs. In a manner of speaking, then, given resource input costs and given equation (1), there is a (total) cost function which gives the lowest feasible cost for any level of output:

\[ C = g(X). \]

This question of technical efficiency and the lowest-cost function may be visualized by referring to Figure 1. The average cost (i.e., cost per unit) curve labelled AC* is the technically efficient one, since all others (e.g., AC' and AC'') have a higher average (and total) cost for each rate of output (in this case taken to be available seat miles per year).

Of course, an airline produces many "outputs" (service between different city pairs, different "classes" of service, etc.), so really it is more accurate to speak of a production function of many outputs as well as many inputs. In implicit form this can be written as

\[ h(X_1, X_2, \ldots, X_n, a, b, c, \ldots) = 0, \]

where \( X_1, X_2, \) etc., are the various outputs. The technically efficient cost equation then becomes,

\[ C = l(X_1, X_2, \ldots X_n). \]

This, of course, means that for any combination of outputs, \( X_1, X_2, \) etc., there is a least-cost means of production.

---

Figure 1
Allocative Efficiency

So far we have talked about what may be termed the "supply side." Equally important is the "demand side." That is, presuming that all outputs will be produced at lowest total cost, what are the appropriate amounts of each output and what is their optimal distribution? This is the basic purview of what economists term "allocative efficiency."

It should be obvious that we are trying to maximize something. What we are trying to maximize is the collective "economic welfare" of producers and consumers. Producer welfare is straightforward -- profits. These are net revenues exceeding a normal return on investment. The economic welfare of consumers is a bit more difficult to define. In essence it is the excess of what they would be willing to pay for the service over what they actually do pay. Obviously consumers will increase their rate of purchase of any service as price is lowered. This is the so-called "law of demand." Stated another way, the maximum price consumers would pay for any incremental increase in total output is given by the inverse of the demand relation, or,

\[ P_i = P_i(X_i), \]

where \( P_i \) is the demand price for output \( X_i \). Consumers' total utility for consumption of any rate of \( X_i \) can be approximated by the area under relation (5). Subtracting total revenues paid, (net) consumer welfare is given by:

\[ CW = \sum_{i=1}^{n} [ \int_0^{X_i} P_i(X_i) dX_i - P_i(X_i) \cdot X_i ]. \]

In analogous fashion, the welfare of producers (i.e., profit) is defined as:
We are now in a position to maximize total economic welfare, weighting the welfare of producers and consumers equally. Adding (6) and (7) and simplifying, we have:
\[
TW = \sum_{i=1}^{n} P_i(X_i)\cdot X_i - C(X_1, X_2, \ldots, X_n).
\]

The first-order conditions for maximizing (8) are:
\[
P_i(X_i) - \frac{\partial C}{\partial X_i} = 0
\]
\[
i = 1, 2, \ldots, n.
\]

This merely states that resources are allocated efficiently when the price of each output \([P_i(X_i)]\) equals the marginal cost of producing that rate of output \((\partial C/\partial X_i)\).

We may verbalize this result as follows. Marginal cost reflects the additional cost of production associated with increasing output by that unit. Demand price is a measure of the value consumers place on the marginal unit. Because demand price decreases with extra units, an output less than where price equals marginal cost means that some consumer values additional output more than the extra cost of production. From a societal point of view, output in that (sub)market is thus suboptimal. There exists a potential for a buyer to compensate a producer for the extra costs incurred and still be better off.

1. Other weights, of course, could be used.
2. The total revenue term cancels out.
3. We shall assume without further comment that second-order conditions obtain.
On the other hand, if the rate of any output exceeds that commensurate with a marginal price equal to marginal cost, then output is "superoptimal" and allocative efficiency does not obtain. In such a case, consumers value the marginal unit less than the associated increment of cost. Alternatively, a reduction in output would mean a savings in cost in excess of the lost value to consumers. Such reasoning thus leads to the conclusion that price must equal marginal cost in each market for allocative efficiency to obtain.\(^1\)

In order to achieve allocative efficiency, it is essential that there be no arbitrary limitations on consumer "eligibility" for particular markets. That is, all consumers must have access to each type of output. Arbitrarily making one group of consumers ineligible and having to enforce such a restraint means that some consumers in the group discriminated against would willingly pay more than the marginal cost of output and thus economic efficiency does not obtain. A similar case is where different consumer groups pay different prices for the same output. To have to enforce such a partition means that some in the group discriminated against would willingly exchange money (i.e., a lower price) for the output consumed by the group most favored. If the favored group obtains output below marginal cost this still means an efficiency loss, for their consumption (at the margin) is valued less than the associated (marginal) cost of production.

\(^1\) We note in passing that generally the production of airline services is characterized by constant returns to scale for relevant ranges of output. [See "Testimony of James C. Miller III," CAB Docket 21866-7, DOT-T-1 (August 25, 1970) and the references cited therein.] Thus "marginal cost pricing" would mean total revenues sufficient to cover total costs.
Optimal Quality

Another allocative efficiency type question relates to the optimal quality of service. (Thus far we have assumed that quality is given.) For example, as George Douglas has shown, lower average load factors mean that flights are more frequent and that the probability of getting a seat on the desired flight is greater. But lower load factors, like other service amenities (such as speedy baggage claim, more elegant on-board accommodations, and more personal attention) can be achieved only at greater cost to the firm and thus to the consumer. From the individual consumer's viewpoint, the problem is basically one of "trading off" the (marginal) value of increased quality with the associated increase in cost. The important thing to consider is that service quality does matter. If the "wrong" quality of service is provided, then allocative efficiency does not obtain any more than efficiency obtains when prices are unequal to marginal costs.

The (conceptual) determination of optimal service quality is illustrated in Figure 2. Quality is measured on the horizontal axis in units and on a scale

---

1. The relevance of service quality can be seen with the model sketched out as follows. Individual i's utility is defined by $U_i = U_i(X, Q, W,)$, where $X =$ quantity of output, $Q =$ quality of output, $W =$ work expended, and where $\partial U_i/\partial X > 0$, $\partial U_i/\partial Q > 0$, and $\partial U_i/\partial W < 0$. The perfectly competitive supply total cost of output is defined as $C = C(X, Q,)$, where $\partial C/\partial X > 0$ and $\partial C/\partial Q > 0$. Finally, total income (for spending on output) is the wage rate $r$ times work expended, $W$. The maximization problem then resolves into Max: $Z = U_i(X, Q, W) - r[C(X, Q) - rW]$. Not counting the budget constraint, the first-order conditions (second-order assumed to hold) come down to: $(\partial U_i/\partial X)/(\partial C/\partial X) = (\partial U_i/\partial Q)/(\partial C/\partial Q) = (\partial U_i/\partial W)/(-r)$, which means that the ratios of marginal utilities of output quantity, output quality, and work expended to their respective "costs" are equal.
Figure 2

Cost, Value

Marginal Cost

Marginal Value

0

Q'

Increasing Quality per Unit
which is commensurate with equal outlays for successive quality increases. While higher quality, of course, is desirable, one presumes that after a point the (extra) value of increased quality becomes less and less. Thus, for quality less than $Q'$, the individual in question values increased quality more than the commensurate increase in per-unit cost. Past $Q'$, greater quality is still desirable, but of less value than the extra cost. Thus, allocative efficiency requires that the quality of service be at $Q'$ and in addition the price of service be equal to marginal cost.

III. Applications to Airline Pricing and Resource Allocation

Having set out these general rules for efficient resource allocation, it is important to understand that their application to transportation industries, specifically the airlines, is no easy task. The pricing of airline service is complicated by a number of very important characteristics of air transport cost and demand.

On the cost side there are indivisibilities in production. Not only do aircraft come in discrete units, but what is probably more important, their seat capacity is not subject to instantaneous change. Even if it were possible to select the "best" aircraft (in the sense of seating capacity) for a set of city-pair markets, because there are variations in density of travel among such cities and because there are economies in reducing the number of different aircraft types employed, one normally would expect that on some routes either
aircraft would fly with some empty seats and/or passengers would be left at the gate unless there were sufficient pricing flexibility to ration off excess demand and/or fill empty seats. Moreover, as Douglas has described, demand is not "certain," but stochastic. Because of this characteristic there will be additional instances of excess demand for seats on the one hand, and excess capacity (i.e., aircraft not fully loaded) on the other.

Another characteristic of airline costs is that seat-mile costs for a given trip distance fall with larger aircraft size. This accounts for the propensity for users of air service to consolidate their demands. While some high-salaried executives may indeed depart via a personal turbojet aircraft when and where they desire, the strong scale economies associated with aircraft size make it desirable for most travelers to aggregate their preferred departure points (and destinations) and their preferred departure (and arrival) times to common ones.

On the demand side, users of airline services place some value on the reliability and stability of rates and service. Since information is not perfect and costs of coordination are not negligible, the convention of scheduled service at assured fares has emerged. If the information and adjustment processes were without cost, then the efficient solution would require holding up departures until a full load of passengers could be generated (at a price commensurate with 100 percent load factors). Or, as William Vickery has suggested, price could be varied instantaneously so as to fill the aircraft by the precise time
of departure. Actually, neither scheme is optimal simply because users of air service value certainty and wish to save on information costs.

A related characteristic of demand is that because of the emerging convention of scheduled service, the presence of excess capacity is highly valued. (This was described by George Douglas in the previous presentation.) If average load factors are 50 percent rather than 75 percent, then the probability of a user's being able to secure passage on the scheduled flight of his choice is higher. Also, for given aircraft capacities, a lower average load factor means a greater frequency of service and thus a higher probability that a flight is scheduled reasonably close to the user's most desired time of departure.

As noted before, however, excess capacity has its costs, since users must pay for it if total costs are to be covered. Thus, the relevant decision is not whether to have excess capacity, but rather how much is optimal. On an aggregate level this depends on users' perception of the marginal values and marginal costs of excess capacity.

There are a number of other economic efficiency questions having to do with excess capacity, an important one being the argument for discriminatory discount fares. Essentially, the proposition is as follows: given that the

2. Compare the advantage of having readily-available information on flight prices and departure times with a need to monitor constantly changing flight-time and price alternatives.
3. These include youth and military discounts, discounts for children, etc.
airlines have excess capacity, why not give a price break to new, previously untapped markets; if these consumers pay anything in excess of "marginal" costs (presumed to be very low), then existing passengers too stand to benefit since this means their fare can be lowered. This argument, while intuitively appealing, fails to recognize the essential role of excess capacity in the quality of service and further ignores relevant opportunity cost concepts.

If excess capacity is one dimension of service quality, then the addition of reserved-seat discount passengers lowers service quality for "regular" passengers. In addition to the lower probability of obtaining a seat on the desired flight, there is the disadvantage of sharing flight attendants with more passengers, plus the extra crowding on-board and greater time taken in aircraft ingress and egress.

More relevant, however, is the fact that the real (i.e., opportunity) cost of adding a discount passenger is the value of the service to the (marginal) potential regular passenger who does not fly because the discount is not made available generally. And because the real cost of the extra service to the (marginal) discount passenger exceeds the fare he pays, there are allocative efficiency losses.

There are two relevant modifications to this analysis that should be mentioned, both having to do with the total volume of traffic under the two pricing schemes. If under discriminatory discount fares the total volume of traffic at any point in time is greater than with a non-discriminatory, lower price (or alternatively lowering the regular price won't "fill" existing aircraft
as effectively as employing discriminatory fares), then this is simply an indication that total airline capacity is excessive. On the other hand, as George Douglas has shown, in very small markets the increase in service quality (via greater frequency, lower seat costs of larger aircraft, etc.) arising out of increased total traffic volume with discounts (as opposed to lower normal fares) provides some justification for discount fares, at least in those markets. However, the optimal fare differential under such circumstances is likely to be very small.¹

Excess capacity is also related to seating density, another obvious quality parameter. For a given flight, the greater the seating density the greater is quality in terms of seat availability, but the less is seating comfort. Of course, passengers differ in their preferences, but it would appear likely that after some point the typical user would prefer to convert some excess capacity (in the form of extra seats) into less dense seating. Moreover, since for a given rate of travel between city pairs the cost of excess capacity is greater for long-haul flights than for short-haul, one would expect optimal load factors and seating densities to be higher for long-distance travel. Finally, since for a given length of haul the marginal value of excess capacity (in terms of reducing delay time) is greater for lower density markets, one would expect optimal load factors and seating densities to be higher the greater the total volume of traffic.²

². Also, see George Douglas' presentation.
The institutions surrounding commercial aviation raise several more interesting types of efficiency problems. For example, since under current arrangements the non-fulfillment of a reservation is costless, for a typical flight more reservations are made than passengers show up. This, in turn, leads carriers to "overbook" flights, relying on "no-shows" to yield enough extra seats. Occasionally, however, the number of showing reserved-seat passengers exceeds the flight's capacity. The U.S. Civil Aeronautics Board (CAB) now fines airlines for this practice, but obviously, given the institution of free reservations, some overbooking is optimal. In fact, the optimal fine is one which causes airlines to overbook just to the point that the number of additional reserved passengers left at the gate just offsets the number of extra passengers who could have been accommodated in seats made available by no-show reservation passengers.

The subject of airline safety is much too broad to receive adequate attention here. However, it is important to note that safety has its "costs." Its benefit, of course, is a reduced probability of a serious or perhaps fatal accident. Depending on one's valuation of human life and suffering, the optimal expenditure on safety is where the expected value reduction in accident "costs" just equals the marginal cost of this (increased) safety provision. ¹

Another type of allocation problem arises in connection with the efficient pricing of different outputs on the same aircraft flight. As between first-class

and coach service, it is important to recognize that the opportunity cost of first-class space is the eliminated coach space; and vice-versa. In effect, except for the extremely short run, first-class and coach space are common costs (i.e., their proportions may be easily varied by moving the bulkhead and changing a few seats). Keeping in mind that first-class passengers receive extra service amenities in the form of more personalized stewardess services (fewer passengers per stewardess), more expensive meals, etc., that they exit the aircraft before coach class (and thus considering opportunity cost their cost is higher), that the space between rows of seats is greater than in coach class, and that load factors in first class are usually lower than in coach, a good rule of thumb is that first-class accommodations should be priced at least 50 percent higher than coach, since first class has four seats abreast whereas coach class typically has six.

The optimal relationship between passenger and cargo prices is more difficult to determine. The problem is that while the ratio of passenger vs. cargo space on a "combination" aircraft is variable at the aircraft manufacturing

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1. Aircraft are much more commonly space-constrained as opposed to weight-constrained. Thus, space is the relevant scarce resource, although obviously weight constrained cases are important.

2. It is worth noting that in many cases what a first-class passenger buys is not so much more luxurious accommodations but simply a confirmed space. That is, since load factors average much lower in first class, peak-hour accommodations are typically rationed by the first-class fare. Also, obviously people pay extra for the ability to obtain a reservation "at the last minute." Both roles for first class could be handled more efficiently by peak-load-pricing and perhaps by reserving a block of standard seats for last-minute sales (at a higher price).
stage, once an aircraft has been produced it is most difficult to reallocate space.\textsuperscript{1} Thus, in the long run, cargo and passenger space are common products; in the strict short run they are joint products. As a forthcoming paper by the author suggests, an appropriate pricing rule is to charge "belly freight," a price equal to the cost of carrying such freight (at comparable service quality) in all-freight aircraft.\textsuperscript{2}

IV. The Relevance of Industry Behavior

Many pricing problems in the airlines must be considered within the context of industry behavior. By "industry behavior," we mean the response pattern that describes industry "competition." Briefly, as DeVany, Douglas, Eads, Jordan, Yance, and I have argued, the domestic airline industry can be characterized as a non-price competing cartel.\textsuperscript{3} Prices are given, being regulated by the CAB. Carriers then "compete" (or rival) in non-price (i.e., quality) dimensions, primarily the extent of excess capacity. Our operational

1. Almost all commonly used passenger aircraft have cargo space in excess of that required for passenger baggage.
hypothesis is that over time schedule frequency will adjust in individual (competitive) markets so that actual load factors approximate break-even (including a normal return on investment).  

To see that carriers have incentives which cause them to move in the direction of break-even load factors, consider first a situation where prevailing load factors are above break-even. In this disequilibrium situation, carriers will expand scheduling in hopes of making profits on extra flights. Load factors will fall. If on the other hand prevailing load factors are below break-even, carriers will be prompted to cut back on scheduling as a means of reducing losses. Load factors will rise.  

We may illustrate the importance of policy-makers' understanding industry behavior with three examples.

**Cross-Subsidy by Length of Haul**

For many years the CAB has fostered a policy of "cross-subsidizing" long-haul and short-haul markets. Essentially the argument is that fares

1. Recently the CAB has recognized the applicability of this model to airline regulation, stating, "It is indisputable that every fare level has a built-in load factor standard. We find, as DOT has stated, that the higher the fare level in relation to cost, the more capacity carriers will offer and the lower load factors will be; and, conversely, the lower the fare level, the less capacity carriers will operate and the higher load factors will be." (CAB Order 71-4-54, April 9, 1972, p. 23.)

2. This argument is often missed (and perhaps purposely obfuscated) by those placing especial emphasis on market share relationships. Douglas and I deal with this in our Brookings study (op. cit.).
cannot be raised to the level of average cost in short-haul markets since there would be "undue diversion" to alternative, competitive modes. Fares in long-hauls, however, should exceed costs, the long-haul profits thereby used to (cross-) subsidize losing short-haul business. The basic price-cost relationship by length of haul is illustrated (conceptually) in Figure 3.

"While this may work in theory, it doesn't work in practice." What happens is that because break-even load factors are high in short-haul markets, actual load factors also tend to be high. Because break-even load factors are low in long-haul markets, actual load factors also tend to be low. This is seen in Table 1. (N.B., load factors for very short-haul markets include many local service subsidized routes where because of the subsidy, break-even load factor is lower than otherwise.) Note particularly the monotonic decline in load factors past 500 miles.

In short, cross-subsidy is largely a fiction and it will continue to be as long as carriers are free to adjust capacity in response to prices and costs.

Pricing Strategies to Control Pollution

With increasing public concern over the "environmental impact" of economic activities, commercial airports have been singled out (somewhat unfairly) as a primary source of air and noise pollution. Much is being done by way of "retrofitting" old jet engines and redesign of new ones. However, this may be viewed as a longer-range solution and even under technology likely to materialize could not be expected to eliminate aircraft pollution entirely.
Table 1: 1969 Coach Load Factors by Length of Haul

<table>
<thead>
<tr>
<th>Miles</th>
<th>Load Factor</th>
<th>Miles</th>
<th>Load Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>50.7</td>
<td>1,300</td>
<td>53.8</td>
</tr>
<tr>
<td>200</td>
<td>53.1</td>
<td>1,600</td>
<td>52.5</td>
</tr>
<tr>
<td>300</td>
<td>53.6</td>
<td>1,900</td>
<td>52.2</td>
</tr>
<tr>
<td>400</td>
<td>54.6</td>
<td>2,200</td>
<td>49.9</td>
</tr>
<tr>
<td>500</td>
<td>55.6</td>
<td>2,500</td>
<td>46.0</td>
</tr>
<tr>
<td>700</td>
<td>55.4</td>
<td>2,800</td>
<td>45.9</td>
</tr>
<tr>
<td>1,000</td>
<td>54.8</td>
<td></td>
<td>Average 50.0</td>
</tr>
</tbody>
</table>

Source: CAB Docket 21866-9, BC-4808.
Economists have often suggested using the price mechanism to "internalize" pollution costs and thus, *ceteris paribus*, bringing about a more efficient level of pollution output. We shall assume that pollution is a monotonic, increasing function of the number and size of aircraft making take-offs and landings, and thus, as a proxy, the narrow policy objective is to decrease the number of seats scheduled by commercial operators.

The industry behavioral model described in the previous section may be sketched out as follows. Quantity of air service demanded (*ex ante* and supplied *ex post*) is a function of both price and the number of seats scheduled: \( D = D(P, X) \). Average and marginal costs are of two kinds: first, those associated with passengers \((C_d)\), and second, those related to seats \((C_x)\).\(^1\) Assuming constant returns to scale in both categories, the total cost function is given by \( C = C_d D + C_x X \). Finally,

\[
\Pi = D(P - C_d) - C_x X = 0,
\]
where \( \Pi \) is profit, and any excess profit (or loss) "slack" is taken up by variations in \( X \).

As discussed below, the important policy variables are \( P \), \( C_d \), and \( C_x \). We wish to know their individual effects on \( X \). Equation (10) may be differentiated to yield,

\[
\frac{dX}{dP} = \frac{D[1+e_d(1-C_d/P)]}{C_x(\partial D/\partial X)(P-C_d)},
\]

\(^1\) This corresponds generally to the conventional distinction between "direct" and "indirect" airline costs.
\[
\frac{dX}{dC_d} = \frac{-D}{C_x - \frac{\partial D}{\partial X}(P-C_d)}, \text{ and }
\]
\[
\frac{dX}{dC_x} = \frac{-X}{C_x - \frac{\partial D}{\partial X}(P-C_d)},
\]
where \(e_d\) is the price elasticity of demand. Also, we note that,

\[
dX = \frac{D[1+e_d(1-C_d/P)]dP-DdCd}{C_x - \frac{\partial D}{\partial X}(P-C_d)}, \text{ and }
\]

\[
\frac{\partial D}{\partial X} < \frac{D}{X}.
\]

Equation (15) simply states a necessary condition for market equilibrium, namely that as carriers put on additional capacity, load factors fall (i.e., "marginal load factor" is less than average load factor). (Otherwise scheduling would increase without limit.)

Public policy to restrain aircraft pollution through market incentives may be initiated by two groups. First, the CAB may effectuate a change in the level of fares. For example, one presumes that a fare increase would have a depressing effect on aircraft pollution. (But read on!) Second, the local-government airport authority may impose some form of "user charges" to curtail total pollution output. ¹ Let us consider the following alternatives: (1) a fare increase imposed by the CAB, (b) an increase in landing fees imposed by local authorities, (c) a "head tax" paid by passengers, (d) a head tax paid by the air carriers, and

¹. Most major commercial airports are owned and operated by local governments. The exceptions include the two Washington, D.C., airports, National and Dulles, owned and operated by the Federal Government. (It has been proposed that these be sold to the highest bidder.) Some airports are privately owned and operated, the largest being Burbank, California.
(e) a head tax paid by the carriers where the CAB allows them to pass along the cost increase in the form of higher fares.\(^1\)

From equation (11) we may determine that an increase in the price of air service will actually increase \(X\) if \(e_d > -1\). The denominator of the right-hand side of (11) [and also of (12), (13), and (14)] is positive by reference to (10) and (15). The numerator is negative only when demand is sufficiently elastic that \(e_d(1 - C_d/P) < -1.\)\(^2\) This is an important result, inasmuch as the CAB, at least, judges air travel demand to be inelastic.\(^3\) If true, then a corollary of the above result is that the Board could bring about a reduction in pollution by lowering fares.

An increase in landing fees would be tantamount to an increase in \(C_x\).\(^4\) From equation (13) we see that the effect would be a reduction in \(X\) since the right-hand side is negative.

A head tax on passengers would be similar to an increase in fares, but the difference is decisive. Whether demand is elastic or inelastic, carriers' total revenue would be reduced (i.e., quantity demanded would fall because of the perceived higher price), and thus scheduling would have to contract.\(^5\)

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1. Of course, there are other alternatives (e.g., flight quotas, price discrimination, etc.), but these are not considered here.
2. Roughly this would require that \(e_d < -2\), since in practice \(C_d/P \approx .5\).
3. The CAB has found demand elasticity to be -.7 (CAB Order 71-4-59, 71-4-60, April 9, 1971, p. 50.). While many researchers disagree with this assessment, few would maintain that \(e_d < -2\).
4. Landing fees are typically in proportion to the gross weight of the aircraft.
5. The application of a head tax would mean an unambiguous decrease in \(D\). Referring to equation (10), since \(C_d < P\) and \(C_x\) is unchanged, \(X\) must decrease.
If the carriers pay the head tax, this would mean an increase in \( C_d \). Since the right-hand side of equation (12) is negative, the result would be a diminution of \( X \) and thus a decrease in pollution.

Finally, a head tax paid by the carriers which is passed along in the form of higher fares would likewise have a depressing effect on \( X \). Note that in this case \( dP = dC_d \) in equation (14) Since \( e_d < 0 \), the numerator is always negative.

Thus, in one case what would seem like a straightforward policy action to control pollution (i.e., higher fares to choke off demand) would be likely to have the reverse result, owing to the industry behavior pattern that has developed under Federal regulation.

**Pricing and the Demand for Aircraft**

A related issue is the effect of airline pricing on the derived demand for aircraft. In other words, how would changes in fare levels (everything else equal) affect airlines' requirements for new aircraft?

First, it is notable that many economists and others have recommended that the airlines be "deregulated." Based on the available experience with a deregulated airline environment (e.g., the California intra-state market\(^1\)), the presumption is that fares would fall substantially. Carriers generally oppose fare reductions, but with increasing pressure from charters and the imposition of the Board's higher load factor standards, prospects for significant fare reductions must be seriously considered.

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1. On this see Jordan, *ibid*. 
Anyway, the normal reaction to the fare-aircraft demand issue goes something like this: lower fares would mean greater travel and thus a greater demand for aircraft. However, it should be recognized that lower fares mean an increase in break-even load factor. The question is whether the rise in break-even load factor is more or less than sufficient to offset the increase in passenger demand.

The answer is given by equation (1\textasteriskcentered), and this result comes as something of a surprise. That is, a decrease in fares (ceteris paribus) would likely curtail airlines' requirements for new aircraft. Given this result, I would expect Boeing, McDonnell-Douglas, Lockheed and even NASA to be ardent supporters of CAB regulation!
I have been asked to discuss differential pricing policy in the airline industry. I plan to confine my remarks to the passenger pricing although there is no question but what cargo is also an important part of this industry. Further, I think the principles that apply to passenger pricing also apply to cargo pricing and most of you are more familiar and more experienced with passenger pricing practices.

Differential pricing policy really has its beginnings in monopolistic theory which says that if the monopolist can successfully discriminate among markets and not permit revenue dilution to occur in his major market as a result of discriminatory pricing in secondary markets, he can increase his total profits as long as he does not increase his investment base or in more pragmatic terms expand his plant size or capacity. That same theory holds true with respect to airlines' differential pricing policy and the rather tenuous relationship between the theoretical application of differential pricing and its actual practice is what I plan to discuss today.

Of our two major methods of differential pricing the first, most difficult and some might say the most sophisticated, is that which discriminates among markets. The second, simpler, less sophisticated perhaps, but at least in practice - frequently the more effective is that of matching peak
price with peak demand. Although I've chosen to treat these two practices separately they are conceptually the same. In practice one usually precedes the other, however.

Before I begin a discussion of the application of differential pricing policy, I would like to make mention of one other factor which is a major consideration in the airline industry and makes us act differently than private industry. That is the presence of our regulatory agency - the Civil Aeronautics Board. The CAB, as you all know, plays a large role in the pricing policy of airlines. It is one of the few regulatory agencies which has the responsibility to promote its industry but coupled with that responsibility is an additional responsibility for passing judgement on the pricing practices of certificated air carriers. The CAB is required to guard against what we might call overly zealous price differentiation. Carriers are not able to maintain pricing practices which the Board judges to be unjustly discriminatory or unduly preferential or that give an unfair advantage to certain customers. Our prices are also totally public knowledge as a result of the requirement that we publish and maintain tariffs. So, within these constraints, we are reasonably free to differentiate our prices and in so doing attempt to increase our overall profitability.

Let's move now to the practice of discrimination among markets. First
of all we must identify those markets. There are probably hundreds of ways to define markets, but as most of you know, in the airline industry we tend to break them down into two basic categories. The business market and the pleasure market.

The business market is the simplest of these two to deal with. It is the market to which we gear our prime product, convenient, reasonably frequent schedules between most major cities in the United States. It is this market that is considered to be basic, and it is to this market that we direct our prime price. It is this market that demands our prime product. The business market then really only splits into two pieces - the first class market and the coach market; and each of these markets has a basic, full, non-discounted price. In the case of first class a premium is applied because the first class passenger receives a premium service in terms of both inflight amenities and the amount of space he is permitted to consume during the time he is on board. The coach market sets the standard for all airline pricing and indeed it is the coach fare which is the basic fare in the industry.

The pleasure market is far more complex than the business market. It is a market which has led to the practice of differential pricing and which
we like to think at least is the most responsive to differential pricing.
The pleasure market is as some are fond of saying -- where the action is, and it is the market that we generally consider to hold the most opportunity for the future growth of this industry. It is a discretionary market. People who are spending their dollars on air transportation are spending dollars that they are not required to spend for the basic essentials of life...food, shelter, clothing, education and some form of transportation to and from their place of work. In order to compete for these dollars, we must compete effectively with many other products and services. Automobiles, for example, particularly the second car; color television perhaps; vacations which do not require a great deal of travel; vacation homes, another growing competitor for discretionary dollars. In one respect we have a product disadvantage. Our product is an intangible, once it is consumed it is gone, and the pleasures of a vacation trip can only be preserved on film and in memories, and on cold winter nights a memory may not be nearly as satisfying as sitting in front of a tangible, visible and sometimes entertaining color television set. These are some of the factors we must contend with and compete with as we seek to reach this market. Nevertheless, as I mentioned, this is where most of us believe the action is and are trying to use price as a means to compete.
It is quite easy to characterize our major markets as business and pleasure. As I mentioned the business market quickly subdivides into the coach and first class markets. But when we consider the pleasure market we find that we are dealing with a large, very heterogeneous and very complex category. We must deal with each of these submarkets and must thoroughly understand them. For example, the bulk of people traveling for what we would consider to be basically pleasure purposes are traveling to visit their friends and relatives. However, another large sector of this market plans to use commercial facilities during the entire trip; that is, they will not only use air transportation as a means of getting there, but they will be staying at a resort area, eating in restaurants, etc. There is a warm weather market; places like Florida, California and Hawaii have a great attraction for pleasure travelers. And a cold weather market, the ski areas for example. There is a young market — we are all familiar with the youth fares, controversial although they may be. And there is an old market which has been demanding equal treatment with youth. There is a market for group fares, and this market too can be subdivided into at least two categories — some who travel with groups are with the group because they enjoy the security of the group, they appreciate the fixed price nature of most group travel, they want someone to make the arrangements for them, to handle the administrative
details and to ensure that everything goes right. The other part of this market, typically a younger part of the market, is very budget conscious. They are there because the price is right - they don't care at all about the security factors. There is a market for package tours, people who want everything planned in advance. Again, this can be either on a group or individual basis, but they like the fixed price aspects of a package tour. They like knowing in advance what they are going to see and where they are going to be, and they may save by buying a package, save both in terms of ground arrangements and air transportation. And finally there is foreign pleasure travel and domestic pleasure travel. And in many cases domestic carriers have an opportunity to participate in the pleasure travel with those going to international destinations.

My reason for discussing these various markets or submarkets is to acquaint you with the fact that almost everyone can be categorized into one or more of these different pleasure market classifications. In fact, most people at any given time, may fit into more than one of these categories. And this is where the difficulty begins when we attempt to practice differential pricing.

I suppose the first attempt made to differentiate prices in the airline industry was made in the late 1930's with the introduction of the family
plan, which I might add is still part of the basic price structure in this industry. But the theory was then, and it is now, that offering a price difference would fill seats that would be flown and would not otherwise have been filled. The execution of this theory is simplicity itself, and the theory itself is certainly simple. You don’t need a PHD in economics to understand that if you can get more revenue than your variable cost, without diluting current revenue or increasing fixed costs, you will improve your overall profitability. And to put this into practice in this industry, or for that matter, I guess, almost any industry, is quite easy.

First, you identify the market both demographically and geographically.

Next, you determine precisely what price that market will pay for your product. Too much and you lose the market, too little and you lose profits.

Then, you structure your product offering so that it just fits this market and cannot be purchased by anyone that is part of a market that would pay more. Because if it could be purchased by someone that is willing to pay more, once again you have eroded your profitability.

In our case, we will review our product to be sure that it will meet all
the regulatory tests, and on the assumption that it will we will file it with the CAB. 30 to 45 days later we can take it to market where we will sell our product, sit back and smile benignly and enjoy our profits.

Oh, and let's not forget that as time passes we will be ever vigilant and not increase the size of our plant (investment base) because if we do our product then must bear its full share of cost and it hasn't been priced at a level which will permit it to do that.

This then is the underlying theory and hypothetical practice of the most common application of differential pricing policy in the airline industry today. Now let's look at the "real world" as we are often fond of saying. The first example I would like to direct your attention to is the Discover America fare. This fare, introduced in 1966, was designed to encourage discretionary spending on air travel. It carried a discount from normal coach fares of 25%, required round trip, required that the individual not depart and return in the same calendar week, he could not be gone more than 30 days, could not travel on Fridays or Mondays, generally peak business travel days, and could not travel during the peak periods of the summer or at peak holidays. All of these restrictions were created to differentiate this product from the basic coach product and to discourage discount travel during prime demand periods as well as discourage those
who were able and willing to pay the full coach price from shifting to this discounted fare. The assumption was that no additional capacity would be added and the revenue from this fare would far more than exceed the variable cost of carrying the traffic. Yet, in only two short years after its introduction, changes were made. The discount was still 25%, a round trip was still required, you still had to be gone 7 days and had to return within 30 days, but Fridays and Mondays were no longer blacked out. Now the blackout was from Friday noon to Friday midnight, and from Sunday noon to Sunday midnight. In other words, 24 hours during the week were excluded as opposed to 48 hours at its inception.

But perhaps the most important difference was that this fare was now valid on a year round basis; so, even in the summer when demand peaked the discounted price was still available.

The Discover America fare is still part of our fare structure, it has changed again in its characteristics from 1969 but it is still far more liberal in terms of periods of applicability than it was at the outset.

The second example I would like to touch on is a group fare filed originally to compete for traffic carried by supplemental carriers who were serving Hawaii from the East Coast, offering low cost transportation predicated on high load factors through group travel. At the outset in order to qualify for
this group fare you had to be part of a group of 88 to 154 people and as the group got larger the price got lower. You could only depart from Chicago, Detroit, Cleveland or New York. And from a practical standpoint most of the business was done from New York. The group had to travel together during the entire trip, both coming and going. They had to buy a tour package so that it was truly an all inclusive tour and they had to stay for a minimum of 14 days. Each of these restrictions was applied to prevent diversion from higher fares to this lower group fare on the part of those who were able and willing to pay a higher fare in order to achieve greater personal travel flexibility and more comfortable travel.

Today, the same group fare is available for groups beginning at 40 persons. It is national in scope rather than applying to the major population centers of the east from where the participating airline was virtually guaranteed a long flight where it could achieve maximum efficiency of operation. First, passengers were permitted and encouraged to consolidate in Chicago by providing a lower price on air transportation from their home to Chicago. Next the West Coast was picked as a consolidation point, and today passengers can originate any place in the United States, travel on an individual basis to or from the West Coast, stopover and spend whatever time they wish on the West Coast, then continue on to Hawaii as a part of a group. In many instances no tour package is required and the
minimum stay is now a short 7 days, which is no problem for anyone going to Hawaii for virtually any purpose.

The point I am trying to make with these two illustrations is that all too frequently the best of intentions and the best applications of true differential pricing theory soon are completely lost in practice. What starts out to be a highly effective, valid attempt to add traffic to existing capacity becomes nothing more than a generally available discount price available to virtually anyone.

Let's look back now to the execution of differential pricing policy which I have described as simplicity itself. I mentioned that all you needed to do was identify the market, arrive at a price, structure the product offering so that it would just fit the market, make sure you met your regulatory requirements, and be sure that you didn't at some time in the future add capacity for this product. It is easy to describe what should be done but it is extremely difficult in actual practice to measure the precise impact of various price levels and the real effect of the restrictions which are frequently applied to promotional or differential pricing.

I think I can say without reservation that everyone in the industry attempts to make these measurements and find these price levels but I doubt that
anyone would be sufficiently bold as to claim that they were able to do so with great precision and anything approaching 100% accuracy. Differential pricing is still far too much of an art and not enough of a science in the airline industry.

Of an even greater concern, there is ample evidence that the industry has not been successful in keeping short variable costs from turning into long run fully allocated costs. And differential pricing will not support fully allocated costs. There is considerable evidence that capacity has been added for incrementally priced traffic, and it is this addition of capacity and the addition of staff and capital investments required that defeats the concept of differential pricing, particularly as it applies on a selective market basis.

A secondary method of differential pricing and one in which there may be more short term promise is that of matching peak price with peak demand. Again the theory here is so basic that it almost needs no explanation. That is, you charge the most when the demand for your product is highest. This can be done on a time of day basis and is, it can be done on a day of week basis and is, and it can be done on a seasonal basis and is. I think the best examples of this type pricing can be found in the international marketplace, but that doesn't make it any less valid for domestic application.
This type of pricing also has the virtue that one needn't worry about the present price structure, for matching peak price with peak demand is merely an attempt to improve the present structure - not to change it. It's workable and we have some good examples of its workability in the Hawaiian market, and more recently in the major midwestern and eastern markets to Las Vegas, which has some very unique demand characteristics as I am sure you can imagine. The only danger in application of this type of pricing is the temptation to cut the price in the off-peak as opposed to increasing it during the peak period. If one yields to the temptation to cut the price, then we become subject for the same need for precision and fallible judgement as we find when we differentiate on a selective market basis. It may work, but the risks are far higher.

Increasing the price during the peak period on the other hand carries little risk except that if your action is too bold or too steep you may discourage the market entirely during those periods. Fortunately, this is something that you will learn very quickly and something which is very easy to correct. It is always easier to adjust price on the downside than it is on the upside. So, in my judgement at least, the application of differential pricing in a fashion which applies peak price to the peak demand period is sound in both theory and practice, provided that those of us who are practitioners do not yield to the temptation to put too much faith in our crystal ball.
I might add, too, that this is an area where the CAB has typically given us a fair degree of freedom so that we have been able to experiment with price differentials and adjust them to some degree of reasonableness, so long as we do not get beyond the basic coach level and so long as we do not make a change of a radical nature at a time when a substantial number of the traveling public are affected. So with a certain amount of guarded optimism I think there is an opportunity for some successful practice of differential pricing as it relates to matching peak demand and peak price.

Let's go back now and talk for a few more minutes about the more difficult problem of selective or differential pricing on an individual market basis. There is no question but what this too is a valid pricing technique - if it is properly applied. The difficulty is how to bring theory and practice together. And I think that that becomes the mutual responsibility of the carriers and their regulators. First of all, the carriers must use caution and restraint both in the development of promotional or differential price offerings and the application of those offerings in the marketplace.

Carriers must stop and realize that long term planning means more than a week from today and that some of the actions that are taken for short term expediency can have some serious long term effects. Experiments must be treated as experiments by both the carriers and the CAB, and when a filing
is described as an experiment, the results of that experiment must be evaluated and its success or failure judged so that only the successful experiments can be allowed to continue.

Differential pricing can be a valid means of improving profits, keeping the total cost of air transportation down, and making it possible for more people to use air transportation. However, until we can truly put theory into practice we must be very critical of differential pricing proposals.
THE

ECONOMIC EFFECT OF COMPETITION

IN THE

AIR TRANSPORTATION INDUSTRY

by

Herbert B. Hubbard

Director of Operations Research and Development

United Air Lines


July 12, 1972

This paper is subject to revision. The statements and opinions advanced are the author's and are his responsibility; they do not necessarily reflect the official views of United Air Lines.
Abstract

The air transportation industry has been described as a highly-competitive, regulated oligopoly or as a price-regulated cartel with blocked entry, resulting in excessive service and low load factors. The current structure of the industry has been strongly influenced by the hypotheses that increased levels of competition are desirable per se, and that more competing carriers can be economically supported in larger markets, in longer-haul markets, with lower unit costs, and with higher fare levels. An elementary application of competition/game theory casts doubt on the validity of these hypotheses, but rather emphasizes the critical importance of the short-term non-variable costs in determining economic levels of competition.

THE ECONOMIC EFFECT OF COMPETITION IN THE AIR TRANSPORTATION INDUSTRY

by Herbert B. Hubbard, United Air Lines

Introduction

Airlines are regulated and controlled by the government as public utilities because their services are deemed essential from the public standpoint and, accordingly, must be rendered efficiently. Furthermore, the economies of large-scale production and decreasing unit costs tend to increase the size of the business unit, and government regulation is designed to prevent the potential attendant unreasonable or unfair rates or inferior or inadequate service. However, unlike most other public utilities, few airlines enjoy monopoly situations with exclusive franchises for a number of years. Airlines are highly-regulated public utilities, but are also highly competitive.

Economists have defined airlines as "a blocked-entry, price-controlled, non-price-competing cartel," or as highly competitive but regulated oligopolies, with their products essentially undifferentiated, with entry of new competitors into a market difficult because of the entrance fee in terms of government regulation and capital costs, and in which the actions of each competitor (who supplies significant portions of the total product) can have a marked effect on the plans and actions of the other competitors. The classical economic theories for monopolies and pure competition do not apply to the air transportation industry, because there are generally more than one competitor in a market, but there are only a limited number of competitors. However, the economic situation of the airlines (that is, the imperfect competition of oligopolies) lends itself less easily to theoretical analyses than do monopolies and pure competition.
It is the purpose of this paper to investigate the economic effect of competition in the air transportation industry in terms of the efficient allocation of resources. The paper will include a discussion of competition, certain basic economic factors in the industry, the types of scheduling decisions made, the importance of flight share in determining market share, an illustration of the application of competition/game theory by means of a simplified example, and a summary of the apparent results of competition with conclusions. The derivation of the various mathematical relationships are included in the appendices.

COMPETITION

Competition is considered to be healthy and desirable in the American economy. There is competition in the transportation industry (1) between the various segments or modes of the industry and (2) within the various segments as certificated by governmental agencies. In the first case, we have a "natural" variety of competition in which technological improvements are paramount and which often results in substantial benefits to the public in the form of improved service and/or lower rates. On the other hand, the second type of competition, with multiple (more than 2 or 3) competitors, has tended to depress the economic viability of the carriers with negligible benefits to the public.

The expansion of route awards in the air transportation industry has made the government policy in this area well known. The amount of competition among the airlines has been increased substantially during recent years. In most cases, the Civil Aeronautics Board has not recognized nor fully considered the probable impact of such awards on the economic viability of the established carriers.

There is a fundamental question as to the amount of competition within the air transportation industry that is desirable and supportable from an economic efficiency point of view:

Federal Aviation Act, Section 102 — Declaration of Policy

"...the Board shall consider...as being in the public interest... Competition to the extent necessary to assure the sound development of an air transportation system...without...unfair or destructive competitive practices."

Bermuda Capacity Principles

"...strong adherence of the United States...authorizing designated carriers to conduct their operations without predetermined limits on capacity, but subject to ex post facto review to require elimination of unjustified capacity....other countries are less enamored of the Bermuda capacity principles and wish to follow more restrictive policies than we in controlling capacity and scheduling."
C.A.B. Statement in the Southern Service to the West Case (1951)

"...accumulated experience strongly suggests that we may have reached, and in some cases even exceeded, the optimum number of certificated services that can be economically supported by the available traffic."

Honorable Charles S. Murphy, Chairman, C.A.B., November 16, 1967

"... the American economy is generally a competitive economy. For the most part, we depend upon free competition among private business enterprises to achieve the most efficient use of resources... belief that vigorous competition is a good thing — even in the airline industry."

Honorable Secor D. Brown, Chairman, C.A.B., August, 1970

"The cardinal sins of the regulators have been in legislating, in effect, wasteful, ruinous over-competition along our routes and then intervening unwisely to forestall the natural adjustments for over-competition — merger, statesmanlike agreement, or business failure."

Critical Hypotheses

There appear to be several hypotheses that gained rather wide acceptance among members within the industry and among observers and analysts of the industry, and that have influenced the current structure of the industry and level of competition:

1. Increased levels of competition are deemed desirable per se.

2. More competing carriers can be economically supported:
   a. In larger passenger markets (in terms of passengers per day),
   b. In longer-haul markets (with greater revenues per passenger),
   c. With lower unit costs (in terms of cents per available seat mile),
   d. With higher fare levels (in terms of cents per revenue passenger mile), and,
   e. With newer technology (with resulting economies of scale).

3. Increases in market share will result in greater profits.
An evaluation of the air transportation industry must recognize economies of scale, the lumpiness (large incremental step-functions) of various types of costs, and marginal analysis for determining the efficient economic allocation of resources.

Economies of Scale

Chart 1 shows a theoretical variation in total costs as a function of the scale of operations. A small firm might have essentially no fixed costs but relatively high variable costs. A medium-sized firm may have some non-variable fixed costs and, as a result, somewhat lower variable costs, in which the total variable costs might be three times the non-variable costs, or, in other words, the total costs might be four times the total non-variable fixed costs. An even larger firm might have significantly higher non-variable fixed costs, with even lower unit variable costs such that the total costs might be only two times the non-variable fixed costs. These relationships show a decreasing total unit cost with increasing scale of operation.

Because various costing methodologies tend to be rather subjective, it is difficult to categorize certain costs as totally variable and others as completely fixed or non-variable in the short term of six months to one year. (Over the
longer term, all costs must be considered as variable. However, in contrast to some economists' contentions, our analyses and detailed costing models have shown the above economies of scale (decreasing unit costs) with great accuracy for United and other carriers, with total costs ranging from 2 to 3 times the non-variable fixed costs. (Such economies of scale have led to the establishment of "natural" monopolies in other industries.)

Lumpiness of Costs

There are four different levels of costs which must be recognized: costs per unit, costs per production lot, costs for capital equipment, and overhead costs. Certain airline costs tend to vary directly with the volume of passengers served (i.e., tickets, meals, insurance, reservations costs, etc.) and can be handled as a deduction to obtain the net fare yield per passenger. Other costs are quite lumpy, such as the marginal operating costs for a given flight (principally fuel, crew, and direct maintenance costs) which are essentially independent of the passenger loads. The capital costs of the equipment vary with the number of airplanes, each of which is used on one or more trips per day. Other airline costs are established on the basis of the planned scale of operations and do not vary with individual scheduling decisions.

Marginal Analysis

For economic efficiency, a firm should expand its volume of operations until the marginal revenues just equal marginal cost, in order to maximize its profits or minimize its losses, as shown in Chart 2.
Although a certain minimum volume of operations might be required to realize the marginal revenue curve shown, the area between the marginal revenue line and the marginal cost line represents the total contribution to non-variable costs. It should be noted that the marginal cost curve has not been assumed to turn up with increasing volumes in accordance with the classical economists' theory, but rather shows no dis-economies of scale.

SCHEDULING DECISIONS

Analyses have shown that the basic schedule pattern for an airline determines 80-90% of its revenues, determines 70-90% of its costs, and also establishes 85-95% of its total capital investment. The basic schedule pattern is established on the basis of a series of scheduling decisions for all of the various airport-pair time markets, together with their interrelationships. For the purpose of simplification, but without distorting the basic factors, there are really only three types of scheduling decisions for an airport-pair time market:

1. Decision to add or subtract a flight, which is an integer number. (It is relatively easy to add a flight in a market, but quite difficult to reduce service, in view of various community pressures.)

2. Decision to change the type of airplane providing the service.

3. Decision to move a flight earlier or later during the day.

MARKET SHARE

Accurate forecasts of market share are essential for the schedule planning and equipment purchase decisions, and for the resulting workforce planning, facilities planning, etc. Experience has shown that an increase in frequency in a major competitive market is generally accompanied by an increase in market share and an attendant increase in revenue. In fact, frequency of service is probably the strongest competitive tool in the airlines' "bag of tricks."

A carrier in search of an increased part of the total industry revenues may act in a rational manner by adding one flight on a segment. His competitors, seeing their share of the market slip and their revenues decline, may act in an equally rational manner by adding one flight in an attempt to retain their market share and profits. After some "settling" time, each carrier could be back to its original market share, so that its operating revenues would be unchanged. However, each carrier would have increased its operating costs by the expense of the additional flight. It can be seen that by changing a relatively stable two-carrier market into a three, four, and sometimes five-carrier market, it becomes more volatile, with the possibility that one carrier will set off a chain-like reaction.
The increase in frequency (capacity and costs), with a resulting reduction in load factor, due to the competitive nature of the industry has been explained by Mr. Joseph V. Yance, consultant to the Office of the Secretary of Transportation (CAB Docket 21866-6, Exhibit DOT-RT-1, pages 6 and 7):

"As we noted earlier, American, United, and TWA argue that the number of competitors in a market has an impact on load factors. In general, the more competitors in a market, the lower the load factors of carriers serving that market. Our theoretical analysis of carrier behavior supports this view.

"The reasoning is as follows. What is critical to an airline in making its schedule decision is the number of "new passengers" attracted by an additional flight. (By "new passengers," we mean passengers the airline is not already carrying on its existing flights.) In either a monopoly or a competitive market, the number of new passengers required to sustain a flight is the same. But the relation between new passengers and average load on board varies significantly between the two types of markets. In a monopoly market, apart from passengers who are flying because of the additional service and who would not fly absent such new service, all of the passengers on board a new flight are drawn from other flights of the (same) airline; hence unless the number of persons who would first fly because of the new service is large enough to cover the costs of a new flight, the flight will not be added.

"The situation is very different in a competitive market. There, new passengers will consist of (1) those persons first traveling because of the additional service (as in the case of a monopoly market), and (2) passengers diverted from existing flights of other airlines. It may thus be profitable for a carrier to add a flight, even though overall load factors in the market decline. On the basis of this analysis, one cause for the decrease in load factors one observes over time is the increasing competitiveness of markets."

"S" Curve Relationships

Many analyses have been made to relate the market share (or percentage participation in the total passenger market) to the flight share (or relative number of flights per day), as shown in Chart 3. The relationship line will obviously pass through the origin and the (100,100) end point, and in a two-carrier market, will generally pass through the (50,50) point. Some analysts have concluded that there is an "S"-shaped curve effect, since a majority of the points in the 15-35% range are below the diagonal regression line, while a majority of the points in the 65-90% range are above it. Such an "S"-shaped curve would imply that the carrier with the highest frequency share would get a disproportionate market share, and that therefore the way to make greater profits is to be the schedule leader. Such reasoning might lead a carrier to emphasize market share and growth to the neglect of the profit objective."
The Civil Aeronautics Board released on July 21, 1970 (CAB 70-96, 382-6031), the first of a projected series of staff studies evaluating route awards made by the Board in recent years. It was their first attempt to determine whether the carriers have actually performed in accordance with the anticipation and intent of the Board. Some of the conclusions reached in the pilot study included:

"2. The total number of flights and the proportionate share of non-stop flights were greater under competition.

"4. There appears to be generally a close relationship between the share of flights provided by each carrier and the share in traffic."

In order to analyze the effect of competition, it is not necessary to assume an "S"-shaped curve but to merely recognize that a change in the frequency share by one carrier will effect its market share. High correlation coefficients in the regressions of market share against flight share have been interpreted as proving the validity of the "S" shape. However, in most analyses, the regression hypothesis is actually whether greater frequency means greater market share, not whether greater frequency means a disproportionate market share.

**Linear Regression Analysis**

As part of United's rebuttal testimony in Phase 6 of the General Domestic Passenger Fare Investigation (Docket 21866-6, Exhibits UR-T-1, pages 12 and 13, and Exhibits UR-8 and 9), the results of a linear regression analysis
of all of the basic data contained in the C.A.B. Bureau of Economics Exhibits BE 6502 (Columns 8 and 10) for all competitive sample markets were summarized:

Market Share = 1.09 x Flight Share - 3.7

(in %) (in %)

280 Observations*

Coefficient of Determination (R²) = 91.4% of Total Variance

Standard Error of Estimate = 6.48 percentage points

F level = 30.05

* In order to avoid the inherent auto-correlation among the data for all carriers in a market, only one data point was used for a two-carrier market, two data points for a three-carrier market, etc.

These results show the extremely high correlation which actually exists between market share and flight share, based on the extensive basic data assembled by the C.A.B. Bureau of Economics. Furthermore, an analysis made of the exceptional variances, between the actual and the predicted values for the various city-pair markets included in the regression analysis, highlighted the practical aspects of on-line, through, and connecting service and the factor of market identity. By recognizing these differences, the relationship between market share and flight share would have become even greater than that indicated in the correlation analysis. It would be very difficult to improve these simple linear regression results (with a nominal threshold value) by more complicated and sophisticated curvilinear relationships to approximate the "S" curve. Accordingly, the following analysis is based initially on the simple diagonal relationship (that is, market share = flight share), and later extended to cover a linear regression with a threshold value and a possible curvilinear relationship.

BASIC ASSUMPTIONS

The following competition/game theory analysis is based on two basic assumptions:

1. There is no collusion, overt or tacit, among competitors.

2. Each carrier purchases and schedules equipment in its own self-interest, i.e.:

   a. Each carrier expands its production (schedules) up to the limit of capacity whenever marginal revenues exceed marginal costs, and,
b. Each carrier purchases additional equipment if the marginal contribution exceeds marginal capital costs.

The second assumption would preclude an airline from seeking growth or increased market share at the expense of profit.

**EXAMPLE OF COMPETITION**

The following simplified example is based on a reasonably typical airport-pair time market:

| Potential Market (If 3 or More Flights) | 200 passengers per day |
| Net Fare Yield | $67.20 per passenger |
| Airplane Seating Capacity | 100 seats |
| Variable Costs | $1,400 per flight |

By simple arithmetic, it can be seen that if this were a monopoly market with only Airline "A" certificated, that carrier would probably operate three (or possibly four) flights.

<table>
<thead>
<tr>
<th></th>
<th>3 Flights</th>
<th>4 Flights</th>
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</thead>
<tbody>
<tr>
<td>Revenues Per Day</td>
<td>$13,440</td>
<td>$13,440</td>
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<tr>
<td>Variable Costs Per Day</td>
<td>$4,200</td>
<td>$5,600</td>
</tr>
<tr>
<td>Net Contribution Per Day</td>
<td>$9,240</td>
<td>$7,840</td>
</tr>
<tr>
<td>Passenger Load Factor</td>
<td>67%</td>
<td>50%</td>
</tr>
</tbody>
</table>

**Two Carriers**

If Airline "B" were to be certificated as a new competitor in this market, with three flights already operated by Airline "A", it would be faced with the marginal economic analysis shown in Chart 4, based on the direct diagonal relationship of market share against flight share. For example, if Airline "B" operates one flight out of a total of four flights, the marginal revenue for that flight would be one-fourth x $13,440, or $3,360. Airline "B", accordingly, would probably operate two flights in the market, because the total contribution for these two flights would be $2,580 per day, $60 greater than if it operated three flights.
However, Airline "A" would now find that its contribution from the market could be increased by $60 if it cut back to two flights per day. The net result would be four flights in the market (two by "A" and two by "B"), with an average passenger load factor of 50%. However, if each airline hoped to increase its share of the market from 50% to 60% at a daily cost of $60, the net result might be six flights in the market (three by "A" and three by "B"), with an average passenger load factor of 33% and with each airline realizing $1,400 per day less contribution than if each airline operated only two flights in the market. Chart 4 also demonstrates graphically the potential impact of attempting to increase market share at the expense of profit.

**Three Carriers**

If a third carrier, Airline "C", were to be authorized, with four flights already serving the market (two by "A" and two by "B"), Airline "C" would operate at least one flight with a contribution of $1,290 per day, but probably two flights with a total contribution of $1,680 per day. A third flight by "C" would have a negative contribution. Neither "A" nor "B" could improve its own contribution by either increasing or decreasing its frequency. The net result would be six flights in the market (two each by "A", "B", and "C"), with an average passenger load factor of 33%.
In a similar manner, the authorization of a fourth airline, "D", would tend to result in eight flights in the market, with an average load factor of 25% and a contribution of only $560 per airline, which probably would be inadequate to cover the allocated capital costs and those cost factors not directly related to this market.

Scheduling Strategy

Chart 5 illustrates the results of various scheduling strategies for the example case, based on the simplified (and most favorable) relationship that market share equals flight share.

<table>
<thead>
<tr>
<th>NUMBER OF FLIGHTS BY COMPETITORS</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
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</thead>
<tbody>
<tr>
<td><strong>MARKET SHARE</strong> = <strong>FLIGHT SHARE</strong></td>
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<td></td>
</tr>
<tr>
<td>NUMERICAL OF OUR FLIGHTS</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The horizontal rows, for various number of flights that we might operate, show the results when faced by various number of flights operated by our competitor(s). The entries in each box show our market share, our resulting revenue based on that market share, our variable costs at $1,400 per flight, our contribution from the market, and the passenger load factors for our flights and for the industry. For example, if we expect our competitors to operate four flights, our greatest contribution from the market would be $1,680 by our operating two flights.
The results for the industry may be summarized as follows:

<table>
<thead>
<tr>
<th>Number of Carriers (Q)</th>
<th>Flights/Carrier</th>
<th>Total Flights</th>
<th>Passenger Load Factor</th>
<th>Industry Revenues</th>
<th>Industry Costs</th>
<th>Industry Net</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>3</td>
<td>3</td>
<td>67%</td>
<td>$13,440</td>
<td>$4,200</td>
<td>$9,240</td>
</tr>
<tr>
<td>2</td>
<td>2</td>
<td>4</td>
<td>50%</td>
<td>$13,440</td>
<td>$5,600</td>
<td>$7,840</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>6</td>
<td>33%</td>
<td>$13,440</td>
<td>$8,400</td>
<td>$5,040</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>8</td>
<td>25%</td>
<td>$13,440</td>
<td>$11,200</td>
<td>$2,240</td>
</tr>
</tbody>
</table>

This summary can be extended to show the industry profits resulting if the variable costs represent only 67% or 50% of the total costs:

If Variable = 67% Total Costs

<table>
<thead>
<tr>
<th>Non-Variable Charge</th>
<th>Industry Profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>2,100</td>
<td>$7,140</td>
</tr>
<tr>
<td>2,800</td>
<td>$5,040</td>
</tr>
<tr>
<td>4,200</td>
<td>$840</td>
</tr>
<tr>
<td>5,600</td>
<td>$-3,360</td>
</tr>
</tbody>
</table>

If Variable = 50% Total Costs

<table>
<thead>
<tr>
<th>Non-Variable Charge</th>
<th>Industry Profit</th>
</tr>
</thead>
<tbody>
<tr>
<td>4,200</td>
<td>$5,040</td>
</tr>
<tr>
<td>5,600</td>
<td>$2,240</td>
</tr>
<tr>
<td>8,400</td>
<td>$-3,360</td>
</tr>
<tr>
<td>11,200</td>
<td>$-8,960</td>
</tr>
</tbody>
</table>

For this illustrative airport-pair time market, four competitors would incur significant losses and three competitors would have either inadequate returns on their investments or losses.
The results of the simplified example can be generalized by the use of micro-economic analysis combined with an elementary form of competition/game theory. However, this application is really not the classical game theory, as developed by J. Von Neumann and Oskar Morgenstern, but rather is derived by the simple application of high school partial differential equations. Appendix A-1 shows that if each carrier adds flights as long as the marginal revenues equal or exceed the marginal cost, and if the market share equals the flight share:

\[
\text{Optimum Number of Flights for Each Carrier} = \frac{\text{Industry Market Revenues}}{\text{Variable Costs Per Flight}} \times \left( \frac{Q - 1}{Q^2} \right)
\]

For \( Q = 2 \),
\[
\left( \frac{Q - 1}{Q^2} \right) = \frac{1}{4}
\]

For \( Q = 3 \),
\[
\left( \frac{Q - 1}{Q^2} \right) = \frac{2}{9}
\]

For \( Q = 4 \),
\[
\left( \frac{Q - 1}{Q^2} \right) = \frac{3}{16}
\]

In this relationship, \( Q \) represents the number of equal competitors in a particular airport-pair time market, with equal drawing power for each competitor's flights. The industry market revenues per day are available to all competitors in the market. In the short term, the variable costs per flight might represent only the costs for fuel, crew, and direct maintenance, but over the longer term would have to include the capital costs for additional equipment. This equation also assumes that the industry market revenue forecasts made at the time of equipment purchase actually materialize when the equipment is placed into service. If not, the number of trips scheduled will exceed the optimum number, making the resulting contributions and profits lower than this equation would suggest.

Application of the above equation to the illustrative example results in the following comparison of the theoretical optimum number of flights for each carrier versus the number determined previously:

<table>
<thead>
<tr>
<th>Number of Carriers (Q)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equation:</td>
<td>$13,440 \times \frac{Q - 1}{Q^2}$</td>
<td>$1,440$</td>
<td>$2.4$</td>
<td>$2.1$</td>
</tr>
<tr>
<td>As Determined Previously</td>
<td>3</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
</tbody>
</table>
Total Industry Relationships

Appendix A-2 extends the above relationship to the total industry by simple algebraic manipulation:

- Total Flights = \( \frac{(\text{Industry Market Revenues})}{(\text{Variable Costs Per Flight})} \times \left( \frac{Q - 1}{Q} \right) \)

- Total Costs = \( g \times (\text{Industry Market Revenues}) \times \left( \frac{Q - 1}{Q} \right) \)

Where \( g = \frac{(\text{Total Costs})}{(\text{Variable Costs})} \)

- Operating Ratio = \( g \left( \frac{Q - 1}{Q} \right) \)

- Profit Margin = \( 1 - g \left( \frac{Q - 1}{Q} \right) \)

- For Breakeven \( g \left( \frac{Q - 1}{Q} \right) = 1 \)

Total Industry Flights

Chart 6 shows the total number of industry flights as a function of the ratio of total market revenues to variable costs per flight for various numbers of carriers.
in an airport-pair time market. It can be seen that the total number of industry flights tends to vary directly with the market size and fare level, and varies inversely with the variable costs per flight. It also increases with the number of carriers. However, it will tend to follow a stepped function because of the requirement of an integer number of flights by each carrier.

The service to the traveling public may be improved by the increased number of flights, but it should be recognized that the costs and capital investments vary also with the increased number of flights, resulting in a deterioration of the return on investment for each carrier. Similarly, the actual passenger load factor realized will be decreased with an increased number of competitors.

On the other hand, the service to the traveling public may not be improved with an increase in the number of competitors. A monopoly carrier could provide good service with five flights, spaced at desirable departure times throughout the day; whereas three carriers in the same market might operate three flights each for a total of nine flights, but with three competing flights peaked at the three largest-demand periods of the day, since this can be shown to be the "best" strategy for each competing carrier.

**Profit Margin**

Chart 7 shows that the profit margin for the industry is a function of the ratio of total costs to variable costs and the number of carriers, covering a representative range of values.

\[
\text{PROFIT MARGIN} = 1 \left( \frac{\text{TOTAL COSTS}}{\text{VARIABLE COSTS}} \right) \left( \frac{Q-1}{Q} \right)
\]

\[\text{WHERE } Q = \text{NUMBER OF CARRIERS CERTIFICATED}\]

<table>
<thead>
<tr>
<th>TOTAL COSTS / VARIABLE COSTS</th>
<th>NUMBER OF CARRIERS (Q)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
</tr>
<tr>
<td>2.00</td>
<td>0</td>
</tr>
<tr>
<td>1.50</td>
<td>25</td>
</tr>
<tr>
<td>1.33</td>
<td>33</td>
</tr>
<tr>
<td>1.25</td>
<td>37</td>
</tr>
</tbody>
</table>
It is enlightening to see that the profit margin is apparently not sensitive to the absolute levels of costs, but is quite sensitive to the ratio of total costs to variable costs. The higher this ratio becomes, the lower the air transportation industry's profits will be. Unfortunately, the trend of this ratio over time has been definitely upward in the air transportation industry as a result of greatly increased capital investments for new aircraft, ground equipment, and facilities. In addition, the annual charges by local airports have risen substantially during recent years. Furthermore, labor contracts are tending in various ways toward greater job security in one form or another, which has the effect of converting variable costs into more fixed, longer-term commitments to the employees. Since the variable cost of flying a jet a certain distance is not substantially greater than that for a piston aircraft over the same distance, the end result of the jet technology has been that higher fixed costs must be allocated over relatively fewer units of production.

Chart 7 shows that, regardless of the size of the market and regardless of the fare level, a three-competitor market can be little better than a break-even operation, and that for healthy profits, only two competitors may be tolerated in any market.

**Break-even Operation**

Chart 8 shows that the maximum number of carriers in any market is equal to the ratio of total costs to non-variable costs and is independent of market size, length of haul, unit cost, and fare level.

\[
\text{FOR BREAK-EVEN, OPERATING RATIO} = 1.0 \\
\frac{(\text{TOTAL COSTS})}{\text{VARIABLE COSTS}} \frac{Q-1}{Q} = 1.0 \\
\text{MAXIMUM NUMBER OF CARRIERS (Q°)} \\
Q° = \frac{\text{TOTAL COSTS}}{\text{TOTAL COSTS - VARIABLE COSTS}} = \frac{\text{TOTAL COSTS}}{\text{NON-VARIABLE COSTS}}
\]

<table>
<thead>
<tr>
<th>TOTAL COSTS</th>
<th>NON-VARIABLE COSTS</th>
<th>MAXIMUM NUMBER OF CARRIERS</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>4</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>5</td>
<td>5</td>
</tr>
</tbody>
</table>

INDEPENDENT OF MARKET SIZE, LENGTH OF HAUL, UNIT COSTS, AND FAKE LEVEL

- 17 -
This rather simple relationship, easy to understand, might also be applicable to other industries and firms which have relatively high fixed costs, such as the fertilizer, plastic, steel, and automotive industries, and possibly even applicable to the number of filling stations at a busy intersection.

Further Extensions

The preceding derivation and results were based on certain simplified assumptions, but what would be the result if the various carriers in a market are not equal and have different drawing powers (or relative load factors), or what if there is a threshold point in the market share versus flight share relationship, or what if an airline's competitors operate more or fewer flights than they really should for maximum profit?

The assumption that all competitors in a market were equal may seem to be a severely limiting assumption, in that there are few markets where all competitors are truly equal. Upon closer inspection of the equations, however, it is clear that we are not bound by this assumption, and that the model can easily be made to apply to unequal competitors. Since industry profits in a market are determined by the number of flights actually scheduled, the value of "Q" can be adjusted to conform to the actual number of trips scheduled in the market. This new "Q" is the number of "equivalent" equal competitors and may be a continuous variable. For example, if three airlines operate in a given market, but one dominates the market, we may be dealing with an effective "Q" of 2.2 rather than 3. By adjusting "Q" in this way, it is possible to use the various equations shown above to describe the actual situation. Furthermore, as shown in Appendix A-3, if the drawing power of one carrier's flights is 10% greater than those of its competitors, the optimum integer number of flights for that carrier and its competitors probably would remain unchanged.

As shown in Appendix A-4, if there were a threshold value in the market share versus flight share relationship (e.g., market share equals 1.10 times flight share minus 5), the optimum number of flights for each carrier would be increased by the slope of the line (10% for the assumed relationship). Unfortunately, the total number of flights, costs, and investment would be increased to the extent that the airline management assumed this slope to be greater than 1.0.

Appendix A-4 also shows that the optimum number of flights, costs, and investment would be increased directly by the exponent in an assumed (or empirically derived) curvilinear relationship of market share as a function of flight share, for example

\[(\text{Market Share}) = K(\text{Flight Share})^2\]

As shown in Appendix A-5, the optimum number of flights for a carrier to operate is quite insensitive to the actual number of flights operated by its competitors, for the basic diagonal linear relationship of market share = flight share.
RESULTS OF COMPETITION

The customer-oriented competitive nature of the air transportation industry has resulted in a frequency battle with more carriers providing more non-stop flights to more destinations at more times of the day from multiple-airports serving the major metropolitan areas. These new flights may have improved the service and convenience for the traveling public, but at lower load factors and higher costs.

Technological developments have resulted in an equipment battle that has further compounded the economic impact of the competitive frequency battle. The engineers and manufacturers have designed and developed faster, bigger, and more expensive types before the airlines have recouped their capital investments in existing fleets. As soon as one airline buys a new design, competitive pressures force the others to follow, with marked increases in total industry indebtedness. New technology large jet aircraft have been introduced to both replace the smaller first-generation jets and to permit a reduction in seat-mile costs in spite of the inflationary cost pressures. However, this growth in seating capacity has exceeded the normal growth in passengers, also resulting in lower load factors.

Sensitivity Analysis

Chart 9 summarizes the probable impact on flight frequency, costs, capital investment, and passenger load factors as the result of changes in passenger volume, fare level, variable costs per flight, and number of carriers certificated. It can

<table>
<thead>
<tr>
<th>NUMBER OF INDUSTRY FLIGHTS</th>
<th>(AIRPORT-PAIR TIME MARKET)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>PERCENTAGE CHANGE IN CONDITIONS</strong></td>
<td><strong>PROBABLE PERCENTAGE CHANGE IN:</strong></td>
</tr>
<tr>
<td></td>
<td>FREQUENCY &amp; COSTS</td>
</tr>
<tr>
<td>PASSENGERS</td>
<td>+10</td>
</tr>
<tr>
<td></td>
<td>-10</td>
</tr>
<tr>
<td>FARE</td>
<td>+10</td>
</tr>
<tr>
<td></td>
<td>-10</td>
</tr>
<tr>
<td>COST PER FLIGHT</td>
<td>+10</td>
</tr>
<tr>
<td></td>
<td>-10</td>
</tr>
<tr>
<td><strong>NUMBER OF CARRIERS CERTIFICATED</strong></td>
<td></td>
</tr>
<tr>
<td>1 ——&gt; 2</td>
<td>+50 to +100</td>
</tr>
<tr>
<td>2 ——&gt; 3</td>
<td>+33 to +50</td>
</tr>
<tr>
<td>3 ——&gt; 4</td>
<td>+12 to +33</td>
</tr>
<tr>
<td>4 ——&gt; 5</td>
<td>+7 to +25</td>
</tr>
</tbody>
</table>

CHART 9
be seen that under most changes in conditions, the number of flights and costs will tend to be increased and the passenger load factor depressed. Only if the fare elasticity of demand were -1.0 or more might the passenger load factor increase as indicated. Obviously, from a sensitivity standpoint, the number of carriers certificated is most critical in determining the increase in flights, costs, and capital investment, with a resultant depressant of passenger load factor.

Case in Point

This summary has been derived from a rather straightforward analysis, but it might be considered theoretical or abstract. One specific example from actual operations might be mentioned: in 1969, United's service to and from Hawaii produced a pre-tax profit of more than $26 million; the next year, after five additional carriers were granted Hawaiian routes, United's Hawaiian service had a pre-tax loss of more than $17 million; a change on this one route of more than $43 million per year. No carrier is currently earning a reasonable return in the Hawaiian service.

CONCLUSIONS

From the foregoing analysis, we may conclude that:

1. The hypotheses which have influenced the current structure of the industry and level of competition, as stated earlier, have not led to the most efficient allocation of resources for either the traveling public or the air transportation industry.

2. The competitive, economic, regulatory, and technological environment for the air transportation industry has resulted in over-competition with resultant:
   a. Excessive numbers of flights, costs, and capital investments, which must be supported by the fare levels.
   b. Low utilization of productive capacity — low load factors.
   c. Marginal or loss operations.

3. The maximum number of fully-competitive carriers possible in any market can not exceed the ratio of total costs to non-variable costs, and is not a function of the market size, length of haul, unit costs, fare level, or aircraft type. With the inherent increases in fixed costs which have occurred over time, the ratio of total costs to non-variable costs in the air transportation industry appears to range from 2 to 3.
BASIC DERIVATION for EACH CARRIER

Let M = Industry Passengers
F = Net Fare per Passenger
C = Variable Costs per Flight
PA = Contribution for Carrier A,
similarly for B and C
Ni = Optimum Number of Flights
for Each of i Carriers
x = Flights by A
y = Flights by B
z = Flights by C
Q = Number of Carriers
g = \frac{\text{Total Costs}}{\text{Variable Costs}}

CONDITION A

1. Each carrier schedules for maximum contribution, that is, marginal
   revenues ≥ marginal costs.


For Q = 2 Competing carriers A and B

PA = \left(\frac{x}{x+y}\right)MF - xC, \hspace{1cm} PB = \left(\frac{y}{x+y}\right)MF - yC

For maximum contribution, \frac{\partial PA}{\partial x} = 0 \hspace{1cm} \text{and} \hspace{1cm} \frac{\partial PB}{\partial y} = 0

\frac{\partial PA}{\partial x} = \left[\frac{(x+y) \cdot 1 - x}{(x+y)^2}\right]MF - C = 0, \hspace{1cm} \frac{\partial PB}{\partial y} = \left[\frac{(x+y) \cdot 1 - y}{(x+y)^2}\right]MF - C = 0

Solving simultaneous equations,

X_{OPT} = Y_{OPT} = N_2 = \frac{MF}{C} \times \frac{1}{4} = \frac{MF}{C} \left(\frac{Q-1}{Q^2}\right) \hspace{1cm} (*)

For Q = 3 Competing carriers A, B, and C

By similar analysis

X_{OPT} = Y_{OPT} = Z_{OPT} = N_3 = \frac{MF}{C} \times \frac{2}{9} = \frac{MF}{C} \left(\frac{Q-1}{Q^2}\right)

For Q carriers, by extension

N_Q = \frac{MF}{C} \left(\frac{Q-1}{Q^2}\right) \hspace{1cm} \text{for each carrier}

* In order for the first derivative of P to result in a maximum value for P, the
  second derivative must, of course, be negative. This will be the case when
  Q is greater than 1.
CONDITION A (Continued)

For the total industry,

(2) \[ \text{Total Flights} = QN_Q = \frac{MF(Q - 1)}{C} \]

Total Variable Costs \[ = C \times \frac{MF(Q - 1)}{C} = MF\left(\frac{Q - 1}{Q}\right) \]

(3) \[ \text{Total Costs} = gMF\left(\frac{Q - 1}{Q}\right) \]

Operating Ratio \[ = \frac{\text{Total Costs}}{\text{Total Revenues}} \]

(4) \[ = g\left(\frac{Q - 1}{Q}\right), \text{ independent of } M, F, \text{ and } C \]

(5) \[ \text{Profit Margin} = 1 - g\left(\frac{Q - 1}{Q}\right), \text{ independent of } M, F, \text{ and } C \]

For break-even, \[ \text{Operating Ratio} = 1.0 \]

\[ g\left(\frac{Q - 1}{Q}\right) = 1.0 \]

Maximum number of carriers \( Q^* \) possible

\[ Q^* = \frac{g}{g - 1} \]

(6) \[ = \frac{\text{Total Costs}}{\text{Non-variable Costs}} \]

Again, independent of \( M, F, \text{ and } C \)
CONDITION B

1. Each carrier schedules for maximum contribution, and
2. Competitors in market are not equal, such that the drawing power of A's flights = 110% of competitors' flights.

For Q = 3, Competing carriers A, B, and C

\[ P_A = \left( \frac{1.1x}{1.1x+y+z} \right) MF - xC \quad , \quad P_B = \left( \frac{y}{1.1x+y+z} \right) MF - yC \]

\[ \frac{\partial P_A}{\partial x} = \frac{(1.1x+y+z - 1.1x)}{(1.1x+y+z)^2} \cdot 1.1MF - C \]

\[ \frac{\partial P_B}{\partial y} = \frac{(1.1x+y+z - y)}{(1.1x+y+z)^2} \cdot MF - C \quad , \quad \text{similarly for } P_C \]

Solving for maximum contribution, simultaneously,

\[ X_{OPT} = \frac{2.4}{(3.2)^2} \frac{MF}{C} = 1.05 \frac{MF}{C} \left( \frac{Q-1}{Q^2} \right) = 1.05 N^3 \]

\[ Y_{OPT} = \frac{2.2}{(3.2)^2} \frac{MF}{C} = 0.97 \frac{MF}{C} \left( \frac{Q-1}{Q^2} \right) = 0.97 N^3 \]

\[ Z_{OPT} = \frac{2.2}{(3.2)^2} \frac{MF}{C} = 0.97 N^3 \]

That is, a reasonably significant difference in drawing power (or relative load factor) generally will not affect the optimum integer number of flights to be operated.
FURTHER EXTENSIONS

CONDITION C

1. Each carrier schedules for maximum contribution, and
2. Market Share = 1.10(Flight Share) - 0.05

\[ PA = \left[ \frac{1.1}{x+y+z} \right] \left( \frac{x}{x+y+z} \right)^{0.5} \text{ MF } - xC, \]  

\[ \frac{dPA}{dx} = \frac{1.1(x+y+z-x)}{(x+y+z)^2} \text{ MF } - C, \]  

Solving for maximum contribution, simultaneously

(8)

\[ X_{OPT} = Y_{OPT} = Z_{OPT} = 1.10 NQ, \]  

\[ \text{Total Industry Flights} = 1.10 QNQ = 1.10 \frac{\text{MF}}{C} \left( \frac{Q-1}{Q} \right) \]

That is, the optimum number of flights for each carrier, and the total number of flights (and costs) for the industry are increased directly by the slope of the regression line of market share against flight share.

CONDITION D

1. Each carrier schedules for maximum contribution, and
2. Market Share_A = K \left( \frac{x}{x+y+z} \right)^2, \]  

\[ = \frac{x^2}{x^2+y^2+z^2}, \]  

\[ PA = \left( \frac{x^2}{x^2+y^2+z^2} \right) \text{ MF } - xC, \]  

\[ \frac{dPA}{dx} = \frac{(x^2+y^2+z^2)2x - x^2 \cdot 2x}{(x^2+y^2+z^2)^2} \text{ MF } - C, \]  

Solving for maximum contribution, simultaneously,

(9)

\[ X_{OPT} = Y_{OPT} = Z_{OPT} = 2 NQ, \]  

\[ \text{Total Industry Flights} = 2QNQ = 2 \frac{\text{MF}}{C} \left( \frac{Q-1}{Q^2} \right) \]

That is, the optimum number of flights for each carrier, and the total number of flights (and costs) for the industry are increased directly by the exponent in the curvilinear relationship of market share as a function of flight share.
FURTHER EXTENSIONS

CONDITION E

1. Carrier A schedules for maximum contribution, but
2. Carrier B actually operates K times $N_2$ flights

$$y = KN_2 = K \frac{MF}{C} \left( \frac{2 - 1}{2^2} \right) = K \left( \frac{MF}{4C} \right)$$

3. Market Share = Flight Share

$$P_A = \left( \frac{x}{x+KN_2} \right) \frac{MF}{C} - xC$$

$$\frac{dP_A}{dx} = \frac{(x+KN_2 - x)}{(x+KN_2)^2} \frac{MF}{C} - C$$

Solving for maximum contribution,

$$X_{OPT} = \left( \frac{KN_2}{C} \right)^{1/2} - KN_2$$

$$= \left( \frac{K}{4C} \left( \frac{MF}{C} \right)^{1/2} - K \left( \frac{MF}{4C} \right) \right)$$

$$= (2K^{1/2} - K) N_2$$

(10)

The flatness of this curve means that the optimum number of flights for a carrier is quite insensitive to the actual number of flights operated by its competitor(s), for the simple linear relationship of market share = flight share.
Abstract

Before an airline can buy new aircraft, it must be able to pay for the plane. The carrier can do this by using its own funds. However, few have enough cash on hand to purchase one aircraft much less a fleet. Therefore, the carrier must rely on outside sources for financial support.

What are the factors that a financial source investigates before deciding to invest or not? The basic information on the health of a carrier can be found from its balance sheet and income statement. If this information is coupled with knowledge of the carrier's working capital and cash flow statements, an investor can compute some key financial ratios that will allow him to determine his potential risks and rewards from financing a carrier's operations.

ACCOUNTING PRINCIPLES

What are the basic indicators of corporate health, and how are they constructed? This is the area of the accountant so a basic knowledge of his techniques will be helpful.

Through the years, certain general rules or guides have been developed that accountants follow in preparing financial documents. These principles do not specify every detail of accounting practice, so the accountant has a great deal of freedom in tailoring his practices and procedures to the particular industry and company he serves. However, there are
some generally accepted standards.

The Basic Accounting Conventions

Although the accountant does have a great deal of freedom in how he sets up and keeps accounts, there are several widely accepted conventions. The most important are:

1. **Consistency** - Once the accountant has decided how he will set up the accounts and handle particular transactions, the Consistency Convention requires him to handle all future events of the same type in the same fashion. Thus, similar transactions in different accounting periods can be compared, on a consistent basis.

   Since circumstances change, accounting procedures may be altered to meet new developments. However, this is not done often, and when it is, the changes must be thoroughly described and documented.

2. **Conservatism** - This convention is often stated as "Anticipate no profits and provide for all possible losses." If there is an option in how a resource is to be evaluated, the accountant will ordinarily select the method that yields the lower value. For example, he would show the value of securities held by the firm at the lower of cost or market value. Although this procedure is often criticized as inconsistent, it is still widely in use and is important.
3. **Materiality** - often the recording of an event would cost considerably more than the information obtained in the process. Therefore, accountants will draw a line based on their experience and common sense between what is important enough to require close attention, and what can be considered immaterial and handled in a less detailed way. For example, an accountant would not require daily reports on how much fuel remains in the tanks of the aircraft in the fleet, but would use some simplifying assumption such as, "fuel is considered used when it is pumped from storage".

The Basic Accounting Concepts

In addition to the Accounting conventions, there are several basic concepts that underlie the keeping of accounts:

1. **Business Entity Concept** - Accounts are kept for businesses, and not for the people associated with them. The accounts reflect how transactions affect the business. This is true whether the business is a giant corporation or a sole proprietorship, totally merged with the personal finances of the owner. In the latter case, the law views both the business and personal transactions of the individual as his own personal property for which he is personally liable. However, the accountant treats the two separately. If the owner takes five dollars from the cash drawer to buy food, the accounts for the
business show a five dollar decrease in cash.

Since a corporation has a totally separate legal existence, corporate activities are easily distinguished from the personal actions of the owners or operators. However, there may still be areas of confusion. To keep tighter controls of activities, a corporation may treat various aspects of its operations as separate business entities and keep separate accounts. Or there may be several distinct corporations linked by stock interests. In this case, a "consolidated" accounting statement could be prepared, treating the whole group as one business entity. Because of these techniques it is sometimes difficult to separate out the information needed about a particular part of the firm.

2. **Going Concern Concept** - Under normal circumstances, accounting assumes that the business entity will exist for an indefinite period into the future. This eliminates the need to constantly compute the worth of the company as if it were to be liquidated, and instead concentrate on measuring performance by estimating the value of production. Market values of machinery and resources acquired, but not yet consumed are ignored since resale value is not important. Their value to the firm is through the creation of future output.

3. **Cost Concept** - Since the Going Concern Concept elimi-
nates the need to value the resources of a company at their going market price, the books of the company will record their worth at initial cost. This value is never changed to reflect market influences, (unless the Conservatism Convention is applied when market value is below cost). Therefore, the dollar amounts on the books of business should not be confused with the actual value of the company's holdings. Some resources such as cash or securities that could rapidly be disposed of will have a book value very close to market value. However, items such as land or equipment may be shown at values considerably below their worth in the market place.

The Cost Concept serves to remove subjective influences in evaluating the company. Two people may disagree widely on the value of a piece of property. By using original cost, a consistent measure is obtained.

4. **The Money Measurement Concept** - Closely allied to the Cost Concept is the Money Measurement Concept -- accounting records only include factors that can be expressed in monetary terms. Thus, a large number of diverse aspects of the firm can be reduced to a common denominator and added, subtracted or compared.

Since accounting records only reflect things that have monetary value, they will not disclose factors that cannot be
expressed in dollars. The accounts will not show potential contracts, the health of a crucial officer or internal management conflicts.

5. **The Dual-Aspect Concept** - The tangible and intangible resources of a business are its "assets". Claims against the business and its assets are called "equities", perhaps because they are often enforced in courts of Equity. The equities are divided into the claims of creditors -- "Liabilities" and the claims of the owners -- "Owners' Equity" (called Shareholders' Equity in a Corporation). The claims of the creditors have first priority, with the owners being entitled to everything that is left. Since the creditors' and owners' claim all the assets and since claims cannot exceed the assets, the Dual-Aspect Concept can be stated as:

\[
\text{ASSETS} = \text{EQUITIES} = \text{LIABILITIES} + \text{OWNERS' EQUITY}
\]

The true implication of the concept is perhaps more clearly shown by rewriting this equation as:

\[
\text{OWNERS' EQUITY} = \text{ASSETS} - \text{LIABILITIES}
\]

The owners are entitled to what is left of the assets after creditors' claims are satisfied.

Since any change in assets must be accompanied by a similar and offsetting change in the equities, the assets and equities are said to "balance." This balance is shown by the "Balance
THE BALANCE SHEET

The balance sheet is the basic accounting report of a business entity showing the financial status of the firm at a given point in time. Every accounting transaction can be reported as a change of the balance sheet. Figure 1 shows the form of a typical although simplified, balance sheet for a small corporation. The categories are defined as follows:

Assets

Earlier, we defined an asset as being a tangible or intangible resource of a business. For an asset to qualify as a balance sheet entity, it must also have value, be owned by the business, and have been acquired at some measurable cost. Assets are categorized as:

1. **Current Assets** - Used to designate cash and other resources reasonably expected to be either consumed, sold or converted to cash during the normal accounting period -- usually one year. The most common items are:

   Cash: Funds available for immediate disbursement without restriction.

   Marketable Securities: Investments which can be readily sold and will be disposed of during the coming year. They are normally the types of short-term investments used to earn
## FIGURE 1

**TECH AIRWAYS INC.**

Balance Sheet as of June 30, 1972

<table>
<thead>
<tr>
<th>ASSETS</th>
<th>EQUITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current Assets:</strong></td>
<td><strong>Current Liabilities:</strong></td>
</tr>
<tr>
<td>Cash</td>
<td>Accounts Payable</td>
</tr>
<tr>
<td>Marketable Securities</td>
<td>Estimated Taxes</td>
</tr>
<tr>
<td>Accounts Receivable</td>
<td>Accrued Expenses</td>
</tr>
<tr>
<td>Inventory</td>
<td>Deferred Income</td>
</tr>
<tr>
<td>Prepaid Expenses</td>
<td>Total Current Liabilities</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Current Assets</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Fixed Assets:</strong></td>
<td><strong>Other Liabilities:</strong></td>
</tr>
<tr>
<td>Land, Buildings and</td>
<td>Bonds Payable</td>
</tr>
<tr>
<td>Equipment</td>
<td>Total Other Liabilities</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Fixed Assets</strong></td>
<td>Stockholders' Equity:</td>
</tr>
<tr>
<td></td>
<td>Common Stock</td>
</tr>
<tr>
<td></td>
<td>Retained Earnings</td>
</tr>
<tr>
<td></td>
<td>Capital Surplus</td>
</tr>
<tr>
<td></td>
<td>Total Equities</td>
</tr>
<tr>
<td><strong>Other Assets:</strong></td>
<td></td>
</tr>
<tr>
<td>Investments</td>
<td></td>
</tr>
<tr>
<td>Intangibles</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Total Assets</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>
interest on cash not immediately needed for business purposes.

**Accounts Receivable:** Money owned to the business and expected to be collected. The money is usually owed by customers, but it could be owed by employees or others. Where a note or other writing has been executed in conjunction with the transaction, it would appear under a separate category -- **Notes Receivable.**

**Inventory:** Inventory items are tangible personal property which is either held for sale in the ordinary course of business or is somewhere in the production process and will be converted into such goods. For example, aircraft awaiting delivery or on the production line would be inventory, as would stocks of sheet metal or rivets. But if the manufacturer uses one of those planes as a corporate aircraft, it is no longer an inventory item, but a fixed asset since it is actually used by the business.

**Prepaid Expenses:** These are often intangible assets such as insurance policies, which have limited life. Once paid, they represent value to the company. Normally, the item will be totally consumed within three to five years at most, and sometimes sooner. An example of a prepaid expense that is tangible would be heating oil purchased for the coming winter.

2. **Fixed Assets** - Fixed assets are tangible resources with a relatively long life expectancy. These are usually resources used in the production process such as land, buildings
and equipment. Fixed assets (except land) are gradually reduced in value through wear or obsolescence. However, they are still shown on the books at their cost with a separate entry made to show the depreciation or loss of value since acquisition. This concept will be discussed in more detail in a later section.

Note that an asset which has a potentially long life that is held for resale is not a fixed asset but an inventory item and would be listed under current assets.

3. **Other Assets** - All other assets are placed in this section. Two major categories are investments and intangible assets. Depending on the policy of the firm, these items could be account groupings on the balance sheet, but here we have listed them as classes of Other Assets.

**Investments:** Long-term holdings of securities, deposits, etc. that are not to be converted back to cash within the year (unlike Marketable Securities which will be converted).

**Intangibles:** Includes patents, copyrights, licenses or goodwill. In keeping with our basic definition of an asset, they must have value, be owned and have been acquired at a measurable cost. Therefore, goodwill that a company builds up through its own operations is not entered on the balance sheet. Only goodwill acquired through the purchase of another firm can be listed.
Equities

The equities of a firm are of two types -- "Liabilities" and "Owners' Equity." In a corporation, Owners' Equity is called Stockholders' Equity.

1. **Current Liabilities** - Like Current Assets, Current Liabilities refer to short-term transactions. This includes long-term liabilities that will mature in the coming year as well as obligations arising from the operations of the business. The major accounts are:

   **Accounts Payable:** The claims of suppliers, creditors and others are recorded in this account. These claims are usually unsecured. If there is a note or other written evidence of the claim, it would be listed under "Notes Payable" or a similarly titled account.

   **Estimated Taxes:** Since taxes can be a relatively large account, they are listed separately. It is shown as an estimate since the exact amount may not be known at the time the balance sheet is prepared.

   **Accrued Expenses:** This account represents obligations incurred by the firm but not yet paid (such as wages owed for work performed). If there is an invoice submitted, or other tangible evidence of the debt, it would be listed under Accounts Payable instead of here.
Deferred Income: If the company has received payments in advance, it is under an obligation to perform its part of the bargain or repay the advance. Therefore, such sums are shown as a Current Liability until the obligation is fulfilled.

2. Other Liabilities - These are long-term liabilities of the firm (such as bonds) which will not come due in the next year.

3. Stockholders' Equity - All the resources left after the liabilities are satisfied equal the Stockholders' Equity. This is sometimes called the residual interest, since the owners only get what remains after the interests of the creditors have been covered.

Capital Stock: In a corporation, the shares of ownership have an initial value called the "stated value" that represents either the price at which it was sold or a "par value" established in advance, or some other value reasonably fixed by the board of directors of the firm. The total represents the paid-in interest of the owners. (This is not necessarily related to the market value of the stock which is determined by owners selling their interests to new owners on the open market.)

Retained Earnings: If the company has profitable operations, it has "earnings". These are either paid out to shareholders as dividends or retained by the company for corporate uses. The
difference between the total earnings of a company from the date of incorporation to the date of the balance sheet and all dividends ever paid is shown in the retained earnings account. If this difference is negative, it is called a "deficit".

**Capital Surplus:** Sometimes the Owners' Equity is changed by transactions unrelated to the company's operations. Perhaps a town interested in attracting new business donates land for a site. The value of the land is shown in the Capital Surplus Account.

**EXAMPLE**

Andy Aviator has established Tech Airways Inc. to operate an air-taxi service. The corporation has authorized the issuance of 100,000 shares of common stock at a par value of $1 per share. Only 10,000 shares have actually been issued, all purchased by Andy for $10,000. Figure 2 shows the balance sheet at this time.

Andy's first step as president and general manager is to buy a plane for $60,000. He uses $5,000 of the cash as a down payment and finances the remaining $55,000 through a $5,000 short-term note and a long-term $50,000 mortgage on the aircraft. Figure 3 shows the balance sheet after these transactions.

Since the remaining $5,000 cash is not sufficient to start operations, Andy decides to issue bonds for $20,000 and issue another 10,000 shares of stock. He finds a friend who is will-
### FIGURE 2

**TECH AIRWAYS INC.**

Balance Sheet as of June 30, 1972

<table>
<thead>
<tr>
<th>ASSETS</th>
<th>EQUITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current Assets:</strong></td>
<td><strong>Current Liabilities:</strong></td>
</tr>
<tr>
<td>Cash</td>
<td></td>
</tr>
<tr>
<td>$10,000</td>
<td></td>
</tr>
<tr>
<td><strong>Total Current Assets</strong></td>
<td><strong>Other Liabilities:</strong></td>
</tr>
<tr>
<td>$10,000</td>
<td></td>
</tr>
<tr>
<td><strong>Fixed Assets:</strong></td>
<td><strong>Stockholders' Equity:</strong></td>
</tr>
<tr>
<td></td>
<td>Common Stock</td>
</tr>
<tr>
<td></td>
<td>$10,000</td>
</tr>
<tr>
<td><strong>Other Assets:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Assets</strong></td>
<td><strong>Total Equities</strong></td>
</tr>
<tr>
<td>$10,000</td>
<td>$10,000</td>
</tr>
</tbody>
</table>

\[
\text{ASSETS ($10,000)} = \text{EQUITIES ($10,000)}
\]
<table>
<thead>
<tr>
<th>ASSETS</th>
<th>EQUITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current Assets:</strong></td>
<td></td>
</tr>
<tr>
<td>Cash</td>
<td></td>
</tr>
<tr>
<td>$10,000</td>
<td></td>
</tr>
<tr>
<td>Total Current Assets $10,000</td>
<td></td>
</tr>
<tr>
<td><strong>Fixed Assets:</strong></td>
<td></td>
</tr>
<tr>
<td>1 Airplane $60,000</td>
<td></td>
</tr>
<tr>
<td>Total Fixed Assets $60,000</td>
<td></td>
</tr>
<tr>
<td><strong>Other Assets:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total Assets</strong></td>
<td><strong>Total Equities</strong> $10,000</td>
</tr>
<tr>
<td>$10,000</td>
<td>$10,000</td>
</tr>
</tbody>
</table>

**Notes Payable** $5,000

**Total Current Liabilities** $5,000

**Total Other Liabilities** $50,000

**Stockholders' Equity:**

- **Common Stock** $10,000
- **Total Stockholders' Equity** $10,000
- **Total Equities** $10,000

**Other Liabilities:**

- **Aircraft Mortgage** $50,000
- **Total Other Liabilities** $50,000
ing to pay $1.50 per share for 5,000 shares, and Andy himself buys the other 5,000 at the same price. Andy uses $10,000 to buy fuel, $5,000 for a two-year insurance policy, and $5,000 to purchase a selection of snacks to be sold on board to passengers. Andy invests the remainder of the new capital in government short-term bonds since it is not presently needed to cover operational costs. Figure 4 reflects the effects of these transactions on the balance sheet.

Tech airways is now ready to start operations. Pete Pilot is hired as chief pilot, and flies 5 flights carrying 15 passengers over the next few weeks. Ten of the passengers pay cash for a total of $5,000, and 5 charge their tickets to Diner's Press Cards for $250. One of the passengers pays $50 for a return flight he has not yet taken. In addition, Pete sold $100 worth of snacks for $200.

$300 worth of fuel is used during these operations, and Pete's salary for the period is $250 which has not yet been paid. (See Figures 5 and 6)

Tech Airways operates profitably. By June of the following year, its balance sheet looks like Figure 7.

Since there is a healthy cash balance, Tech Airways pays off the $5,000 note. Andy also decides that the company should buy out Avonic Airways, its only competitor for $25,000--$10,000 in
FIGURE 4

TECH AIRWAYS INC.

Balance Sheet as of July 31, 1972

<table>
<thead>
<tr>
<th>ASSETS</th>
<th>EQUITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ASSETS</strong></td>
<td><strong>EQUITIES</strong></td>
</tr>
<tr>
<td><strong>Current Assets:</strong></td>
<td><strong>Current Liabilities:</strong></td>
</tr>
<tr>
<td>Cash</td>
<td>$5,000</td>
</tr>
<tr>
<td>Marketable Securities</td>
<td>$15,000</td>
</tr>
<tr>
<td>Inventory (Snacks)</td>
<td>$5,000</td>
</tr>
<tr>
<td>Prepaid Expenses</td>
<td></td>
</tr>
<tr>
<td>Fuel Insurance</td>
<td>$10,000</td>
</tr>
<tr>
<td>Total Current Assets</td>
<td>$50,000</td>
</tr>
<tr>
<td>Total Fixed Assets</td>
<td>$60,000</td>
</tr>
<tr>
<td>1 Airplane</td>
<td>$60,000</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Assets</td>
<td>$65,000</td>
</tr>
<tr>
<td>(ASSETS ($65,000))</td>
<td>EQUITIES ($65,000)</td>
</tr>
</tbody>
</table>

*Note: Valuations as of July 31, 1972.*
# Figure 5

**Tech Airways Inc.**

Balance Sheet as of July 8, 1972

## Assets

<table>
<thead>
<tr>
<th>Current Assets:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash</td>
<td>$5,000</td>
</tr>
<tr>
<td>Marketable Securities</td>
<td>$15,000</td>
</tr>
<tr>
<td>Inventory (Snacks)</td>
<td>$5,000</td>
</tr>
<tr>
<td>Prepaid Expenses</td>
<td>$10,000</td>
</tr>
<tr>
<td>Fuel</td>
<td>$5,000</td>
</tr>
<tr>
<td>Prepaid Expenses</td>
<td>$7,000</td>
</tr>
<tr>
<td>Prepaid Insurance</td>
<td>$5,000</td>
</tr>
<tr>
<td>Total Current Assets</td>
<td>$40,550</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fixed Assets:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Aircraft</td>
<td>$60,000</td>
</tr>
<tr>
<td>Total Fixed Assets</td>
<td>$60,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other Assets:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Assets</td>
<td>$100,550</td>
</tr>
</tbody>
</table>

## Liabilities

<table>
<thead>
<tr>
<th>Current Liabilities:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Notes Payable</td>
<td>$5,000</td>
</tr>
<tr>
<td>Accrued Expenses (Salary)</td>
<td>$250</td>
</tr>
<tr>
<td>Deferred Income (Advanced Sale)</td>
<td>$50</td>
</tr>
<tr>
<td>Total Current Liabilities</td>
<td>$5,300</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other Liabilities:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Aircraft Mortgage</td>
<td>$50,000</td>
</tr>
<tr>
<td>Bonds Outstanding</td>
<td>$20,000</td>
</tr>
<tr>
<td>Total Other Liabilities</td>
<td>$70,000</td>
</tr>
</tbody>
</table>

## Stockholders' Equity

<table>
<thead>
<tr>
<th>Stockholders' Equity:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Common Stock</td>
<td>$20,000</td>
</tr>
<tr>
<td>Capital Surplus</td>
<td>$5,000</td>
</tr>
<tr>
<td>Retained Earnings</td>
<td>$250</td>
</tr>
<tr>
<td>Total Stockholder's Equity</td>
<td>$25,250</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Equities</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$100,550</td>
</tr>
</tbody>
</table>

\[
\text{Assets (}$100,550\text{)} = \text{Equities (}$100,550\text{)}
\]
FIGURE 6
TECH AIRWAYS INC.

Balance Sheet as of July 21, 1972

<table>
<thead>
<tr>
<th>ASSETS</th>
<th>EQUITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Assets:</td>
<td>Current Liabilities:</td>
</tr>
<tr>
<td>Cash $5,700</td>
<td>Notes Payable $5,000</td>
</tr>
<tr>
<td>Marketable Securities $15,000</td>
<td>Accrued Expenses 250</td>
</tr>
<tr>
<td>Accounts Receivable 250</td>
<td>Deferred Income 50</td>
</tr>
<tr>
<td>Inventory (Snacks) 4,900</td>
<td></td>
</tr>
<tr>
<td>Prepaid Expenses:</td>
<td></td>
</tr>
<tr>
<td>fuel 9,700</td>
<td></td>
</tr>
<tr>
<td>insurance 5,000</td>
<td></td>
</tr>
<tr>
<td>Total Current Assets $40,550</td>
<td>Total Current Liabilities $5,300</td>
</tr>
<tr>
<td>Fixed Assets:</td>
<td></td>
</tr>
<tr>
<td>Airplane $60,000</td>
<td></td>
</tr>
<tr>
<td>Total Fixed Assets $60,000</td>
<td></td>
</tr>
<tr>
<td>Other Assets:</td>
<td>Other Liabilities:</td>
</tr>
<tr>
<td>Total Assets $100,550</td>
<td>Aircraft Mortgage $50,000</td>
</tr>
<tr>
<td></td>
<td>Bonds Outstanding 20,000</td>
</tr>
<tr>
<td></td>
<td>Total Other Liabilities $70,000</td>
</tr>
<tr>
<td></td>
<td>Stockholders' Equity:</td>
</tr>
<tr>
<td></td>
<td>Common Stock 20,000</td>
</tr>
<tr>
<td></td>
<td>Retained Earnings 250</td>
</tr>
<tr>
<td></td>
<td>Capital Surplus 5,000</td>
</tr>
<tr>
<td></td>
<td>Total Stockholder's Equity $25,250</td>
</tr>
<tr>
<td></td>
<td>Total Equity $100,550</td>
</tr>
</tbody>
</table>

(ASSETS ($100,550) = EQUITIES ($100,550))
## FIGURE 7

TECH AIRWAYS INC.

Balance Sheet as of June 1, 1973

<table>
<thead>
<tr>
<th>ASSETS</th>
<th>EQUITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current Assets:</strong></td>
<td><strong>Current Liabilities:</strong></td>
</tr>
<tr>
<td>Cash</td>
<td>Notes Payable $5,000</td>
</tr>
<tr>
<td>Marketable Securities</td>
<td>Accrued Expenses 2,000</td>
</tr>
<tr>
<td>Accounts Receivable</td>
<td>Deferred Income 2,500</td>
</tr>
<tr>
<td>Inventory</td>
<td>Total Current Assets $9,500</td>
</tr>
<tr>
<td>Prepaid Expenses</td>
<td></td>
</tr>
<tr>
<td>fuel</td>
<td></td>
</tr>
<tr>
<td>insurance</td>
<td></td>
</tr>
<tr>
<td>Total Current Assets $144,500</td>
<td></td>
</tr>
<tr>
<td><strong>Fixed Assets:</strong></td>
<td><strong>Other Liabilities:</strong></td>
</tr>
<tr>
<td>Airplane</td>
<td>Aircraft Mortgage $50,000</td>
</tr>
<tr>
<td></td>
<td>Bonds Outstanding 20,000</td>
</tr>
<tr>
<td>Total Fixed Assets $60,000</td>
<td>Total Other Liabilities $70,000</td>
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<td><strong>Other Assets:</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Stockholders' Equity</td>
</tr>
<tr>
<td></td>
<td>Common Stock $20,000</td>
</tr>
<tr>
<td></td>
<td>Retained Earnings 100,000</td>
</tr>
<tr>
<td></td>
<td>Capital Surplus 5,000</td>
</tr>
<tr>
<td></td>
<td>Total Stockholders Equity $125,000</td>
</tr>
<tr>
<td><strong>Total Assets $204,500</strong></td>
<td>Total Equities $204,500</td>
</tr>
</tbody>
</table>

\[\text{(ASSETS ($204,500) = EQUITIES ($204,500))}\]
cash and $15,000 in stock at the stated par value of $1.00 per share. Avonic has assets of 1 airplane worth $10,000 and a $10,000 hanger. The extra $5,000 paid is for the goodwill Avonic has gained by its record of service (See Figure 8).

Tech Airways, Inc. still looks profitable. With the end of the year approaching, Andy estimates Tech Airway's tax liability, based on projected operations and $6,000 depreciation on the first aircraft. The short-term bonds are sold to increase cash.

Since a year of the prepaid insurance has been used up, its value is decreased on the balance sheet. Since prospects for the company are still bright, a $1 per share dividend is paid to build stockholder confidence. (See Figure 9).

Because of his huge success, Andy decides he wants to become a regularly scheduled interstate carrier and applies and receives a Civil Aeronautics Board Certificate of Public Convenience and Necessity. If Andy receives the certificate he will have to comply with CAB reporting requirements. Figure 10 shows the balance sheet accounts used by the Board and published in Title 14, Part 241 of the Code of Federal Regulations (CFR). The details of this document can be found in the CFR where each Account Grouping and each Account is described in great detail.

Figure 11 shows a typical Balance Sheet for an airline, as published in its annual report. Although it follows the C.A.B.
## TECH AIRWAYS INC.

**Balance Sheet as of June 1, 1973**

### ASSETS

<table>
<thead>
<tr>
<th>Current Assets:</th>
<th>Total Current Assets</th>
<th>$144,500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash</td>
<td>$74,500</td>
<td>$74,500</td>
</tr>
<tr>
<td>Marketable Securities</td>
<td>$15,000</td>
<td>$15,000</td>
</tr>
<tr>
<td>Accounts Receivable</td>
<td>$25,000</td>
<td>$25,000</td>
</tr>
<tr>
<td>Inventory</td>
<td>$5,000</td>
<td>$5,000</td>
</tr>
<tr>
<td>Prepaid Expenses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>fuel</td>
<td>$20,000</td>
<td>$20,000</td>
</tr>
<tr>
<td>insurance</td>
<td>$5,000</td>
<td>$5,000</td>
</tr>
<tr>
<td>Total Current Assets</td>
<td>$129,500</td>
<td>$129,500</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Fixed Assets:</th>
<th>Total Fixed Assets</th>
<th>$80,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airplane</td>
<td>$60,000</td>
<td>$60,000</td>
</tr>
<tr>
<td>Hangers</td>
<td>$10,000</td>
<td>$10,000</td>
</tr>
<tr>
<td>Total Fixed Assets</td>
<td></td>
<td>$80,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other Assets:</th>
<th>Total Other Assets</th>
<th>$214,500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goodwill</td>
<td>$5,000</td>
<td>$5,000</td>
</tr>
<tr>
<td>Total Assets</td>
<td></td>
<td>$214,500</td>
</tr>
</tbody>
</table>

### EQUITIES

<table>
<thead>
<tr>
<th>Current Liabilities:</th>
<th>Total Current Liabilities</th>
<th>$9,500</th>
</tr>
</thead>
<tbody>
<tr>
<td>Notes Payable</td>
<td>$5,000</td>
<td>$5,000</td>
</tr>
<tr>
<td>Accrued Expense</td>
<td>$2,000</td>
<td>$2,000</td>
</tr>
<tr>
<td>Deferred Income</td>
<td>$2,500</td>
<td>$2,500</td>
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<tr>
<td>Total Current Liabilities</td>
<td>$9,500</td>
<td>$9,500</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other Liabilities:</th>
<th>Total Other Liabilities</th>
<th>$70,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aircraft Mortgage</td>
<td>$50,000</td>
<td>$50,000</td>
</tr>
<tr>
<td>Bonds Outstanding</td>
<td>$20,000</td>
<td>$20,000</td>
</tr>
<tr>
<td>Total Other Liabilities</td>
<td>$70,000</td>
<td>$70,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Stockholders' Equity:</th>
<th>Total Stockholders Equity</th>
<th>$125,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common Stock</td>
<td>$20,000</td>
<td>$20,000</td>
</tr>
<tr>
<td>Retained Earnings</td>
<td>$100,000</td>
<td>$100,000</td>
</tr>
<tr>
<td>Capital Surplus</td>
<td>$5,000</td>
<td>$5,000</td>
</tr>
<tr>
<td>Total Stockholders Equity</td>
<td>$125,000</td>
<td>$125,000</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Total Equities</th>
<th></th>
<th>$204,500</th>
</tr>
</thead>
<tbody>
<tr>
<td>(ASSETS ($214,500) = EQUITIES ($204,500))</td>
<td></td>
<td>$204,500</td>
</tr>
</tbody>
</table>
**FIGURE 9**

**TECH AIRWAYS INC.**

Balance Sheet as of June 30, 1973

<table>
<thead>
<tr>
<th>ASSETS</th>
<th>EQUITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current Assets:</strong></td>
<td><strong>EQUITIES:</strong></td>
</tr>
<tr>
<td>Cash $59,500 - $25,000 Dividends</td>
<td>Accrued Expenses $2,000</td>
</tr>
<tr>
<td>Marketable Securities $15,000 = $17,500 Cash</td>
<td>Deferred Income 2,500</td>
</tr>
<tr>
<td>Accounts Receivable 25,000</td>
<td>Estimated Taxes $40,000</td>
</tr>
<tr>
<td>Inventory 5,000</td>
<td></td>
</tr>
<tr>
<td>Prepaid Expense</td>
<td></td>
</tr>
<tr>
<td>Fuel 20,000</td>
<td></td>
</tr>
<tr>
<td>Insurance $2,500</td>
<td></td>
</tr>
<tr>
<td><strong>Total Current Assets $129,500</strong></td>
<td><strong>Total Current Liabilities $44,500</strong></td>
</tr>
<tr>
<td><strong>Fixed Assets:</strong></td>
<td>Other Liabilities:</td>
</tr>
<tr>
<td>Airplane (Depreciation $60,000)</td>
<td>Aircraft Mortgage $50,000</td>
</tr>
<tr>
<td>Airplane 10,000</td>
<td>Bonds Outstanding 20,000</td>
</tr>
<tr>
<td>Hanger 10,000</td>
<td><strong>Total Other Liabilities $70,000</strong></td>
</tr>
<tr>
<td><strong>Total Fixed Assets $90,000</strong></td>
<td>Stockholders' Equity:</td>
</tr>
<tr>
<td></td>
<td>Common Stock $35,000</td>
</tr>
<tr>
<td></td>
<td>Retained Earnings $100,000 $16,500</td>
</tr>
<tr>
<td></td>
<td>Capital Surplus 5,000</td>
</tr>
<tr>
<td></td>
<td><strong>Total Stockholders' Equity $140,000</strong></td>
</tr>
<tr>
<td>Other Assets:</td>
<td><strong>Total Equities $214,500</strong></td>
</tr>
<tr>
<td>Goodwill $5,000</td>
<td></td>
</tr>
<tr>
<td><strong>Total Other Assets $5,000</strong></td>
<td></td>
</tr>
<tr>
<td><strong>Total Assets $214,500</strong></td>
<td></td>
</tr>
<tr>
<td><strong>$171,000</strong></td>
<td><strong>EQUITIES ($214,500)</strong></td>
</tr>
</tbody>
</table>

(ASSETS ($214,500) = EQUITIES ($214,500))
### FIGURE 10

#### BALANCE SHEET CLASSIFICATIONS

<table>
<thead>
<tr>
<th>Name of account</th>
<th>Operating</th>
<th>Nonoperating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Special deposits</td>
<td>1101</td>
<td>1701</td>
</tr>
<tr>
<td>United States Government securities</td>
<td>1102</td>
<td>1702</td>
</tr>
<tr>
<td>Accounts receivable—debt due from agents</td>
<td>1103</td>
<td>1703</td>
</tr>
<tr>
<td>Notes and accounts receivable—debt due from agents</td>
<td>1104</td>
<td>1704</td>
</tr>
<tr>
<td>Reserve for depreciation—aircraft</td>
<td>1105</td>
<td>1705</td>
</tr>
<tr>
<td>Reserve for depreciation—aircraft equipment</td>
<td>1106</td>
<td>1706</td>
</tr>
<tr>
<td>Reserve for depreciation—communication and navigational equipment</td>
<td>1107</td>
<td>1707</td>
</tr>
<tr>
<td>Reserve for depreciation—miscellaneous items</td>
<td>1108</td>
<td>1708</td>
</tr>
<tr>
<td>Reserve for depreciation—improvements of leased equipment</td>
<td>1109</td>
<td>1709</td>
</tr>
<tr>
<td>Reserve for depreciation—miscellaneous items</td>
<td>1110</td>
<td>1710</td>
</tr>
<tr>
<td>Reserve for depreciation—miscellaneous items</td>
<td>1111</td>
<td>1711</td>
</tr>
<tr>
<td>Reserve for depreciation—miscellaneous items</td>
<td>1112</td>
<td>1712</td>
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<tr>
<td>Reserve for depreciation—miscellaneous items</td>
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<td>1713</td>
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<tr>
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<td>1714</td>
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<tr>
<td>Reserve for depreciation—miscellaneous items</td>
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<td>1715</td>
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<tr>
<td>Reserve for depreciation—miscellaneous items</td>
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<td>1716</td>
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<tr>
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<td>1719</td>
</tr>
<tr>
<td>Reserve for depreciation—miscellaneous items</td>
<td>1120</td>
<td>1720</td>
</tr>
<tr>
<td>Reserve for depreciation—miscellaneous items</td>
<td>1121</td>
<td>1721</td>
</tr>
<tr>
<td>Reserve for depreciation—miscellaneous items</td>
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<td>1722</td>
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<td>Reserve for depreciation—miscellaneous items</td>
<td>1123</td>
<td>1723</td>
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<tr>
<td>Reserve for depreciation—miscellaneous items</td>
<td>1124</td>
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<td>Reserve for depreciation—miscellaneous items</td>
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<td>1725</td>
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<td>Reserve for depreciation—miscellaneous items</td>
<td>1126</td>
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<tr>
<td>Reserve for depreciation—miscellaneous items</td>
<td>1127</td>
<td>1727</td>
</tr>
<tr>
<td>Reserve for depreciation—miscellaneous items</td>
<td>1128</td>
<td>1728</td>
</tr>
<tr>
<td>Reserve for depreciation—miscellaneous items</td>
<td>1129</td>
<td>1729</td>
</tr>
<tr>
<td>Reserve for depreciation—miscellaneous items</td>
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<td>1730</td>
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<td>Reserve for depreciation—miscellaneous items</td>
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<td>Reserve for depreciation—miscellaneous items</td>
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<td>Reserve for depreciation—miscellaneous items</td>
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<td>Reserve for depreciation—miscellaneous items</td>
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<td>1734</td>
</tr>
<tr>
<td>Reserve for depreciation—miscellaneous items</td>
<td>1135</td>
<td>1735</td>
</tr>
<tr>
<td>Reserve for depreciation—miscellaneous items</td>
<td>1136</td>
<td>1736</td>
</tr>
<tr>
<td>Reserve for depreciation—miscellaneous items</td>
<td>1137</td>
<td>1737</td>
</tr>
<tr>
<td>Reserve for depreciation—miscellaneous items</td>
<td>1138</td>
<td>1738</td>
</tr>
</tbody>
</table>

#### BALANCE SHEET CLASSIFICATIONS—Continued

<table>
<thead>
<tr>
<th>Name of account</th>
<th>Operating</th>
<th>Nonoperating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common stock</td>
<td>2101</td>
<td>2701</td>
</tr>
<tr>
<td>Preferred stock</td>
<td>2102</td>
<td>2702</td>
</tr>
<tr>
<td>Paid-in capital</td>
<td>2103</td>
<td>2703</td>
</tr>
<tr>
<td>Retained earnings</td>
<td>2104</td>
<td>2704</td>
</tr>
<tr>
<td>Treasury stock</td>
<td>2105</td>
<td>2705</td>
</tr>
</tbody>
</table>

### Footnotes
1. For Group II and Group III air carriers only.
2. At the option of the air carrier these accounts may be assigned numbers 2000 and 2500, respectively, for accounting purposes.
Continental Airlines, Inc.

Balance Sheet December 31, 1968 with comparative figures for 1967

<table>
<thead>
<tr>
<th>Assets</th>
<th>1968</th>
<th>1967</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current assets:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cash</td>
<td>$17,063,705</td>
<td>$12,463,157</td>
</tr>
<tr>
<td>United States Government and other</td>
<td>2,019,632</td>
<td>16,795,068</td>
</tr>
<tr>
<td>securities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Accounts receivable:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>United States Government</td>
<td>5,268,613</td>
<td>6,431,548</td>
</tr>
<tr>
<td>Airline traffic</td>
<td>14,405,401</td>
<td>11,123,574</td>
</tr>
<tr>
<td>Other, net</td>
<td>2,564,214</td>
<td>2,420,810</td>
</tr>
<tr>
<td>Total accounts receivable</td>
<td>22,258,228</td>
<td>18,978,930</td>
</tr>
<tr>
<td>Spare parts and supplies, at average cost</td>
<td>11,602,801</td>
<td>8,808,278</td>
</tr>
<tr>
<td>Prepaid expenses</td>
<td>3,014,443</td>
<td>926,768</td>
</tr>
<tr>
<td>Total current assets</td>
<td>35,358,869</td>
<td>55,742,399</td>
</tr>
<tr>
<td><strong>Investments and special funds:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Advance payments on equipment purchase contracts (note 5)</td>
<td>14,439,276</td>
<td>32,899,273</td>
</tr>
<tr>
<td>Investment in subsidiaries and affiliates, at cost</td>
<td>3,984,760</td>
<td>3,540,310</td>
</tr>
<tr>
<td>Other investments and deposits</td>
<td>2,010,427</td>
<td>1,389,558</td>
</tr>
<tr>
<td>Total investments and special funds</td>
<td>20,434,463</td>
<td>37,823,141</td>
</tr>
<tr>
<td><strong>Property and equipment, at cost (note 1):</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Flight equipment</td>
<td>323,554,928</td>
<td>208,717,681</td>
</tr>
<tr>
<td>Less accumulated depreciation</td>
<td>58,690,271</td>
<td>37,864,497</td>
</tr>
<tr>
<td>Flight equipment, net</td>
<td>264,864,657</td>
<td>170,853,184</td>
</tr>
<tr>
<td>Other property and equipment</td>
<td>47,420,872</td>
<td>26,012,781</td>
</tr>
<tr>
<td>Less accumulated depreciation</td>
<td>13,593,176</td>
<td>10,636,234</td>
</tr>
<tr>
<td>Other property and equipment, net</td>
<td>33,827,696</td>
<td>18,176,547</td>
</tr>
<tr>
<td>Construction in progress</td>
<td>935,556</td>
<td>6,115,712</td>
</tr>
<tr>
<td>Net property and equipment</td>
<td>299,627,711</td>
<td>194,045,443</td>
</tr>
</tbody>
</table>

**Deferred charges:**

- Contribution to the development of supersonic aircraft, net of amortization, $600,000
- Other

Total deferred charges

<table>
<thead>
<tr>
<th>Liabilities and Stockholders' Equity</th>
<th>1968</th>
<th>1967</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Current liabilities:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Long-term debt, portion due within one year</td>
<td>$22,694,131</td>
<td>$9,131,722</td>
</tr>
<tr>
<td>Accounts payable:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>General</td>
<td>10,532,205</td>
<td>11,584,054</td>
</tr>
<tr>
<td>Transportation taxes and payroll deductions</td>
<td>8,364,589</td>
<td>7,491,016</td>
</tr>
<tr>
<td>Total accounts payable</td>
<td>21,748,716</td>
<td>20,074,961</td>
</tr>
<tr>
<td>Accrued liabilities</td>
<td>5,256,556</td>
<td>4,278,505</td>
</tr>
<tr>
<td>Federal income taxes</td>
<td>690,635</td>
<td>498,549</td>
</tr>
<tr>
<td>Unearned transportation revenue</td>
<td>1,385,399</td>
<td>785,320</td>
</tr>
<tr>
<td>Total current liabilities</td>
<td>31,384,667</td>
<td>26,238,726</td>
</tr>
<tr>
<td>Long-term debt, less portion due within one year (note 2)</td>
<td>219,832,298</td>
<td>151,265,390</td>
</tr>
<tr>
<td>Reserve for overhaul of flight equipment, net</td>
<td>8,607,328</td>
<td>7,305,223</td>
</tr>
<tr>
<td>Deferred income taxes</td>
<td>10,340,723</td>
<td>6,630,406</td>
</tr>
<tr>
<td>Unamortized investment tax credits (note 3)</td>
<td>9,737,975</td>
<td>11,061,076</td>
</tr>
<tr>
<td>Other deferred credits and non-current liabilities</td>
<td>1,400,862</td>
<td>1,467,733</td>
</tr>
<tr>
<td><strong>Stockholders' equity:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Common stock of $0.50 par value per share, Authorized 15,000,000 shares; issued 10,050,967 shares, 1966; 10,015,907 shares, 1967 (notes 2 and 4)</td>
<td>5,025,434</td>
<td>5,007,933</td>
</tr>
<tr>
<td>Capital in excess of par value</td>
<td>18,848,260</td>
<td>18,848,260</td>
</tr>
<tr>
<td>Retained earnings (note 2)</td>
<td>54,421,397</td>
<td>54,327,353</td>
</tr>
<tr>
<td>Total stockholders' equity</td>
<td>77,266,256</td>
<td>75,143,558</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>1968</th>
<th>1967</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current assets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total accounts receivable</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total current assets</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Liabilities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total liabilities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stockholders' equity</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$379,526,918 $291,231,233
classifications, the accounts have been condensed for ease of reading by the stockholders.

THE INCOME STATEMENT

Before the Income Statement can be explained, a few more accounting concepts must be mentioned.

The Accounting Period

The Balance Sheet reflects the status of a business at a point in time. Balance Sheets are prepared on a periodic basis, usually once per year. This is called the Accounting Period. The Income Statement reports flows during the Accounting Period rather than status at a point in time. Since management needs information updated more frequently than annually, there may be "interim" reports prepared at the required time intervals.

The Accrual Concept

Income is associated with a change in Stockholders' Equity and not necessarily with changes in the cash account of the business. In our earlier example, one of the transactions was the sale of $100 worth of snacks for $200. Since the business did not incur additional liability by the sale, the changes in assets must be balanced by changes in the Stockholders' Equity. When the Cash Account is increased by $200, Stockholders' Equity is increased by the same amount. Likewise, Stockholders' Equity
is decreased by $100 to offset the removal of $100 worth of goods from the Inventory Account.

Any increase in the Stockholders' Equity from the operation of the business is called "revenue." Any decrease is an "expense." "Income" is the excess of revenue over expenses. If expenses are greater than revenue there is a "loss". The sale of the snacks thus represented $200 of revenue, $100 worth of expenses and $100 income. The cash change and the income are not the same.

1. **Expense vs. Expenditure** - An Expenditure occurs when an asset is obtained either by the payment of cash, by the exchange of another asset or by the assumption of an additional liability. An Expense arises when an asset is used up and reflects a corresponding decrease in Stockholders' Equity. When $5,000 cash is used to purchase an inventory of snacks, there is an "Expenditure" of one asset for another -- cash for inventory. There is no "Expense" since there is no change in equity. When $100 worth of snacks are removed from inventory, there is no "Expenditure" since no new asset is acquired. However, there is an "Expense" since the decrease in assets must be reflected by a decrease in Stockholders' Equity Account.

2. **Revenue vs. Receipts** - A "Revenue" arises when Stockholders' Equity increases. A "Receipt" occurs when one asset is received in place of another. When an air ticket is sold on
credit, Accounts Receivable are increased. This is a "Revenue" since Stockholders' Equity is increased by a corresponding amount. When the obligation is paid, there is a "Receipt" but no "Revenue" since equity stays the same. The only transaction is an increase in Cash offset by a decrease in Accounts Payable.

The Accrual Concept holds that income is measured as the difference between revenues and expenses and not between receipts and expenditures.

**The Realization Concept**

The Realization Concept is closely connected with the Actual Concept. Broadly stated, a revenue is recognized when it is realized, that is when the product is delivered or the service performed. The revenue and expense accounts are updated, not when the contract is signed or the goods manufactured, but when the actual transfer of value takes place.

Since the Accrual Concept requires revenues and expenses to be compared, expenses are recognized in the same accounting period that the revenue arises. (The Matching Principle) Thus, the costs of manufacturing an item for inventory are not expenses until the item is sold. They are then recorded as "Cost of Goods Sold."

Some expenses cannot be connected to a particular revenue transaction. These are entered into the accounts during the
period when they are incurred—which is not necessarily when they are actually paid for.

Figures 12 and 13 demonstrate these principles. In the first transaction, goods manufactured in January are sold on credit in February, and actually paid for in March. Following the principles outlined, all bookkeeping entries are made in February, the month when the goods were transferred.

In the second case (Figure 13), the goods are paid for in advance in January, and manufactured in February. But all bookkeeping entries are made in March when actual transfer takes place.

The Income Statement

The Income Statement (or Profit and Loss Statement or Statement of Earnings) reports on the revenues and expenses which have accrued during the accounting period. Normally, the preceding year's information is also given for comparison purposes. Figure 14 shows a sample of a carrier statement of Earnings from an annual report. Like the Balance Sheet shown in Figure 11, the major categories follow the Civil Aeronautics Board regulations, but the subaccounts have been condensed and show less detail than the statements filed with the Board.
**ACCRUAL CONCEPT**

<table>
<thead>
<tr>
<th>JAN.</th>
<th>FEB.</th>
<th>MARCH</th>
</tr>
</thead>
<tbody>
<tr>
<td>GOODS MANUFACTURED</td>
<td>GOODS SOLD ON CREDIT</td>
<td>CREDIT PAID</td>
</tr>
</tbody>
</table>

- **REVENUE ACCOUNTED FOR IN FEBRUARY** (ACCURAL CONCEPT)
- **EXPENSES ACCOUNTED FOR IN FEBRUARY** (MATCHING PRINCIPLE)
## ACCRUAL CONCEPT

<table>
<thead>
<tr>
<th>JAN.</th>
<th>FEB.</th>
<th>MARCH</th>
</tr>
</thead>
<tbody>
<tr>
<td>CASH PAID IN ADVANCE</td>
<td>GOODS MANUFACTURED</td>
<td>GOODS DELIVERED</td>
</tr>
</tbody>
</table>

- Revenue accounted for in March (Accrual Concept)
- Expenses accounted for in March (Matching Principle)
### Continental Air Lines, Inc.

**Statement of Earnings**

Year ended December 31, 1968 with comparative figures for 1967

<table>
<thead>
<tr>
<th></th>
<th>1968</th>
<th>1967</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Operating revenues:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Passenger</td>
<td>$138,769,984</td>
<td>$107,101,678</td>
</tr>
<tr>
<td>Mail</td>
<td>2,689,949</td>
<td>2,155,930</td>
</tr>
<tr>
<td>Express</td>
<td>713,771</td>
<td>663,806</td>
</tr>
<tr>
<td>Freight</td>
<td>6,354,749</td>
<td>5,038,256</td>
</tr>
<tr>
<td>Excess baggage</td>
<td>266,140</td>
<td>178,655</td>
</tr>
<tr>
<td>Aircraft interchange rentals, net</td>
<td>-</td>
<td>45,200</td>
</tr>
<tr>
<td>Charter and contract services</td>
<td>57,865,758</td>
<td>71,263,689</td>
</tr>
<tr>
<td>Miscellaneous, net</td>
<td>1,534,240</td>
<td>1,700,627</td>
</tr>
<tr>
<td><strong>Total operating revenue</strong></td>
<td>$208,194,591</td>
<td>$188,167,841</td>
</tr>
</tbody>
</table>

| **Operating expenses:** |                 |                 |
| Flying operations      | 54,410,014      | 44,367,712      |
| Ground operations      | 23,174,429      | 20,083,117      |
| Maintenance and repairs| 37,045,607      | 31,081,921      |
| Passenger service      | 21,662,004      | 17,995,883      |
| Reservations and sales | 10,922,710      | 8,204,667       |
| Advertising and publicity | 8,397,102      | 5,017,587       |
| General and administrative | 9,262,464      | 8,004,931       |
| Depreciation and amortization | 28,367,869     | 21,028,121      |
| **Total operating expenses** | $193,242,199    | $155,783,939    |
| **Operating income**   | $14,952,392     | $32,383,902     |

| **Non-operating expenses and income:** |                 |                 |
| Interest expense        | 10,129,202      | 6,208,524       |
| Other, net              | (275,598)       | (327,624)       |
| **Total non-operating expenses and income** | $9,853,604      | $5,880,900      |

| Earnings before Federal and State income taxes and extraordinary items | 5,098,788 | 26,503,002 |
| Federal and State income taxes | 966,684 | 11,572,061 |
| **Earnings before extraordinary items** | 4,132,104 | 14,930,941 |

**Extraordinary items — gains on major dispositions of flight equipment, less income taxes, $2,329,407**

Net earnings | $4,132,104 | $17,307,407 |

**Net earnings per share of common stock:**

| Before extraordinary items | $0.41 | $1.49 |
| Extraordinary items | - | 0.24 |
| **Total** | $0.41 | $1.73 |

- 32 -
FUNDS FLOW STATEMENTS

Funds can be defined in general terms as economic values, or in specific terms as cash. The latter is a subset of the former. The balance sheet shows the financial position of the firm at a gross point in time and reflects the firm's investments (assets) and the claims against it (equities). In general the assets side of the balance sheet shows how funds have been used, while the equities side reflects their source.

The Funds Flow Concept

An understanding of the flow of funds through the business enterprise is essential to sound financial management and proper allocation of available resources. The financial manager must know where he can obtain funds on the best terms and how to allocate them within his company to maximize the return on the investment.

The process of funds flow analysis compares two successive balance sheets. The differences between individual accounts shows the flows of funds resulting from management decisions. Analysis will indicate where management has decided to connect funds (uses), to liquidate assets (sources), to acquire additional funds (sources), and to reduce claims against the firm (uses).
Circulating Capital and Working Capital

Figure 15 shows day to day cycle of funds flow in a company. Sales are made from inventory. In return, the company receives either a direct cash payment, or extends credit which is shown as an addition to Accounts Receivable. In turn, the company buys supplies to produce more inventory. It makes cash payments or shows its debts in Accounts Payable. Eventually, cash transfers occur that close out either Accounts Receivable or Payable.

This process is on a continuous state of flux. For some purposes, it is easier to lump current assets and current liabilities and refer to these accounts as the "Circulating Capital" of the firm. The difference between the current assets and current liabilities of the firm is referred to as "Working Capital" and is an important indicator of the firm's ability to meet short term obligations.

Cash Flow Statement

A Cash Flow Statement is a detailed breakdown of the changes in Working Capital. In particular, it concentrates on those transactions that affect the Cash Account. Figure 16 shows these various transactions grouped as operational transactions that arise from the day to day business; financial transactions that raise funds and retire debts; and other transactions. The latter includes discretionary transactions not necessary to the operation or regular finances of the firm.
CIRCULATING CAPITAL FLOW

CUSTOMER
  ACCOUNTS PAYABLE

COMPANY
  INVENTORY
  CASH
  ACCOUNTS RECEIVABLE

CREDITOR
  ACCOUNTS RECEIVABLE

SALES
SUPPLIES
PAYMENT
CREDIT
BILLINGS
The Funds Flow Statement

The Funds Flow Statement concentrates on the sources and uses of capital in a more aggregate sense. Rather than concentrating on fluctuations in working capital, it reflects changes in long term capital commitments in both the assets and equities of the firm. Only the net change in working capital over the accounting period is shown.

Figure 17 shows a typical funds flow statement. Sources of funds come from increase in equities, (e.g., issue of new stock) or decreases in assets (e.g., depreciation). The uses of funds decrease equities (e.g., retirement of bonds), or increase assets (e.g., purchase of aircraft). Since the dual aspect concept requires assets and equities to balance, sources must equal uses, or

\[
\text{Equity Increases} + \text{Asset Decreases} = \text{Equity Decreases} + \text{Asset Increases}
\]

Figure 18 diagrams the Funds Flow Concept.
FIGURE 17

ABC INC.
FUNDS FLOW STATEMENT

YEAR ENDED JUNE 30, 1972

SOURCES OF FUNDS:

<table>
<thead>
<tr>
<th>Source</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net Income</td>
<td>$20,000</td>
</tr>
<tr>
<td>Add back: Depreciation</td>
<td>$6,000</td>
</tr>
<tr>
<td>Funds from operations</td>
<td>$26,000</td>
</tr>
<tr>
<td>Capital stock issued</td>
<td>$20,000</td>
</tr>
<tr>
<td>Bonds issued</td>
<td>$10,000</td>
</tr>
<tr>
<td><strong>Total funds acquired</strong></td>
<td><strong>$56,000</strong></td>
</tr>
</tbody>
</table>

USES OF FUNDS:

<table>
<thead>
<tr>
<th>Use</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purchase of hanger</td>
<td>$10,000</td>
</tr>
<tr>
<td>Purchase of aircraft</td>
<td>$10,000</td>
</tr>
<tr>
<td>Retirement of bonds</td>
<td>$10,000</td>
</tr>
<tr>
<td>Cash dividends paid</td>
<td>$10,000</td>
</tr>
<tr>
<td>Net addition to working capital</td>
<td>$16,000</td>
</tr>
<tr>
<td><strong>Total uses</strong></td>
<td><strong>$56,000</strong></td>
</tr>
</tbody>
</table>

SCHEDULE OF WORKING CAPITAL CHANGES

<table>
<thead>
<tr>
<th></th>
<th>1971</th>
<th>1972</th>
<th>Increase (Decrease)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current assets</td>
<td>100,000</td>
<td>98,000</td>
<td>(2,000)</td>
</tr>
<tr>
<td>Current liabilities</td>
<td>50,000</td>
<td>32,000</td>
<td>18,000*</td>
</tr>
<tr>
<td>Working capital</td>
<td>______</td>
<td>______</td>
<td><strong>$16,000</strong></td>
</tr>
</tbody>
</table>

*NOTE: Since a decrease in liabilities is an increase in working capital, it is shown as an increase and not a decrease as it would on a comparative balance sheet.
SOURCES AND USES OF FUNDS

INTERNAL
- RETAINED EARNINGS
- DEPRECIATION AND AMORTIZATION
- INVESTMENT TAX CREDIT
- INVESTMENT TAX CREDIT LEASE
- DECREASE WORKING CAPITAL
- SALE OF FIXED ASSETS
- PURCHASE OF FIXED ASSETS
- INCREASE OTHER ASSETS
- INCREASE WORKING CAPITAL (ACQUIRE CURRENT ASSETS)
- INCREASE WORKING CAPITAL (DECREASE CURRENT LIABILITIES)

EXTERNAL
- EQUITY
  - COMMON STOCK
  - PREFERRED STOCK
- CONVERTIBLE DEBT
- STRAIGHT DEBT
  - LONG TERM NOTES
  - SUBORDINATE DEBENTURES
  - REVOLVING BANK CREDIT
  - EQUIPMENT INSTALLMENT LOANS
- RETURN CAPITAL
- PAY DIVIDENDS
- DECREASE LONG TERM DEBT
Sources and uses of funds can be divided into "internal" and "external" categories. External transactions affect the relationships between the firm and other parties. The firm incurs debt from lenders, it makes payments to its shareholders, etc. In contrast, internal transactions depend solely on management decisions and do not affect liability to outside parties. For example, management can decide to use cash to purchase assets. This does not affect the external debts of the firm.

Most categories of Figure 18 are self-explanatory. However, some need further clarification.

Internal Sources

1. **Depreciation and Amortization.** Many assets are used for years after they are paid for. It is common practice to spread the cost over the entire lifetime rather than show a one-time large expense. In fact, tax laws require a long term write off in many instances. But, in fact, payment has already been made. So when depreciation or amortization appears as an expense, it does not actually represent a funds outlay. So these amounts which lower accounting income (profits) must be added to other sources of funds to see how much is actually available for use. (See figure 17).
Depreciation refers to the write off of tangible assets such as flight or group equipment, while Amortization applies to the write off of intangibles such as pilot training or good will. Together, depreciation and amortization amount to almost 40% of the total financial resources of major U.S. carriers in 1969.

The straight-line method is used by almost all of the major U.S. airlines to depreciate their flight equipment for bookkeeping purposes. The residual value and the period of depreciation varies within the range of 10-15% and 10-15 years. Recently some of the carriers have increased the depreciable life of their flight equipment for several reasons: first, certain aircraft have longer useful lives than was first assumed; second, an increase in the depreciable life improves reported earnings in future years since from an accounting point of view, it costs the carrier less to provide the same service; and third, the resulting short term higher profits can be offset against the carrier's accumulated investment tax credits.

For tax purposes, major airlines use accelerated depreciation in their accounting for the Internal Revenue Service. A typical accelerated depreciation is the double declining balance method. The carriers depreciate their assets over 8 years to a 5% residual value. During the early years, a greater proportion of the asset is expended on the books kept for tax purposes than in
METHODS OF DEPRECIATION
STRAIGHT LINE VS. DOUBLE DECLINING BALANCE

REPORTED VALUE OF ASSETS

STRAIGHT LINE

DDB

YEARS
those kept for the general operations the stockholders reports, which use a straight line method. This insures that the income, as reported to IRS, is lower and hence the taxes actually paid are less than those stated in the stockholders reports. Later on, the trend reverses, and more taxes have to be paid than reported to the stockholders. This eventuality is provided for by the liability account "deferred taxes." (See figure 19). Under this system, a carrier has the use of the cash credited to Deferred Taxes until that cash is actually needed. However, since fleet acquisition is a continuous process, deferred taxes are a relatively permanent source of funds for the industry.

In cases where there are no before-tax-profits, or actual before tax losses, there would be no expense. Consequently there would be no difference between publicly reported tax payments and actual IRS tax liability. In this case, therefore, no deferred tax "source" of funds. Unless there are profits, there will be no deferred tax "source."

(In the case of an actual loss, there could be a tax loss credit that could be used to offset future tax liability but only if and when there are positive earnings.) In addition to tax and internal depreciation methods, a third scheme is imposed by the Civil Aeronautics Board for rate-making purposes. When the Board computes the rate of return on investment, it uses a straight line method to determine the investment value of the equipment
(owned by the carrier. Table 1 shows the service life and residual values used by the Board).

2. Investment Tax Credit - The investment tax credit was initiated in 1962 to provide an incentive for the industry to modernize its facilities through the purchase of capital equipment. Carriers were allowed to claim a tax deduction of up to 7% of their investment in qualifying property. The qualifications were: first, the property had to be tangible, depreciable and have a useful life of at least four years; and second, the property had to be placed in service during the year in which the tax credit was claimed. The credit is 7% on assets with useful lives of at least 8 years, 4.7% for assets having useful lives of 6 to 7 years, and 2.3% for assets with a 4 to 5 year useful life.

Up until October 10, 1966, when the ITC was suspended for 5 months, the tax deduction could be used to offset tax liability dollar-for-dollar for the first $25,000, but only at 25¢ to the dollar above that level. Unused credits could be carried back 3 years and forward five. On March 10, 1967, the ITC was restored with expanded provisions. Effective January 1, 1968, the limit on the amount of tax liability that could be offset above $25,000 was raised from 25 to 50 ¢ on the dollar and the carry-forward period was extended to seven years.
TABLE 1

FLIGHT EQUIPMENT DEPRECIATION AND RESIDUAL VALUES
AS SET BY THE CAB FOR RATE-MAKING PURPOSES

<table>
<thead>
<tr>
<th></th>
<th>SERVICE LIFE</th>
<th>RESIDUAL VALUE AS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>IN YEARS</td>
<td>% OF COST</td>
</tr>
<tr>
<td><strong>TURBO-FAN EQUIPMENT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-ENGINE</td>
<td>14</td>
<td>2</td>
</tr>
<tr>
<td>3-ENGINE</td>
<td>14</td>
<td>2</td>
</tr>
<tr>
<td>2-ENGINE</td>
<td>14</td>
<td>2</td>
</tr>
<tr>
<td><strong>TURBO-JET EQUIPMENT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-ENGINE</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>2-ENGINE</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td><strong>TURBO-PROP EQUIPMENT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-ENGINE</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>2-ENGINE</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td><strong>WIDE-BODY EQUIPMENT</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4-ENGINE</td>
<td>14</td>
<td>10</td>
</tr>
<tr>
<td>3-ENGINE</td>
<td>16</td>
<td>10</td>
</tr>
</tbody>
</table>

SOURCE: CAB, "PART 399 - STATEMENTS OF GENERAL POLICY: TREATMENT OF FLIGHT EQUIPMENT DEPRECIATION AND RESIDUAL VALUES FOR RATE PURPOSES," APRIL 9, 1971
There are two options for handling investment tax credits. The first is the "flow-through" method that allows the entire amount of the credit to be taken in the year the capital expenditures are made. The second is "service-life flow-through" which reduces the tax liability over the service lives of the related assets. The first method concentrates the full effect of the credit in one year, while the "service-life" method provides for a more even distribution.

The investment tax credit can only be used if there is tax liability. Whereas the 25% limitation prevented full utilization of the ITC before 1966, in recent years the downward trend in profits has limited its usefulness.

Table 2 summarizes the major internal sources of funds for the major U. S. carriers, and their amounts.

External Sources

1. **Straight Debt** - There are four basic types of straight debt financing employed by the airlines: long-term notes, subordinated debentures, revolving credit and equipment installment loans.

   1.1 **Long Term Notes**

   Senior long term notes are by far the most widely used debt instruments in the airline industry. They are typically sold to institutional investors (banks and insurance companies) and have
### TABLE 2

**INTERNAL SOURCES OF FUNDS**  
**MAJOR U.S. AIR CARRIERS - 1969**

<table>
<thead>
<tr>
<th>SOURCE</th>
<th>FUNDS ($MILLIONS)</th>
<th>PERCENTAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>EARNINGS AFTER TAXES BUT BEFORE ITC</td>
<td>318</td>
<td>21.1</td>
</tr>
<tr>
<td>DEPRECIATION &amp; AMORTIZATION</td>
<td>808</td>
<td>53.7</td>
</tr>
<tr>
<td>DEFERRED TAXES</td>
<td>341</td>
<td>22.7</td>
</tr>
<tr>
<td>INVESTMENT TAX CREDIT</td>
<td>37</td>
<td>2.5</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>1504</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>

**SOURCE:** ATA, "MAJOR U.S. AIRLINES, ECONOMIC REVIEW AND FINANCIAL OUTLOOK", JUNE, 1969
maturities of 20 to 40 years. Some of these notes are secured by specific equipment pledged as collateral. Holders of unsecured notes have priority against unpledged assets of the carrier in case of bankruptcy, but no specific assets are mentioned in the terms of the loan agreement. All long term notes have indentures specifying the details to the financial agreement, and any protective covenants that exist.

1.2. **Subordinated Debentures**

A subordinated debenture is an unsecured debt. In the event of liquidation, the holder has a claim on the assets left after the unsubordinated or senior debt is satisfied. Banks and insurance companies supplying senior debt often require subordination of other debts in order to protect their investment. In contrast to senior debt subordinated debentures are often sold in the securities markets in comparatively small denominations ($1000).

1.3. **Revolving Credit**

Revolving credit loans are short term credit arrangements between the carrier and bank or group of banks. The financial source guarantees that it will provide up to some amount of dollars to the carrier on demand. In return, the carrier may pay a basic service charge, or more often, a premium rate for the funds it actually uses.
1.4. **Equipment Installment Loans**

Equipment installment loans are similar to automobile financing arrangements. They provide the smallest contribution to the air carriers' debt. These notes represent the willingness of the various manufacturers to participate in the financing of equipment orders and are usually secured by the equipment purchased.

2. **Equity** - In equity financing, the carrier sells additional shares in its own ownership through the issuance of preferred or common stock.

2.1. **Preferred Stock**

Preferred stockholders usually have the first option on dividends when available, and a preference over the common shareholders if the company is liquidated. The disadvantages of holding preferred stocks are first, that the dividend, when paid, is usually fixed and not proportional to corporate profits; and second, that the preferred stock usually has no voting rights.

Unlike interest payments on debt, preferred stock dividends are not deductible from income before taxes which is one reason that it is seldom used by airlines today.

2.2. **Common Stock**

Common stock offers many advantages as a source of funds. First, there are no fixed charges, interest or dividends that
must be paid. Second, there is no maturity date when the debt must be retired. Third, common stock provides an "equity cushion" against losses for senior creditors since it is subordinate to their claims. Fourth, common stock may be more appealing than bonds to certain investor groups, since it has the potential of high dividends and rapid appreciation if the company is successful.

The disadvantages are that a new issue of common stock further divides ownership in the airline. Second, the new owners expect to share in the profits, which can put pressure on management to reduce retained earnings by dividend payments. Third, the cost of underwriting and distribution common stock is usually higher than for an equal dollar amount of bonds. Finally, like preferred stock, dividends paid are not deductible from pre-tax income.

3. Convertible Debt - A convertible debenture is a hybrid security having characteristics of both straight debt and common equity. It is issued as a subordinate debenture carrying a fixed interest provision. In addition, the holder is given the option of converting his debenture into a specified number of shares of the airline's common stock at a specified price (usually considerably above the present market price of the common stock). Because
of the conversion privilege with its potential for capital appreciation, the bond carries a lower interest rate than comparable straight debt obligations. (See Table 3). On the other hand, convertible debentures provide greater present income and security than common stock.

The airlines have found this type of financing very attractive. Since the debenture is a debt, interest payments are tax deductible until the bond is converted. Because of the conversion privilege, the airline can get a lower interest rate than if it were forced to use straight debt financing. And once conversion takes place, the carrier's obligation to pay interest and repay principle is over. The book value is shifted to the common equity account, reducing the carrier's debt/equity ratio which improves the chances of further borrowing on more favorable terms.

4. Investment Tax Credit Lease - A financial intermediary with a high marginal tax rate (usually a large commercial bank or a group of wealthy investors) purchases an aircraft and simultaneously leases it on a long term basis to an airline. Normally the intermediary itself provides only 20% of the aircraft's purchase price selling equipment trust certificates to finance the remaining 80%. In the event of default, the equipment trust certificates are secured by the aircraft in question which can be repossessed by the certificate holders. They do not have a claim against the
<table>
<thead>
<tr>
<th></th>
<th>CONVERTIBLE</th>
<th>NONCOVERTIBLE</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
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</tr>
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<td>4.71</td>
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<td>4.70</td>
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</tr>
<tr>
<td>NA</td>
<td>6.00</td>
<td>6.90</td>
<td>6.90</td>
</tr>
</tbody>
</table>

financial intermediary under these circumstances. Generally the trust certificates are purchased by a syndicate of life insurance companies or in some cases, a bank or a group of banks will simply pay the full price of the aircraft without creating the equipment trust at all.

By leasing the aircraft, the air carrier usually pays a lower effective interest rate. The rental payments need only cover the repayment (interest + principal) of the equipment trust certificates, which represent only 80% of the cost of the aircraft. (However, the airline has no claim to any residual value at the end of the lease). The intermediary, being the legal owner of the aircraft, receives the full investment tax credit and depreciation tax shield in return for his 20% investment. In addition, he gets title to the aircraft at the end of the lease, although the airline often has the option to purchase the airplane for its residual value.

Table 4 summarizes the major external sources of funds for the major U. S. carriers and their amounts, while Table 5 shows the capital structure of several specific airlines.
<table>
<thead>
<tr>
<th>EXTERNAL SOURCES OF FUNDS</th>
<th>FUND</th>
<th>PERCENTAGE</th>
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<tbody>
<tr>
<td>MAJOR U.S. AIR CARRIERS - 1969</td>
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<td></td>
</tr>
<tr>
<td>SENIOR DEBT</td>
<td>2626.6</td>
<td>39.3</td>
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<tr>
<td>REVOLVING CREDIT</td>
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<td></td>
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<tr>
<td>AVAILABLE 1710.0</td>
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<tr>
<td>USED 503.2</td>
<td>503.2</td>
<td>7.5</td>
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<td>STRAIGHT SUBORDINATED DEBT</td>
<td>153.3</td>
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<td>EQUIPMENT NOTES</td>
<td>108.7</td>
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<tr>
<td>CONVERTIBLE SUBORDINATED NOTES</td>
<td>1484.4</td>
<td>22.2</td>
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<td>ESTIMATED CAPITAL VALUE OF LEASED AIRCRAFT</td>
<td>1806.9</td>
<td>27.0</td>
</tr>
<tr>
<td>TOTAL IMPUTED DEBT</td>
<td>6683.1</td>
<td>100.0</td>
</tr>
<tr>
<td></td>
<td>TOTAL BOOK EQUITY</td>
<td>DEBT CONVERTIBLE</td>
</tr>
<tr>
<td>----</td>
<td>-------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>AA</td>
<td>403.3</td>
<td>282.8</td>
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<tr>
<td>EA</td>
<td>225.0</td>
<td>127.4</td>
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<tr>
<td>TW</td>
<td>361.8</td>
<td>250.0</td>
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<td>UA</td>
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<td>-0-</td>
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<td>NW</td>
<td>426.8</td>
<td>-0-</td>
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<tr>
<td>CO</td>
<td>96.3</td>
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</tr>
<tr>
<td>NA</td>
<td>130.5</td>
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### Components of Capital Structure as of 12/31/69 (%)

<table>
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<tr>
<th></th>
<th>TOTAL BOOK EQUITY</th>
<th>DEBT CONVERTIBLE</th>
<th>DEBT NONCONVERTIBLE</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>AA</td>
<td>37.2</td>
<td>26.1</td>
<td>36.7</td>
<td>62.8</td>
</tr>
<tr>
<td>EA</td>
<td>26.4</td>
<td>15.0</td>
<td>58.6</td>
<td>73.6</td>
</tr>
<tr>
<td>TW</td>
<td>32.3</td>
<td>22.3</td>
<td>45.7</td>
<td>67.7</td>
</tr>
<tr>
<td>UA</td>
<td>40.1</td>
<td>15.7</td>
<td>44.2</td>
<td>59.9</td>
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<tr>
<td>DL</td>
<td>50.5</td>
<td>-0-</td>
<td>49.5</td>
<td>49.5</td>
</tr>
<tr>
<td>NW</td>
<td>79.2</td>
<td>-0-</td>
<td>20.8</td>
<td>20.8</td>
</tr>
<tr>
<td>CO</td>
<td>32.5</td>
<td>11.8</td>
<td>55.7</td>
<td>67.5</td>
</tr>
<tr>
<td>NA</td>
<td>66.3</td>
<td>0.3</td>
<td>33.4</td>
<td>33.7</td>
</tr>
</tbody>
</table>

FINANCIAL RATIOS

The various financial statements discussed contain a great deal of information. A large amount of additional information can be gained by studying the relationships between the items in the basic statements. Financial analysts often find that these relationships are best expressed as ratios which provide additional insight into the operations of the firm. Ratios can also provide a method of quick analysis that isolates a problem area for further study.

Any ratio in itself is meaningless. There must be a standard of comparison. Often these standards are based on the historical trends of the firm. Often the performance of competing firms can be used. Other standards can be derived from industry performance, or performance of the economy as a whole. Another valuable source of comparison comes from the general background and experience of the analyst and his feelings for what various financial ratios ought to be.

Although innumerable ratios could be formed from the various items on the financial statements, several of particular value have been standardized through usage and experience. In general, these can be grouped into those that are useful in making short term financial decisions, long term financial decision and investment decisions. Ratios may also be an aide in evaluating management performance or market performance of a firm's stock.
Short Term

Before a financial source makes a short term loan, it must determine the liquidity of the firm - its ability to repay on a short term basis. The lender is not concerned with the overall assets of the firm, but with its ability to pay its bills without liquidating long term holdings. Some of the ratios commonly used to evaluate debt paying ability to potential creditors are:

1. **Current ratio** - The current ratio is a very rough measure of the ability to meet short term obligations. It is defined as current assets divided by current liabilities. As a rule of thumb for industry on the average, a healthy firm should have a current ratio of about 2 to 1. However, industries with a large fixed investment like utilities or hotels have satisfactory working capital at a current ratio of 1. The airlines typically have a current ratio of 1.2 to 1.5.

2. **Acid Test Ratio** - Since current assets include monitories which may be hard to sell in an emergency, the current ratio may not really reflect liquidity. The acid test ratio is often used as a better measure. It is defined as current assets minus monitories, divided by current liabilities. For an airline, it would be computed on the basis of current assets minus spare parts and supplies, and might run between .8 and 1.
3. **Cash and Equivalent Ratio** - This ratio only compares cash on hand and assets quickly convertible to cash (such as government securities) to current liabilities. This may be too extreme a measure of ability to repay a short term obligation since it is doubtful that all current liabilities would fall due at once. For an airline, this ratio might typically fall between .3 and .5.

**Long Term**

An investor who considers purchasing a long term obligation from an airline is not as concerned with liquidity as he is with his overall security. This is typically measured by the Debt Ratio, long term debt divided by stockholders equity. Table 6 shows typical debt ratios for the airlines and for other transportation firms. In general, the lower the ratio, the more secure the investment.

**Investment**

Investment in this context is the original purchase of stockholder's equity in the firm, contrasted with market transactions between stockholders. It applies to original issues only. In deciding whether or not to buy a new stock, the investor is concerned with the potential rate of return, and the risk involved.

Rate of return is a ratio of net income to total equity - that is, liabilities plus stockholder's equity. Tables 7 and 8 show
<table>
<thead>
<tr>
<th>INDUSTRY</th>
<th>RATIO</th>
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<tbody>
<tr>
<td>AIRLINES:</td>
<td></td>
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<tr>
<td>ALL TRUNKLINES</td>
<td>1.50</td>
</tr>
<tr>
<td>BIG 4 (AA, EA, TW, UA)</td>
<td>1.87</td>
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<tr>
<td>LITTLE 4 (CO, DL, NA, NW)</td>
<td>0.69</td>
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<tr>
<td>TRUCKING:</td>
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<tr>
<td>CONSOLIDATED FREIGHTWAYS</td>
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<tr>
<td>MCLEAN TRUCKING COMPANY</td>
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<td>RAILROADS:</td>
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<tr>
<td>PENN CENTRAL TRANSPORTATION COMPANY</td>
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<tr>
<td>CHESAPEAKE AND OHIO RAILWAY COMPANY</td>
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<tr>
<td>BUSSING:</td>
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</tr>
<tr>
<td>GREYHOUND</td>
<td>0.83</td>
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</table>

SOURCE: **MOODY'S TRANSPORTATION MANUAL** (NEW YORK, 1971) CAB
<table>
<thead>
<tr>
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</thead>
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<td>TOTAL TRUNKS, DOMESTIC</td>
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<td>5.28%</td>
<td>5.67%</td>
<td>8.85%</td>
<td>10.36%</td>
<td>12.04%</td>
<td>9.62%</td>
<td>4.20%</td>
<td>4.10%</td>
<td>1.46%</td>
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<td>7.48</td>
<td>9.76</td>
<td>7.79</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>15.9</td>
<td>15.7</td>
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<td>Domestic Trunklines*</td>
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<td>Publishing, Printing</td>
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<td>Measuring, Scientific, Photographic Equipment</td>
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<tr>
<td>Shipbuilding and Railroad Equipment</td>
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<td>14.4</td>
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<td>Appliances, Electronics</td>
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<td>13.3</td>
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</tr>
<tr>
<td>Motor Vehicles and Parts</td>
<td>11.6</td>
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<td>14.3</td>
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<td>Office Machinery (Includes Computers)</td>
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<td>9.1</td>
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<td>Paper and Wood Products</td>
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<td>10.4</td>
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<td>Glass, Cement, Gypsum, Concrete</td>
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<td>8.3</td>
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<tr>
<td><strong>All Industry</strong></td>
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<td><strong>11.3</strong></td>
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<td></td>
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</tbody>
</table>

* Approximate Values

rates of return for airlines and for various other industries over a several year period. An investor would be interested in both the trend and size of returns in the firm he is considering as well as what would be available to him from other firms in the same or other industries.

The mixture of debt and equity financing is very important in determining the risk. This is measured by the Debt Ratio previously mentioned. The ratio of debt to stockholder's equity determines the leverage of the firm. Leverage involves the use of borrowed funds in expectation that the earned rate of return will be higher than the cost of those funds.

Table 9 shows the effect of different debt ratios on the stockholder's return on investment. In all cases, a total investment of $1,000,000 and a 10% cost of servicing the debt is assumed. The higher the debt ratio, the more sensitive is the stockholder's return to the overall rate of return of the firm.

Management Performance Ratios

Financial ratios can be used to compare the effectiveness of management. The better the management, the more profits it can make on the investment and the lower the expenses with respect to revenues. Table 10 shows some of the ratios used to evaluate management performance and some typical values for the airline industry.


<table>
<thead>
<tr>
<th>TOTAL INVESTMENT</th>
<th>DEBT RATIO</th>
<th>DEBT</th>
<th>SHAREHOLDERS EQUITY</th>
<th>RATE OF RETURN</th>
<th>NET INCOME BEFORE INTEREST</th>
<th>INTEREST (at 10%)</th>
<th>NET INCOME</th>
<th>RETURN ON STOCKHOLDERS EQUITY</th>
</tr>
</thead>
<tbody>
<tr>
<td>$1,000,000</td>
<td>1</td>
<td>$500,000</td>
<td>$500,000</td>
<td>12%</td>
<td>$120,000</td>
<td>$50,000</td>
<td>$70,000</td>
<td>14%</td>
</tr>
<tr>
<td>$1,000,000</td>
<td>1</td>
<td>$500,000</td>
<td>$500,000</td>
<td>15%</td>
<td>$150,000</td>
<td>$50,000</td>
<td>$100,000</td>
<td>20%</td>
</tr>
<tr>
<td>$1,000,000</td>
<td>1</td>
<td>$500,000</td>
<td>$500,000</td>
<td>7.5%</td>
<td>$75,000</td>
<td>$50,000</td>
<td>$25,000</td>
<td>5%</td>
</tr>
<tr>
<td>$1,000,000</td>
<td>3</td>
<td>$750,000</td>
<td>$250,000</td>
<td>12%</td>
<td>$120,000</td>
<td>$75,000</td>
<td>$45,000</td>
<td>18%</td>
</tr>
<tr>
<td>$1,000,000</td>
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<td>$750,000</td>
<td>$250,000</td>
<td>15%</td>
<td>$150,000</td>
<td>$75,000</td>
<td>$75,000</td>
<td>30%</td>
</tr>
<tr>
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<td>3</td>
<td>$750,000</td>
<td>$250,000</td>
<td>7.5%</td>
<td>$75,000</td>
<td>$75,000</td>
<td>- 0 -</td>
<td>0%</td>
</tr>
<tr>
<td>$1,000,000</td>
<td>1.5</td>
<td>$600,000</td>
<td>$400,000</td>
<td>12%</td>
<td>$120,000</td>
<td>$60,000</td>
<td>$60,000</td>
<td>15%</td>
</tr>
<tr>
<td>$1,000,000</td>
<td>1.5</td>
<td>$600,000</td>
<td>$400,000</td>
<td>15%</td>
<td>$150,000</td>
<td>$60,000</td>
<td>$90,000</td>
<td>22.5%</td>
</tr>
<tr>
<td>$1,000,000</td>
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<td>$600,000</td>
<td>$400,000</td>
<td>7.5%</td>
<td>$75,000</td>
<td>$60,000</td>
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**Source** = AIRLINE INDUSTRY DATA: DOUGLAS AIRCRAFT CO. SEPT. 1968
Internal Rate of Return

When management plans a financial investment, it has traditionally evaluated the potential rate of return on the investment base. This process can be confusing, however, particularly where the useful life of the investment and its depreciation period are not the same. As an alternative, airlines are starting to use the "Internal Rate of Return" method to evaluate investment alternatives. This method is based on discounted cash flows and not on the investment base, depreciation, etc.

If Ao is the initial investment, and Ai is the expected net cash flow, in or out during the ith time period, the equation can be formulated as:

$$ Ao = \frac{A_1}{(1+r)} + \frac{A_2}{(1+r)^2} + \ldots + \frac{A_n}{(1+r)^n} $$

r then represents the rate of return on the initial investment, Ao, earned from the future total cash flow $\sum_{i=1}^{n} A_i$ discounted over the appropriate time periods. By comparing the various internal rates of return that can be expected from different investment strategies, the firm can decide which project offers the best return on the money presently available.
Market Performance Ratios

Market performance is important when one purchases stock in the market from a prior stockholder, rather than from the company itself as part of an initial stock issue. The market investor is concerned with the health of the company whose stock he is buying. But he is also interested in how the stock compares with other stocks he might purchase in the market place.

1. **Earnings Per Share** - this is the ratio of the net income of the firm to the number of shares outstanding and gives some measure of the worth and earning power of the stock.

2. **Price-Earnings Ratio** - The market price of the stock is divided by the earnings per share as computed above. This relates the earning power of the stock to how much it costs.

3. **Yield (Dividend Yield)** - To determine the return on his investment, the stockholder is not only interested in how large a dividend is paid on a share, but how much the share costs. Yield is defined as dividends per share divided by the price per share and represents the percentage return on investment in the stock.
CAPITAL REQUIREMENTS FOR THE AIR TRANSPORT INDUSTRY

by George James

A. T. A.

July 20, 1972

Abstract

In recent years the U.S scheduled airline industry has been involved in the largest re-equipment program in its history. This program which is still continuing involves the addition of hundreds of new wide-body and other aircraft to the airline fleet. Capital expenditures for the twelve major airlines alone during the past two years have amounted to nearly $4 billion. As of June 1, 1972, the U.S. scheduled airlines had orders for 243 aircraft for delivery in 1972 and beyond. The requirements for new aircraft and ground support equipment have come at a time when the industry has experienced very adverse financial conditions. The costs associated with the purchase of this new equipment along with the other costs involving such matters as the environment and security are presenting the carriers with significant financial challenges.
One of the problems in trying to forecast the capital requirements for the air transport industry, is that we have to make many assumptions. We try to put together the best assumptions and even then there can be a number of errors, and as you will see as we go through this series of slides, some of the assumptions are quite sensitive to the results. I will try to identify those and indicate to you how sensitive they may be.

This is a two part program this morning. I'm going to try to show what the needs are in the industry and then Don Lloyd-Jones will tell you how easy it is to raise the money to meet those needs.

Looking at the first slide. Now, all I'm trying to show here is the methodology and then to show you in very gross terms, what steps we took, and then some of the data we try to rely on as we made the forecast.

You have to begin with attempting to anticipate what the level of traffic growth would be in the period, in this case, between 1972 to 1980, and then give the traffic growth, as well as try to indicate what the present capacity is; and what the future capacity is likely to be; and the measurement of that capacity against the traffic growth, and some indication of the load factor that might be involved in the time period will give you then an idea of how much additional capacity you might need. From this
cost estimate of capacity need, you can figure out your capital requirements.

On the traffic side, there are a number of groups which have made forecasts of airline traffic growth, throughout this period of 1972 to 1980 or even to 1985, and some even go out to the year 2000. What we have done, of course, within the industry itself is our own forecasts which we have developed in the last three or four years and have had one revision in that regard.

Now, if you just take the passenger growth from 1972 to 1980. One group that has forecast in this area is the FAA. They indicated about 10 ½% per year average annual growth in our domestic revenue passenger miles. The aviation Advisory Commission has worked with the figure of about 10% per year. Sam Brown from the Civil Aeronautics Board is giving a speech in Milwaukee today in which he will indicate that the figure for the CAB is approximately 8% per year average annual growth over this time period.

Now you see on this second slide the ATA forecast. The top figure that you see for domestic passenger growth average annual from 1972 to 1980 is 8.8% per year. The figure that we are using falls somewhere in this spectrum but more on the low side perhaps with CAB's at 8%, and to ourselves 8.8%, and to Aviation Advisory Commission's at about 10% and the FAA about 10 ½%. We are using our figure because we did it. And we have, through a committee composed of as many as a hundred representative personnel from
the various carriers working two or three years hammering out this particular forecast and came up with 8.8%. So it is not the figure that is identified just with the staff of ATA, but with the industry as a whole. At the same time, the international passenger growth figure they used is 12.4%. The domestic cargo at 16.3% and the international cargo at 15.9%. The aggregate of this in terms of revenue ton mile growth will actually give you a figure of average annual growth of 10.5%.

Let me try to show you what the 8.8% per year means between 1970-1980. We have 95 billion passenger-miles in 1970, 144 by 1975 and 220 billion by 1980. So we are talking on the level of one and a half fold increase from '70 to '75 and about 2.3 fold increase from '70 to '80 between 95 and 220 billions. If you used the 8% figure that the CAB was using, they will have 2.2 fold increase between '70 and '80. So our figure is not too far away from this. In terms of enplaning passengers, this 8.8% per year domestic passenger growth that we have, would have 149 million passengers as a base in 1970, 214 by 1975, and 325 million by 1980.

So the ratio here is slightly less than the 1.5 and 2.3 from '70 to '80 which is largely do to forecast the increase in length of haul. So we're actually cutting down the number of passengers relative to the increase in revenue passenger miles.
Still though, you have 65 million more passengers in 1975 than you have in 1970. We have another 175 million more in 1980 over 1970. In other words, the increment of 175 million is actually greater than 149 million that you were carrying in 1970.

This 325 million is a lot of passengers, and all we are working at is an 8.8% growth which is not too far out of line. Given some of our growth factors in the latter part of the '60's which ranged as high as 19% to 20% in certain years and given the performance that we have had this year so far which is bordering on the level of about 11%, it seems very high compared with 1970. In 1971 we are showing a nearly flat growth, no change over 1970 however. Now, if we return to the particular methodology that we were talking about, we now have the traffic on one side and what we attempt to do now, given this traffic growth of 8.8% per year or the 10 1/2% revenue ton mile figure when you make the composite with passenger and cargo, and domestic and international. We now try to measure against what the present fleet is, take out the anticipated retirements to get a net figure on that, add the planned additions that the carriers' plans show, and determine whether or not that is enough to carry that particular traffic at a particular load factor. And that if it does not we will have to go out to purchase some additional ATMs (available ton miles) in order to provide sufficient capacity to carry that amount of traffic, as you have just seen, something on the order of 325 million passengers by 1980. We get the information on the
present fleet and the planned additions from two sources at this point. About 6 to 9 months ago, a comprehensive study was obtained by the ATA from the carriers on their present fleet and anticipated plane additions up to 1980, for environmental purposes, particularly with regard to anticipating the need for noise retrofit. And then each year, we get from the carriers, sometimes about twice a year, a survey on their new equipment they plan on purchasing over the next two or three years. So when we combine these two, we are able to get a figure within this block, if you will, to tell us what the capacity the carriers are planning over this time period at this time. Normally, a carrier has a more finite plan for the next three years than they might have for 1975 to 1980.

Let's take a look at the present fleet and the planned additions—the aircraft type 707, 727, 737, and so on down to DC10, L 10-11 and the 747; what the inventory was in 1970, what the carriers are planning for 1975, what are the plans for 1980. Notice that a number of these are being retired. The 707, with an inventory of 412 in 1970, dropping to 263 by 1980 is one example. The 720's will be phased out by 1980. The DC8's would drop from 258 to 172. On the other hand, there are some others growing, of course. The 747 from 40 up to 173, and we didn't have the 3-engine wide-body in the fleet in 1970, they will grow to 555 by 1980. Now, if you put all this together, you end up
with an inventory of 2007 in 1970, 2110 in 1975, 2307 in 1980. So that you are adding about 300 from '70 to '80. But at the same time, you are retiring 458 in this process. These drops in 707's, 720's, DC 8's and so forth add up to 458 taken out of the fleet, but the addition, in the wide-bodies in particular, bring on additional 758. So you have a net growth of 300 in that time period. These do not include the new types of aircraft -- the A300, the Concord, or even the twin-engine DC 10 STOL. This is only the anticipated addition from the present aircraft that are now being manufactured. 707's will retire 149, 720's will retire 126, DC 8's will retire 76 over the time period of 1970 to 1980. In addition, we have in terms of new orders of aircraft, 243 are actually on order as of June 1 of this year. And you notice that 88 of those were scheduled to delivery in 1972, 78 next year, 52 in '74. They may have plans of adding additional aircraft which have not been decided yet. But as far as orders are concerned, as of June 1, 243 have been confirmed and are valued in today's dollars at $4 billion.

Now, most of these will be stretched 727 - 200's. On order are approximately 180 of the wide-body tri-jets: DC 10, L1011 and 6, at this point, 747's on order. 747's reached their peak of delivery last year, the DC 10's will reach peak this year, and L 1011 will kind of split as far as the peak of delivery is between '73 and '74, because of the stretch out of Rolls Royce engines.
What we have done then is we've taken a look at the traffic growth, the 8.8% passenger and 10 \( \frac{1}{4} \% \) revenue ton mile growth, and taken a look at the present fleet and the planned addition now, and how then to consider whether or not they have plans to meet this particular growth pattern.

We have to do it on a load factor assumption. So that we need a guideline then. Once more, incidentally, I should mention that throughout all of this we are attempting now to stick with basic forecasting that may have been done in one of the areas and try to remove the element of apparent judgement as much as possible. So here is the study that has lasted 2 or 3 years to give us that particular figure. This information is now coming from the surveys that ATA has done with the carriers. And what do you do here. Well, the one thing you can do is to assume that we will get the load factor standard that was laid down in the recent domestic passenger fare investigation by the CAB at 55%. We have attempted to see what would happen if this were set at 55%. But, on the other hand, we also said that it may be that you will reach a point in this growth pattern that you might even go higher than 55% before you trigger the need for additional ATMs or additional capacity for a number of reasons. One of these is that the carriers are under severe financial situations in recent years and they will look for every wedge they possibly can to minimize the additional capital cost and the additional capacity that might
result from that. So, consequently, we have a triggered system here, that we will start ordering for more capacity at 55%, but we will go up to 57 ½% towards the end of the 1970's before we actually drew the line and said that we must have new capacity beyond that point. What I'm saying is if we move up of that 55% load factor, we begin to order some, but as we get to 57 ½%, we hold at that. We do not allow the load factor to rise beyond 57.5%.

What we now have then in this figure is we get here, with the assumption I just gave you for a cut-off at 57.5%. We have today in 1970 a ton mile load factor of 44.3% and by 1980 we would have a ton mile load factor of approximately 55.7%. This is almost a 25% increase in load factor alone, in terms of this particular model, before you actually go out and place market demand for new equipment.

As far as the principal characteristics are concerned, we will break it down to 2 time periods, '71 to '75 and '76 to '80. The domestic passenger growth we already indicated at 8.8% per year in '71 to '75 and '76 to '80 period, the load factor we are raising throughout this period from 48.5 to 55%, and from '76 to '80 it continues to grow from 55% to 57.5% cut-off. The utilization we take at an average of 9 hours per day which is the utilization we were getting the '70 to '71 period, that is relatively low at this point in time, a lot of it due to the fact that we have to
cut back during the '70 to '71 recession. One can expect us to increase utilization as the traffic grows. So we will increase it about 10% or about 10 hours per day in '76-'80 period.

Now for the seating configuration that we are using in the '71 to '75 period. The seating configuration that we had in the '70 to '71 period, that also is low. You can increase the seating capacity through elimination of lounges or reseating the present seating configuration in particularly the wide-bodies. So we assume that you hold the present base until this traffic grows to a point when you need to get additional capacity, hopefully without having to purchase. So you expect to expand seating configuration about 1974 and the expansion takes you for the next 3 years up to 1977, and it grows, gradually increasing from 10 to 15% depending upon whether you are working with a 727-200 standard jet or a wide-body 747. We use a different growth figure on the seating configuration depending upon the type of aircraft, but it runs about 10 to 15% in total. These are the characteristics that you are now getting in '71 to '75 and '76 to '80 period.

You notice the various assumptions that are built in to each of these time periods '71 to '75, '76 to '80. Now, when you take all of this growth against what the carriers had planned, you come up with insufficient amount of capacity. You now have to add capacity and there are some capital costs in that and then you cost out what they have already planned. You added
the two, what they planned, what additional they will need. That factors out in the '71 to '75 period to a little under $6 billion of flight equipment alone in that 5 year period. Historically, we have run a factor of about 17% of our flight equipment that comes out in ground equipment. If we continue to use that 17% relationship, that's another billion dollars. And, of course, we have to assume that we aren't going to be able to purchase those in the future at the same dollar values of today. We have assumed a 4% per year inflation. That costs us in this time period another half billion dollars. So we end up with a little under 7 ½ billion dollars in the '71 to '75 time period. So for a five year basis, it is averaged at a billion and a half a year and that is about our present rate; we are running as high a 2.3 billion as in the latter part of the '60's and we cut back as you well know. So this assumed about a billion and a half rate.

The surprise then comes in the '76 to '80 period which as you see the flight equipment now goes up to $13 billion. A 17% ground equipment would account for another $2.2 billion and the inflation factor accounts for $5 billion on this 4% per year. So now you have a total of about $20 billion in this time period. And, of course, almost $28 billion in the decade for 1970-1980. What is this compared with history? Well, interesting enough, the schedules airlines' capital equipment expenditures from '61 to '65, $4 billion; from '66 to '70, $12 billion; '71 to '75, $7 billion; '76 to '80, $20 billion. You can see the extreme cycles
that are going on which is hitting the bottom in the first half of the decade and hitting the peaks in the last half. The '71 to '75 figure is $3 B more than that from '61 to '65, and the $20 B for '76 to '80 is $8 B more than the $12 B for '66 to '70 period. It is interesting to look at this $12 B and increase it for the '76 to '80 period at 4% per year inflation. If you do and take the $12 B figure and run it up at 4% per year until you go to this time period, it comes up to about $19 1/2 B. So in one respect this $20 B is only buying in constant dollars about $12 B worth in the '66 to '70 period. What I want to point out is, of course, that we have a lot of inflation to swallow in this '76 to '80 period.

Now, let me take the $20 B in the '76 to '80 period and break it down into $13 B of flight equipment without inflation; $15 B of flight and ground equipment without inflation, and then $20 B for flight and ground equipment with inflation. So the flight equipment alone in this time period -- $13 B -- is just slightly more than our total expenditures of $12 B in 1966 to 1970 period, and the $5 B of inflation between these 2 figures is actually greater than all of our expenditures in the period '61 to '65 which is $4 B. So we will have to pay more for inflation before we can get hold of our equipment, than we pay for equipment in '61 to '65.

Just how good is this forecast of capital requirements in 1960 to 1980 of some $20 B. We have to look more or less at the
validity of assumptions on utilization, seating, load factor and traffic and retirement. We can say, as far as utilization of seating, since we have expected utilization up about 10%, and the seating configuration up between 10 to 15%, this is a pretty fair assumption, the rate at which you do it may be subject to some question. Some may feel the load factor may not get that high before it actually triggers the demand for equipment because you have that kind of growth and irregular competition among the carriers to get a larger share of market of capacity, before you get to 55% or 57 1/2% load factor. The traffic may be subject to some question. But at this point, the spectrum of forecasts that have been done may be slightly on the low side, but the retirement is probably accurate because pressures have been put on to make the noise retrofit adjustment.

To give you some idea the sensitivity of it. If the load factor grows from 55 to 60%, that 5% of additional load factor in '76 to '80 period, this $20 B will be reduced by about $1.6 B. Or, if you can get another 10% of utilization, this is worth about $2 1/2 B. If you didn't retire any of you aircraft which have been scheduled to retire between '76 to '80, that will be worth about $1 1/2 B. If you took a combination of these: another 5% increase in load factor, and 10% increase of utilization, may be worth as much as $4 B. So you now have some trade-off. But even if you took the combination that I just indicated, worth $4 B, you still
have about $16 B which is a significantly large amount for air
 carriers to finance.

You have a range in the change of cost of aircraft from
7 1/2% to about 18%. Certainly, there is some quality improvement
in the aircraft itself. You can't say that it is not exactly the
same aircraft. But still these figures are more markedly above
the 4% we have put into the assumption; so it is very possible
that inflation will be greater than what we have indicated.

I would summarize by saying that it would appear to us and
we've just now gone through this exercise and we still have some
other adjustments that we have to make in order to shake it down
some. I think we can conclude that the capital requirements on
the industry in the latter half of the '70's with inflation would
be greater than they were in the '76 to '80 period. This is going
to put increasing pressure on the carriers to maintain an adequate
level of earnings in order to finance themselves through this
time period, hopefully providing an adequate public service with-
out congestion problems, and so forth as in the latter half of
the '60's.
Gentlemen: It is a pleasure to be here today to speak in such a lovely location and on a subject close to my heart. It is a particular pleasure to be on the same program with Dr. George James with whom I have had a warm association for many years. I say this in spite of the fact that Dr. James has just made some capital requirement forecasts substantially higher than I had anticipated. The $20 billion capital requirement that George is forecasting for the second half of the 1970's is final confirmation that the aerospace manufacturers have infiltrated the ATA.

I know you've spent a lot of time this week, and some of last week, on the basic characteristics of the industry. I want to touch on them briefly today to show how they affect the financing requirements and patterns of the industry. (Chart: I) First of all, we are highly susceptible to the business cycle. This means that we have to choose our financial timing carefully in order to get the best possible interest rates available. There are in fact times when we cannot finance at all, when things are at the bottom. It also means that our investors, our lenders, tend to request higher interest rates or expect higher rates of return on their equity from us than they do from more stable industries, such as other utility industries whose earnings tend to be reasonably stable percentages.

Second, we are a service industry; therefore we cannot store our product. This fact has a fairly major effect on the amount of equipment we buy and therefore the amount of capital investment that we make.
Third, we are closely government regulated. We are regulated with regard to the routes we can fly and the rates we may charge. Nonetheless we are highly competitive and the combination of this fact and our close regulation has tended in the past to drive the industry periodically into an over-capacity posture. This puts heavy burdens on the financial officers, and the financial resources of the airlines.

Fifth, we are a high growth industry, so that, if we were normal in all other respects, we would have a fairly high rate of new equipment acquisitions. We are not normal in all other respects, however. We have a rapid technological cycle. Since the airlines first became significant entities in transportation in the early 1930's, there has been a major technological revolution in the equipment we operate on the average of about every seven years. Therefore, we are capital hungry and that is what I am going to be talking about to a very large degree today. Finally, seasonality enters into our economic picture in that we must equip our fleets to satisfy a reasonable percentage of peak demand. In the case of American Airlines, our seasonal peak falls in the summertime on the east-west routes. New York-Los Angeles traffic, for example, may be 50% higher in the month of August than it is on an average day in the month of February.

The "Four Seasons" of Airline Financing

Let me turn now to a historical review of airline financing because I think some historical perspective is necessary to understand how we got to where we are today and how we can, hopefully, finance the requirements of the future. Season I in airline financing I will date as including all years up until the end of 1954. This date was chosen because this was when the manufacturers
first approached the airlines to purchase the new jets, the 707's, DC-8's. Now, let's look at the balance sheet just before that happened. (Chart II) We had a fairly comfortable working capital level relative to about half a billion in operating property. Other assets were insignificant and debt was a minor factor, $214 million or 27% of our total capitalization. The bulk of our capitalization, 71%, was stockholders' equity. Outside of a few really minor debt agreements including some RFC financing back in the 1930's, a small amount in the 1940's, and some insignificant insurance company financing in the 1950's, we had financed our growth and our new equipment throughout this time period by stockholder equity: new equity issues, retained earnings and internal cash generation. This period then can be called the equity period and it is the first season of airline financing.

Now let's look at the ratios that come out of the simplified balance sheet that we just saw. (Chart III) First of all the current ratio (the current assets divided by the current liabilities) was about 1.4. That's a healthy ratio. We've learned to live with a lot lower ratio than that since 1954. The debt to equity ratio was 0.4, a very insignificant amount of debt and a very healthy situation. There were no leases, so, even if you include capitalized leases, the ratio is still 0.4. Finally, we were covering our interest charges 13.3 times through internally generated cash flow. Based on these healthy financial ratios, I think you can see why the insurance companies became interested in financing the jet program for the airlines in the period 1955 to 1959. We were healthy, we had a lot of cash flow and we were buying a product which offered true productivity improvement to the airlines. Financing the first jet purchases then was not too difficult a job.
The next chart (Chart IV) shows what aircraft commitments were made by the major U.S. airlines in the 1955 to 1959 time period. These were virtually all 707 and DC-8 aircraft. There were 262 of them committed for in this time period. The total commitment turned out to be $1.5 billion for aircraft and a grand total, adding in ground and other commitments necessary to support this equipment, of $2.2 billion. Comparing that commitment of $2.2 billion to the capitalization base at the beginning of the period of $780 million results in a ratio of commitment to capital base of 2.8. I will be referring to that same ratio as we go along through the various periods of financing. The 2.8 was as high as any ratio that we have had since the second World War. But since we had started with a very strong balance sheet, it was not a very difficult financing problem. How did we do it?

In the period 1955 to 1959, there was $2.2 billion of capital expenditures, as I just mentioned. (Chart V) We also paid out some dividends, about 7% of our total capital usage was dividends, so about $2.3 - $2.4 billion had to be raised. 55% came from internal sources, depreciation plus earnings and 35% came from debt. $841 million of debt was raised in that period on top of the $214 million we had had in the 1954 base year. So we quintupled our debt in this four year time period and over 90% of it came out of the insurance companies. In addition there was an insignificant amount of lease financing and there was a little bit of equity financing, but less than 8% of the total. I have called this time period Season II, the insurance company period, a time when almost all external financing was senior long-term debt placed with insurance companies.
Q. What forms did these loans take?
A. They took various forms, but generally speaking they were unsecured, senior debt. Guaranteed lease obligations, for example, are senior to these insurance obligations.

Q. The interest rates?
A. The interest rates during this period were delightful by today's standards - in the neighborhood of 4½% or 4¾%. A lot of these original loans have been re-negotiated since and the interest rates have been re-negotiated upwards.

We have reviewed how we sourced our funds in the 1955-1959 time period. Our year-end 1959 balance sheet is shown on Chart VI. Compared to 1954 our working capital had risen to $188 million, not a significant increase. Our operating property, on the other hand, had risen by about a billion dollars to a billion five hundred and sixty two million dollars and our other assets had just about quadrupled. They were $71 million in 1954 and they were $309 million at year end 1959. The balance sheet then, had changed quite drastically. You recall that the stockholder equity was over 70% at the end of 1954; at year-end 1959 it was 43% and debt had risen to 51%. In dollar terms we had increased to almost $1.1 billion from $214 million in debt, and in equity we had gone from $551 million to $880 million. So, for the first time we were beginning to see heavy use of debt financing by the airline industry. Of this total of $1.1 billion, $706 million was in the hands of the insurance companies at the end of 1959, a little better than 2/3 of the entire debt of the industry.

The ratios that result from that balance sheet are shown on Chart VII. The current ratio hasn't changed very much since 1954. The debt-equity ratio, however, had gone from 0.4 to 1.2, so we were then over 50% debt. Inclusion of leases
doesn't really change these figures very much because we hadn't turned to leasing at all heavily at that point in time. One key ratio had worsened dramatically. Our times interest coverage had dropped from thirteen fold to three fold and it was just about at this point that the insurance companies began to get a little nervous about loaning more money to the airline industry.

There were additional technological developments in the early 1960's, however, and efficiency required their purchase. The three-engine jet, the 727 came along, the two-engine jets, the BAC's and the DC-9's came along and the industry required additional four-engine jets to retire some of its older piston equipment and to meet growth. So, in this time period we ordered an additional 842 total aircraft (Chart VIII) with a dollar value, including necessary ground facilities, of $4.2 billion. Now, that was a lot of money, but compared to the year-end 1959 capital base, the commitment was small relative to the early jet acquisition program. Our capitalization, debt plus equity, at the end of 1959 had been $2.1 billion. Our 1960-1965 commitments of $4.3 billion result in a ratio to base capitalization of 2.1. That figure compares to the 2.8 ratio in the latter half of the 1950's.

On Chart IX we see the $4.2 billion in capital expenditures plus another $233 million in dividends. This period I have called the third season of airline financing because we were able to finance a very high percentage of our commitments through internal cash flow, from depreciation and from quite healthy profits in the 1963-1965 period. We did have to turn to debt to some degree - $854 million - but it was only 19% of the total sourcing of capital during this time period. There was little insurance money in this period and leasing and equity financing were not a major factor. So the key to this entire period was the ability we had to finance our commitments from internal sources.
Adding the 1960-1965 cash flows to the balance sheet of 1959, you derive the picture shown in Chart X. Working capital and operating property had each about doubled from 1959 and other assets were up about 50% from the prior total. Total debt had risen to $1.9 billion compared from just over one billion at the end of 1959, but had declined as a percentage to 45% of our total capitalization. Leases still played a nominal role in our balance sheet. Stockholder equity had just about doubled rising to $1.6 billion from $880 million at the end of 1959.

We still, however, had more debt than equity as shown in the next slide. (Chart XI) The current ratio was still running along at about the same level, no problem. The debt-equity ratio had actually improved a little bit between 1959 and 1965. If you add the nominal leasing that had been done, we had just about held our own. We did improve our times interest coverage: we got it back to 6.6 from the level of 3.1 that it had hit in 1959. That was the picture at the end of that era as we came into the most difficult financing period that the airlines have had since World War II.

Q. Would you define times interest coverage?
A. It's the internal generation of cash divided by the interest commitment of the carriers.

We had bought 262 aircraft in the 1955-1959 time period (Chart XII); 842 aircraft in the 1960-1965 time period; and in the 1966-1971 time period we committed for 912 aircraft. These were a lot more expensive aircraft, since inflation really started to bite into us in the latter 1960's. We ordered 214 of the old narrow bodied four-engine jets, we ordered 260 more three-engine 727's, with the 727-200's representing a large proportion of this number. We
also ordered some twin engine jets - 143 of them. The bulk of the dollars, however, went to order 121 747's and 174 of the DC-10 and L-1011 variety. The total commitment for aircraft for the period reached just under ten billion dollars. Including the ground equipment, facilities, etc., the total commitment in this time period was $11.9 billion. Now let's again compare that figure to the capital base that we had entering the period. The capital base at the end of 1965 was $4.2 billion which results in a commitment to capitalization ratio of 2.8. This is the same ratio that we had had in the late 1950's; in between it had been 2.1.

On the face of it then our problem was no more difficult in the late 1960's than it had been back in the late 1950's, but that was not really the case. We didn't have the same balance sheet in 1965, that we had had before we ordered the first jets in 1954. Most financing sources were either drying up, had dried up or had become extremely expensive. We were beginning to get into an inflationary period, interest rates were rising for everyone, but they were rising more rapidly for the kind of credit that the airlines represented than for other kinds of corporations because of our relatively poorer balance sheets and erratic earnings. Insurance companies were not willing to extend further unsecured senior money. (Chart XIII) Prospective equity investors were looking for higher dividend yields because of inflation and, after about 1967, were turned away by declining airline stock prices. So, we came into this period, not with a bigger commitment problem, but with a bigger balance sheet problem, and a much more adverse financing environment than we had had previously. I call this period the fourth season or the "get it wherever you can" season.
There were three sub-phases to this period. The first phase was use of subordinated convertible debenture financing in order to attract the insurance companies by giving them a sweetener in the form of an equity kicker. The second phase was bank financing and the third phase was lease financing. Those last two phases represent the least desirable types of financing that the airlines can do. We had to turn to them as an industry because other sources were unavailable. They were generally more expensive; nonetheless we had to use them.

Q. Those are sort of the classic money sources. I understand that there are other places like oil companies that have money. How do you get money out of something like that?

A. Out of an oil company? It's quite difficult if you're thinking in terms of direct investment. Airlines normally don't get direct debt financing out of an oil company until they are really in pretty bad shape. Then they may give it to you.

Q. Why shouldn't they care about you being in bad shape?

A. Because they want to collect their money.

Q. Oh, I see.

A. You'll find that carriers really on the ropes may get some oil company financing, but it's just to keep the carrier going and hopefully to collect some back debts. In those cases the oil companies are already so far in, they've got to go little bit more. If you're seeking lease financing by oil companies, you run into real problems with the Internal Revenue Service, when you start to deal with other than financial institutions. To be sure that you have tax credits, you really have to be a financial institution.
Let's take a look now at where the insurance companies stood in the airline financing picture in 1968, the middle of this last time period. (Chart XIV) We've already seen that back in the late 1950's they had financed two-thirds of the original jet acquisitions and accounted for 90% of the direct debt. In the next ten years they represented only 28.5% of the total debt sourcing done by the airlines. Even that financing took a different form, as we will see in just a moment. Seven companies that you're all very familiar with, accounted for the large majority of the airline loans. The Metropolitan has the heaviest position, they have about $600 million in the airlines, the Prudential, $500 million, and just a little bit behind them, the Equitable at $220 million and then Hancock, Aetna, MONY, Connecticut General and a batch of others make up the remainder. That is a very heavy concentration, as Mr. Nader says, but only a handful of insurance companies had the assets in this time period to loan the kinds of monies that the airlines needed and never in my experience have these companies in any way attempted to exert control.

There was then a small expansion in insurance company lending and it came in 1966 and 1967. (Chart XV) As an industry we had trifled with convertible subordinated financing prior to this time period, but I really do characterize it as trifling. There had been a little bit in 1958, a nominal amount in 1961, and one issue in 1964. Just at the end of 1965 the real push on subordinated convertible financing began, with a $53 million issue at 4%, which I believe was ours. Then there was a batch of them in 1966 and 1967. You could pick up the paper practically every day and find that some airline was doing subordinated convertible financing. It was cheap and the insurance companies would take that kind of a piece of paper whereas they wouldn't take senior debt financing.
After 1967, however, airline security prices started to fall out of bed. As a result, convertible financing decreased sharply in 1968. Then we had an aberration in 1969. As you may recall, when Pan Am's stock price got down to a low level and Pan Am's total value in the market place fell slightly below $300 million dollars, International Leisure made an attempt to try and take control of Pan Am. Pan Am shrewdly used that run-up in their stock price to finance. They issued a fairly sizable subordinated convertible debenture issue. TWA rode on Pan Am's coat tails, since their stock price had risen with Pan Am's, and they also did a subordinated issue. Those two issues accounted for the $325 million in 1969. The 1970 financing was Eastern Air Line's. It is the only subordinated convertible debenture that I can recall that carried an 8% coupon rate. It was issued when Eastern's stock was selling at 13, or thereabouts, and the conversion price was set between 15 and 16. It was a very, very expensive kind of financing, but it was all that was available to Eastern at the time. Excluding these aberrations, this phase one of season four ended in the third or fourth quarter of 1967 and subordinated convertible markets became closed for airline financing purposes.

Q. Must airlines have senior lender approval when it's a bond issue?
A. Not if it's a subordinated issue - unless, of course, the airline has reached its limit for such financing contained in its loan covenants.

Q. Does the zero in the 1970 debt represent conversion or does it represent laying off of some airlines?
A. It represents conversions. The conversion price as I mentioned on Eastern was 16 or a little below. Eastern's stock price went right through that level in 1971 and they called. Two of American's issues were convertible
at 31 3/4; we called them late last year, and finished the conversion in January. When you get stock prices that permit you to convert these issues, you try and convert them into equity to improve your balance sheet and give you more flexibility.

Q. How do these interest rates compare with insurance interest rates?
A. It depends on what premium is set on the conversion. If it's a 20% premium or a 30% premium above existing market price, it will effect the interest rates that are charged. I would say on balance in this time period a direct senior debt placement would have cost you one-half to a full point higher than these rates.

Q. I think that the VA rate was 3/4 less and a point higher than these.
A. Yes.

Q. Do you do any borrowing from foreign countries?
A. American has none, but some of the international carriers have done some. For a while in 1970 the Swiss market was a pretty good source. You could deal in Eurodollars in a couple of other markets. That was equivalent to bank borrowing, short term borrowing. As an industry we did turn to bank borrowing, but we were able by and large to get our domestic banks to loan at rates that were pretty close to the Eurodollar rate or even below most of the time.

Q. This may not be appropriate now, but if you were unregulated in terms of fare structure would you be better able to cope with your current problem?
A. Yes, I think there would be no question that, if we were unregulated in relation to rate structure, the financial community would feel more secure in lending to us and I suspect the equity investors would also feel more secure. Regulation in certain other areas, however, does give the senior
lenders and the equity investors some security. Regulation as a whole is a bit of a mixed bag, but rate regulations, per se, probably does cost us some points.

So the insurance monies were dried up, we had run out of subordinated convertible opportunities essentially at the end of 1967 and we had to turn to the banks. (Chart XVI) The banks had been only a very minor factor up until the end of 1964. Of our total long-term debt at that point, the banks only had $291 million or 17%. At the end of this period, in 1971, we had total debt of $5.2 billion. Of the new debt placed in this time period, the banks took 27½% of it. Bank financing is probably the least attractive kind of financing that an airline can do. Your commitments are invariably long-term commitments. You're looking at purchases of aircraft which you anticipate will have 12 or 14 or 16 year lives. To go to the bank and finance on a five year type of financing makes little sense. In effect, you are committing to finance that particular debt two or three times during the course of the life of that aircraft. Therefore, whenever possible, you try and do longer term financing. It wasn't possible in this period, so we did turn to the banks quite heavily. At year end 1971, the 12 carriers had $2.1 billion worth of authorized revolving credit at the banks and were using 44% of it, or just over $900 million. Most airlines view such credits first as something you're going to try to refinance as soon as possible, and second, as an insurance policy. It's awfully nice when you're trying to go to sleep at night to know that you have a $300 million revolver down at the bank and you're only using $50 million
of it. It means that, if market conditions suddenly go sour or if that lease
deal you're trying to work out doesn't go through, you can go down to the bank
and use your insurance policy to tide you over until market conditions improve.
It's expensive insurance, however, and it's not something you carry just for
the fun of it.

Finally, very late in 1969 the airline industry entered phase three of
this era: the use of a lease instrument very similar to a railroad equipment
trust certificate. (Chart XVII) This was an instrument that TWA invented.
In December, 1969 they did a $70 million 747 guaranteed loan certificate
financing at a 10% coupon rate. We seized upon this and American Airlines lease
financed seven 747's in three separate issues during 1970, representing the
majority of this total of $248 million in 1970. We paid interest rates ranging
from about 10% on up. I'll never forget our highest rate, it was 11%. Another
was at 10 7/8% and I forget what the third issue was. Other carriers issued
lease certificates at 11 ¼% and even a little higher. This was the nadir of the
airline financial picture during this time period.

Q. Who picked those up?
A. Most of the ones that American did were sold publicly. It becomes a rather
   expensive transaction in that you have an equity owner and then you sell the
   long term bonds to the public at the coupon rates shown on Chart XVII. You
   then, of course, have to have trustees, etc.

Q. They usually are bonds aren't they?
A. These were bonds. All but the last couple were guaranteed by the corporation.
   In addition to representing a lien on the aircraft as security for the bond,
   we had to give a separate corporate guarantee in order to sell the bonds.
Q. You didn't tell us about the highest interest rate I've seen in public bonds?

A. In this kind of financing you are selling 70% to 75% of the value of the aircraft in the form of long-term bonds to the public and 25% to 30% is being placed at very low interest rates with equity investors, usually banks who have unused investment tax credits. When one factors in the very low equity rates with the high bond coupon rates, you typically reduce them 3% to 3 1/2% points in terms of the effective borrowing rates to the airline. The airline, of course, is giving up investment tax credit when it finances this way. I'm not taking account of that.

Q. What was the term?

A. We did ours on an 18 year term, most were done on a 16 year term.

Q. Were these callable bonds?

A. They are not callable, they are actually paid out just like you pay out a lease every six months. You're paying off 1/36th or 1/32nd of the face value of the total bond twice a year.

Chart XVIII is as good a summary of the difficulties that the airlines were in in 1971 as any I can think of. I don't know how many of you are familiar with the New York State Insurance Laws and with similar insurance laws in many other states. This law says that the airline, or any corporation to whom an insurance company makes a loan, must have cash flow equivalent to 1.5 times the fixed interest obligations for the year. Any loans to corporations that fail to meet that test in one of the last two years or on average in the last five years are put into a special pot and the insurance company has to increase its reserve against that particular loan. Normally an insurance company will carry
a 1% to 2% reserve against a loan. If you fail this test, however, that will jump to 10% or 20%, depending upon the state. The insurance company just will not loan when they fear that they may have to reserve 10% to 20% against the loan. If they would, the rate would be so high that no airline would be interested in it. American failed this test for the first time in 1970 and was still under in 1971 so we're not eligible at the moment to borrow on an unsecured basis from insurance companies, except under this very high reserve position. Eastern has been under since 1969, Pan Am has been under since, I believe, before 1969, TWA has also been under for three years. United passed in 1969 and then fell out of bed, Braniff has been under throughout the three years, Continental was under for two, they did make it in 1971. Western has been under for the last two years. There are only three carriers today that could go to an insurance company and say I want to borrow some money and the insurance man would smile. They are Delta, National and Northwest. This is an interesting test to watch since it means it is going to be at least a couple of years before we as an industry have real access to the insurance company market.

Q. Have the insurance companies lost anything on their airline loans?
A. They haven't lost anything but when they see figures of this kind their insurance examiners talk to them pretty seriously about how secure is this debt. I went down with Mr. Spater in 1968 and talked to the Chairman of the Board of one of the very large insurance companies and he said we're not going to loan you another cent until you get your current obligation to us down by 33%. That's about $65 million and it's going to be 1980 before we get it that far down on the current repayment schedule.
Q. You defined the fixed charges there as interest and amortization of debt?
A. Yes that's correct. Interest and amortization of the debt and scheduled debt/repayments.

Q. Don, this thing includes rentals?
A. And it does include rentals, yes.

Q. Moreover the ICC has a less onerous test?
A. The ICC has a less onerous test. Under the New York State Insurance Law airlines must include full lease payments whereas the railroads need only include the imputed interest cost portion of lease payments.

Q. Your answer to a question previously asked about oil company money would be that the insurance companies possibly have something better to do with their money?
A. Loan to other people?

Q. Yes.

A. That's what they have been doing to a very large extent. You can sometimes intrigue them with some of the high coupon rates on the guaranteed lease certificates. We did get some insurance companies to participate at 10 1/2% and 11% kinds of rates. Naturally, they like that, because they have the security of the aircraft and they've got the total guarantee of the whole corporation. That's a pretty good piece of paper. It's pretty hard to tempt them, as yet, with less security or with much lower interest rates.

Q. Why wouldn't that same rate attract other investors?
A. It did. For example, a number of pension funds participated in these guaranteed lease certificates from all over the country as did banks and private individuals.
Finally, in the spring of 1971 the airlines got a break. The big investment funds began to believe that 1972 and beyond were going to be very good airline earnings years and airline stocks shot up to double or a little more than double their recession lows. This enabled each of the big five carriers to do equity financing in fairly significant quantities, amounting to increases in shares outstanding ranging from 11% up to 15%. (Chart XIX) You could well see some more such financing. Continental has just completed one in July of 1972, a $27 million issue representing a 10% increase in their shares outstanding. There are other smaller carriers who could follow suit, but I don't think you'll see a lot more of it unless market conditions improve substantially from today's levels.

Q. What's the cost of that?
A. The cost of equity financing? Generally, you have to figure that equity financing in this industry costs you about 15%. It depends, of course, on what you think your cost of capital is and you base your calculations primarily on the expectations of the guy who invests and your historical growth in earnings per share than on anything else. It is expensive, but there comes a point after you've borrowed so much where you have to raise equity to get your balance sheet back in shape.

Q. You show that Continental on the previous chart has been eligible for insurance borrowing. Why did they let them do this instead?
A. Well, I'm not really sure. When they bought their DC-10's they went very heavily into a bank loan. This was in the fall of 1970. They had to get out of the banks, to whom they were further heavily commited, and find some
means of lengthening their terms. Continental has a very high debt equity ratio. It may be because of their debt equity ratio that the insurance companies just didn't want to loan to them. They may have had to do something to their equity side to get their balance sheet looking better.

In summarizing then, in the 1967-1971 time period, for the first time since 1956, the industry failed to generate half of its commitments internally. (Chart XX) We only generated 48%. Debt increased by $3.3 billion and as I indicated, it was bank debt and subordinated convertible debt in large part. Leases for the first time became a major factor in the sourcing of funds, accounting for 16% of the total monies raised during that time period. In the latter years of this period half or more of the aircraft being delivered to the carriers were being leased, because that was the most efficient available kind of financing. Equity money, raised mainly in 1970, represented just under 10% of the money sourced. In all, we spent $11.9 billion. Dividends again dropped as a percentage, down to 3.6% of our fund usage, and of course all but a couple of carriers had suspended any dividend payments by the conclusion of this time period.

Looking now at the balance sheet at year-end 1971, (Chart XXI) working capital was $360 million, actually down in dollar terms from where it had been six years earlier. Operating property had quadrupled during the same period and other assets rose about two and half times. Debt had risen sharply to $5.2 billion from $1.9 billion six years earlier and represented 44% of total capitalization. For the first time leases suddenly emerged as a factor at $2.2 billion or 19%. They had only been $200 million six years before. Stockholder equity also rose, to
$3.3 billion from $1.7 billion, but you can see on the next chart the adverse change in the ratio of debt to equity. (Chart XXII)

The current ratio had fallen sharply to 1.18. You can live with this level, but it can't go much lower. The debt-equity ratio which had risen from 0.4 in 1954 to about 1.2 in the 1960's, has now jumped to 1.56 at the end of 1971. Including leases, the ratio was now up to 2.22. Stated another way, 70% of our total capitalization was debt and capitalized leases.

Now let's look at the future and oddly enough, George James forecasted capital requirements don't pose much of a problem in the 1972-1975 period.

Q. Can I interrupt. Your times interest coverage, was it 1.1?
A. Yes.

Q. That 10%, is that all you have to cover dividends and repayment of principle?
A. That's correct. I suspect we just lost another potential investor here.

Q. Your problem is bigger than I can handle.

On the balance sheet chart for the end of 1971 we saw that our total capitalization, excluding leases, was about $9.7 billion. Dr. James has forecasted for the 1971-1975 period that the commitments of the airlines will be about $7 billion. That produces a commitment to capitalization ratio that's totally different from anything we've been looking at. You will recall that these ratios for the previous time periods were: 1954-1959 - 2.8; 1960-1965 - 2.1; 1966-1971 - 2.8. In contrast commitments now are actually less than the capitalization of the airlines going into this 1972-1975 time period resulting in a ratio of only 0.7. There should be relatively no problem in sourcing these funds.
The next chart (Chart XXIII) is an American Airlines sources and uses of funds schedule. It shows you what a typical carrier like ourselves went through in 1971 and what we've been going through in 1972. In 1971, we spent about $250 million for aircraft, another $140 million for facility expenditures, a little bit for debt retirement and about $20 million for other uses, including dividends. Our sources included depreciation at a little over $100 million and deposits with manufacturers, which had been made previously and were applied at the time of delivery of the aircraft, of $45 million. That left us with a short-fall of some $300 million. To bridge this gap we used leasing heavily, principally the equipment trust certificates that I referred to earlier, and we began to use our revolving credit in 1971 for the first time. We also did an $85 million equity issue. So, we were scrambling, we used leasing; we used revolving bank credit; we used equity financing; we used everything we could find to lay our hands on in 1971. And we met this total commitment of about $450 million.

In 1972 American Airlines still has very heavy commitments, about $430 million in all. Some 19 DC-10's are being delivered to us in 1972. That means we have aircraft financing requirements alone of $350 million this year. In the facilities area we appear to be over the hump, as is the industry generally, I think. The big facility expenditures you saw in the 1969-1971 period are a thing of the past, at least for this equipment cycle. For American they should now run somewhere in the neighborhood of $30 million on a continuing basis for several years. Finally, we have debt retirement of about $30 million. On the sources side of the ledger, depreciation will provide about $110 million and deposits another $140 million because we're taking delivery of so many aircraft. This leaves us with a gap to fill which will be met primarily through leasing and,
hopefully, some profits. We also, of course, have substantial unused revolving credit. We will use that, of course, to fill the portion of this gap that is not filled by other means.

Now, look what happens to our capital requirements in 1973. No aircraft are on order for 1973 delivery. The same is true for 1974, and at the moment, at least, for 1975. So there are no aircraft commitments to fund. The ground facility expenditures should average only about $30 million. Finally, there are debt retirements of about $30 million which brings us up to a total of about $60 odd million funds required for the year 1973. On the source side, our depreciation will be $125 million and normally we have about $30 million in other odds and ends. We have then about $150 million of sources, plus an opportunity to earn money above that. There should, therefore, be a substantial positive cash flow for the airlines in the 1973-1975 time period. This is the first time that there has been more than one year of a positive cash flow for the airlines in the post-war period. It says we have no new financing problems until 1975.

If you add the anticipated cash sources and uses over the next four years to the industry's 1971 balance sheet, you derive the 1975 balance sheet for the airline industry, shown on Chart XXIV. For this purpose we have assumed working capital will be unchanged. In the area of operating property, we have added the aircraft deliveries forecasted by Dr. James. Other assets have been increased nominally. On the liability side the industry's positive cash flow should reduce debt by $700,000. We have assumed that about 30% of the new deliveries will be leased, so lease commitments go up from $2.2 to $2.7 billion. Deferred credits also go up, leaving stockholder equity to rise by 50%.
This 1975 balance sheet looks a lot healthier than the current one. The debt-equity ratio, excluding capitalized leases, is 0.9. In other words, the industry should have more equity than debt for the first time in a long, long time. Even if you include capitalized leases, the debt equity ratio is only 1.4, which is quite a tolerable level. In deriving this 1975 picture we have assumed that earnings recover steadily in 1972 and beyond, but that they don't recover all the way to the 12% rate of return by any means. We have assumed that the industry will resume paying dividends in 1973, with about a 1/3 payout of earnings after taxes. Finally, we have assumed that those convertible issues which are callable reasonably near their current stock market prices will be called during this time period.

Q. What happens to your times interest ratio now?
A. I didn't calculate it, but we improve markedly from today's levels.
Q. Back up to the 13 level?
A. Oh no. We would be back to a point where we qualify for insurance test purposes. I think it would get back into the 3-5 range.
Q. If all the airlines had a moratorium, no new equipment for five or six years, and if there was a traffic buildup, could you sort of have a guaranteed recovery?
A. We have the cash position for that to happen, but the earnings would be the question mark. We have assumed a fairly good level of earnings in this analysis. Realization of those earnings depends on how we meet our growth. If it is done through high load factor, yes we ought to have the recovery.

Let's turn now to my last slide. (Chart XXV) Until yesterday I thought that
Dr. James was going to forecast commitments of $13 billion in the last half of the decade, but he has come up with a figure of $20 billion. One must put that $20 billion in perspective to understand the challenge that it creates for the airline industry. At the end of 1975, on the balance sheet we just looked at, the capitalization of the airlines should be about $11 billion. The $20 billion commitment versus the $11 billion capitalization results in a ratio of 1.8. Remember we have lived with ratios of 2.8, 2.1 and 2.8 in the past. That should indicate that we ought to be able to live with something less than 2.

Nonetheless, there are problems. First, it is questionable whether the insurance companies will provide a major source of long-term funds. Second, the industry has existing bank credits of about a billion dollars which, I doubt, will be expanded very much. Third, I believe we will lease something like 30% of our new aircraft, but probably not much more than 30% can be leased because of covenant restrictions. Leasing also becomes quite expensive unless we continue to have investment tax credits. Convertible debt is a possibility, but its availability depends upon the stock market price. We will have a flow of $7 billion from depreciation in the 1976-1980 time period, but relative to the forecasted $20 billion commitment this would represent a minor contribution. We have never fallen significantly short of financing about half of our commitments from internal sources, i.e., depreciation plus earnings. In order to maintain that record the industry needs to earn about $3 billion in this five year time period. That is equal to $600 million per year after tax on average. Earnings then are the key to whether or not we can meet this kind of a commitment without ruining ourselves in the process.
Q. Will you repeat that last statement?
A. In the past, I said, we have generated approximately half or more than half of our fixed commitments from internally generated funds. In the latter half of the 1970's we will have $7 billion in depreciation, compared to the $20 billion commitment. So to close the gap, we need another $3 billion to total $10 billion or 50%. That $3 billion has to be earnings. If you divide that by five, you get $600 million per year after tax.

Q. What's the total cash flow?
A. Today, for the industry depreciation is running about $875 million per year. Earnings, according to Mr. Secor Browne, should be in the neighborhood of $250 million this year for the airlines.
BASIC CHARACTERISTICS OF THE AIRLINE INDUSTRY

1. SUSCEPTIBLE TO BUSINESS CYCLE.
2. SERVICE INDUSTRY.
3. CLOSELY GOVERNMENT REGULATED.
   (ROUTES, RATES, SAFETY)
4. HIGHLY COMPETITIVE.
5. HIGH GROWTH.
6. RAPID TECHNOLOGICAL CHANGE.
7. CAPITAL HUNGRY.
8. HIGHLY SEASONAL.
### CHART II

**SEASON I**
**THE EQUITY PERIOD**
**UP TO 12/31/54**

**BALANCE SHEET**
**MAJOR U. S. AIRLINES**
**YEAR END 1954**

($ millions)

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<tr>
<th>Description</th>
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KEY FINANCING RATIOS
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<td>Times Interest Coverage</td>
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AIRCRAFT COMMITMENTS
MAJOR U.S. AIRLINES

BILLIONS OF DOLLARS
10 —

8 —

6 —

4 —

2 —

0 —

1955 - 1959
SEASON II
THE INSURANCE CO. PERIOD
1955 - 1959

SOURCES & USES OF FUNDS
MAJOR U. S. AIRLINES
1955-1959
($ millions)

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<tr>
<td>Debt</td>
<td>35.4%</td>
</tr>
<tr>
<td>Leases</td>
<td>1.8%</td>
</tr>
<tr>
<td>Equity</td>
<td>7.8%</td>
</tr>
</tbody>
</table>

Sources

Uses

- Capital Expenditures $2212 93.2%
- Dividends 162 6.8%
<table>
<thead>
<tr>
<th>Asset Category</th>
<th>Amount ($ millions)</th>
<th>% of Capitalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working Capital</td>
<td>$188</td>
<td></td>
</tr>
<tr>
<td>Operating Property</td>
<td>1562</td>
<td></td>
</tr>
<tr>
<td>Other Assets</td>
<td>309</td>
<td></td>
</tr>
<tr>
<td><strong>Total Assets</strong></td>
<td><strong>$2,069</strong></td>
<td></td>
</tr>
<tr>
<td>Debt</td>
<td>$1055</td>
<td>51.2%</td>
</tr>
<tr>
<td>Deferred Credits</td>
<td>124</td>
<td>6.0</td>
</tr>
<tr>
<td>Stockholders' Equity</td>
<td>880</td>
<td>42.8</td>
</tr>
</tbody>
</table>

**BALANCE SHEET**

MAJOR U.S. AIRLINES

YEAR END 1959

($ millions)
## Key Financing Ratios
### Major U.S. Airlines

<table>
<thead>
<tr>
<th></th>
<th>1954</th>
<th>1959</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Ratio</td>
<td>1.39</td>
<td>1.33</td>
</tr>
<tr>
<td>Debt/Equity</td>
<td>.39</td>
<td>1.20</td>
</tr>
<tr>
<td>Debt/Equity (incl. Leases)</td>
<td>.39</td>
<td>1.25</td>
</tr>
<tr>
<td>Times Interest Coverage</td>
<td>13.3</td>
<td>3.1</td>
</tr>
</tbody>
</table>
AIRCRAFT COMMITMENTS
MAJOR U.S. AIRLINES

BILLIONS OF DOLLARS

1955 - 1959 1960 - 1965
### SEASON III
INTERNALLY FINANCED GROWTH

**SOURCES & USES OF FUNDS**
**MAJOR U. S. AIRLINES**
**1960-1965**
($ millions)

<table>
<thead>
<tr>
<th>Sources</th>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal</td>
<td>$3174</td>
</tr>
<tr>
<td>Debt</td>
<td>854</td>
</tr>
<tr>
<td>Leases</td>
<td>175</td>
</tr>
<tr>
<td>Equity</td>
<td>290</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Uses</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Capital Expenditures</td>
<td>$4260</td>
</tr>
<tr>
<td>Dividends</td>
<td>233</td>
</tr>
<tr>
<td>Description</td>
<td>Amount ($ millions)</td>
</tr>
<tr>
<td>--------------------------</td>
<td>---------------------</td>
</tr>
<tr>
<td>Working Capital</td>
<td>378</td>
</tr>
<tr>
<td>Operating Property</td>
<td>3352</td>
</tr>
<tr>
<td>Other Assets</td>
<td>488</td>
</tr>
<tr>
<td>Debt</td>
<td>1908</td>
</tr>
<tr>
<td>Leases</td>
<td>218</td>
</tr>
<tr>
<td>Deferred Credits</td>
<td>431</td>
</tr>
<tr>
<td>Stockholders' Equity</td>
<td>1661</td>
</tr>
</tbody>
</table>

1/ includes capitalized leases for aircraft
### KEY FINANCING RATIOS
#### MAJOR U. S. AIRLINES

<table>
<thead>
<tr>
<th></th>
<th>1954</th>
<th>1959</th>
<th>1965</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Ratio</td>
<td>1.39</td>
<td>1.33</td>
<td>1.39</td>
</tr>
<tr>
<td>Debt/Equity</td>
<td>.39</td>
<td>1.20</td>
<td>1.15</td>
</tr>
<tr>
<td>Debt/Equity (incl. Leases)</td>
<td>.39</td>
<td>1.25</td>
<td>1.28</td>
</tr>
<tr>
<td>Times Interest Coverage</td>
<td>13.3</td>
<td>3.1</td>
<td>6.6</td>
</tr>
</tbody>
</table>
AIRCRAFT COMMITMENTS
MAJOR U.S. AIRLINES

BILLIONS OF DOLLARS
10 -

8 -

6 -

4 -

2 -

0 -

1955 - 1959

1960 - 1965

1966 - 1971

262
4 Engine Jets

229
2 Engine Jets

252
3 Engine Jets

361
4 Engine Jets

174
3 Engine Wide Bodies

121
4 Engine Wide Bodies

143
2 Engine Jets

260
3 Engine Jets

214
4 Engine Jets
SEASON IV
GET IT WHERE YOU CAN

THE SECOND HALF OF THE DECADE

MOST FINANCING SOURCES DRIED UP OR BECAME VERY EXPENSIVE

- INTEREST RATES RISING
- INSURANCE COMPANIES NOT WILLING TO INCREASE LENDING
- PROSPECTIVE EQUITY INVESTORS SEEKING HIGHER DIVIDEND YIELDS
- AIRLINE EQUITY MARKET ANTICIPATING DECLINING EARNINGS

BUT CONSIDERABLE EXTERNAL FINANCING WAS NECESSARY TO MEET THE
COMMITMENTS FOR NEW AIRCRAFT. MORE EXPENSIVE SOURCES OF FINANCING
HAD TO BE TAPPED

a. SUBORDINATED CONVERTIBLE DEBENTURES
b. BANK CREDITS
c. LEASING
### CHART XIV

**MAJOR U. S. AIRLINES**
**SOURCE OF LONG TERM DEBT**
**INSURANCE COMPANIES**

<table>
<thead>
<tr>
<th></th>
<th>Total Long Term Debt at Year End</th>
<th>Debt Held by Insurance Companies</th>
<th>Insurance Debt as % of Total</th>
<th>% of New Debt Financed By Insurance Companies</th>
<th>% of 1968 Insurance Total</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1959</strong></td>
<td>$1,055</td>
<td>706</td>
<td>66.9%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>1968</strong></td>
<td>$4,592</td>
<td>1,713</td>
<td>37.3%</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Representative Companies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Metropolitan</td>
<td>30.1%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prudential</td>
<td>21.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Equitable</td>
<td>12.7</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>John Hancock</td>
<td>5.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aetna</td>
<td>5.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mutual Life of New York</td>
<td>3.5</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Connecticut General</td>
<td>3.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Others</td>
<td>18.9</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Year</td>
<td>Amount ($ millions)</td>
<td>Average Interest Rate</td>
<td>% Outstanding At Year End 1971</td>
<td></td>
<td></td>
</tr>
<tr>
<td>------</td>
<td>---------------------</td>
<td>-----------------------</td>
<td>-------------------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1959</td>
<td>47</td>
<td>4.9%</td>
<td>8.5%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1961</td>
<td>10</td>
<td>6.0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1964</td>
<td>60</td>
<td>4.5</td>
<td>41.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1965</td>
<td>53</td>
<td>4.0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1966</td>
<td>382</td>
<td>5.0</td>
<td>77.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1967</td>
<td>508</td>
<td>4.3</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1968</td>
<td>80</td>
<td>4.9</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1969</td>
<td>325</td>
<td>5.1</td>
<td>100.0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1970</td>
<td>80</td>
<td>8.0</td>
<td>0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### MAJOR U. S. AIRLINES
### SOURCE OF LONG TERM DEBT

<table>
<thead>
<tr>
<th></th>
<th>1964</th>
<th>1971</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Long Term Debt at Year End</td>
<td>$1,689</td>
<td>$5,194</td>
</tr>
<tr>
<td>Debt Held by Banks</td>
<td>291</td>
<td>1,256</td>
</tr>
<tr>
<td>Bank Debt as % of Total</td>
<td>17.2%</td>
<td>24.2%</td>
</tr>
<tr>
<td>Revolving Credit Agreements</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Available Credit Authorized</td>
<td>$2,120</td>
<td></td>
</tr>
<tr>
<td>Amount Borrowed</td>
<td>908</td>
<td></td>
</tr>
</tbody>
</table>

% of New Debt Financed by Banks: 27.5%
### MAJOR U. S. AIRLINES
GUARANTEED LOAN CERTIFICATES
($ millions)

<table>
<thead>
<tr>
<th></th>
<th>Amount</th>
<th>Average Coupon</th>
<th>Interest Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1969</td>
<td>$ 70</td>
<td></td>
<td>10.0%</td>
</tr>
<tr>
<td>1970</td>
<td>248</td>
<td></td>
<td>11.1</td>
</tr>
<tr>
<td>1971</td>
<td>103</td>
<td></td>
<td>10.7</td>
</tr>
</tbody>
</table>
### Major U.S. Airlines Coverage of Fixed Charges

<table>
<thead>
<tr>
<th></th>
<th>1969</th>
<th>1970</th>
<th>1971</th>
</tr>
</thead>
<tbody>
<tr>
<td>American</td>
<td>1.55</td>
<td>1.02</td>
<td></td>
</tr>
<tr>
<td>Eastern</td>
<td>0.96</td>
<td>1.07</td>
<td>1.08</td>
</tr>
<tr>
<td>Pan Am</td>
<td>0.38</td>
<td>0.33</td>
<td>0.43</td>
</tr>
<tr>
<td>TWA</td>
<td>1.17</td>
<td>1.26</td>
<td>1.01</td>
</tr>
<tr>
<td>United</td>
<td>1.88</td>
<td>1.58</td>
<td>1.01</td>
</tr>
<tr>
<td>Braniff</td>
<td>1.25</td>
<td>0.90</td>
<td>1.32</td>
</tr>
<tr>
<td>Continental</td>
<td>1.27</td>
<td>1.24</td>
<td>1.56</td>
</tr>
<tr>
<td>Delta</td>
<td>3.87</td>
<td>3.26</td>
<td>2.97</td>
</tr>
<tr>
<td>National</td>
<td>3.09</td>
<td>1.77</td>
<td></td>
</tr>
<tr>
<td>Northwest</td>
<td>6.51</td>
<td>3.13</td>
<td></td>
</tr>
<tr>
<td>Western</td>
<td>0.93</td>
<td>1.46</td>
<td></td>
</tr>
</tbody>
</table>

[ ] does not meet requirement of N.Y. State Insurance Law for coverage by 1.5 times.

* not representative because of strike.
## MAJOR U.S. AIRLINES
### RECENT EQUITY FINANCING
($ millions)

<table>
<thead>
<tr>
<th>Company</th>
<th>Amount</th>
<th>Increase in Shares Outstanding</th>
</tr>
</thead>
<tbody>
<tr>
<td>April 1971</td>
<td>$67.0</td>
<td>11.2%</td>
</tr>
<tr>
<td>May 1971</td>
<td>88.8</td>
<td>13.6</td>
</tr>
<tr>
<td>June 1971</td>
<td>89.9</td>
<td>15.7</td>
</tr>
<tr>
<td>July 1971</td>
<td>37.9</td>
<td>14.2</td>
</tr>
<tr>
<td>May 1972</td>
<td>54.3</td>
<td>14.2</td>
</tr>
<tr>
<td>July 1972</td>
<td>27.0</td>
<td>10.6</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>$364.9</strong></td>
<td></td>
</tr>
</tbody>
</table>

---

**Note:** This table summarizes recent equity financing for major U.S. airlines, including the amount raised and the increase in shares outstanding. The data is presented for specific months in 1971 and 1972.
### SOURCES & USES OF FUNDS
#### MAJOR U.S. AIRLINES
1966-1971

<table>
<thead>
<tr>
<th>($ millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Internal</td>
</tr>
<tr>
<td>Debt</td>
</tr>
<tr>
<td>Leases</td>
</tr>
<tr>
<td>Equity</td>
</tr>
</tbody>
</table>

*Sources*

<table>
<thead>
<tr>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>$5929</td>
</tr>
<tr>
<td>3322</td>
</tr>
<tr>
<td>2001</td>
</tr>
<tr>
<td>1132</td>
</tr>
</tbody>
</table>

*Uses*

| Capital Expenditures | $11934   |
| Dividends           | 450      |

<table>
<thead>
<tr>
<th>% of Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>11934</td>
</tr>
<tr>
<td>450</td>
</tr>
</tbody>
</table>
### CHART XXI

**BALANCE SHEET**

**MAJOR U.S. AIRLINES**

**YEAR END 1971**

($ millions)

<table>
<thead>
<tr>
<th>Category</th>
<th>Amount</th>
<th>% of Capitalization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Working Capital</td>
<td>$363</td>
<td></td>
</tr>
<tr>
<td>Operating Property</td>
<td>10147</td>
<td></td>
</tr>
<tr>
<td>Other Assets</td>
<td>1360</td>
<td></td>
</tr>
<tr>
<td>Debt</td>
<td>$5230</td>
<td>44.1%</td>
</tr>
<tr>
<td>Leases</td>
<td>2219</td>
<td>18.7</td>
</tr>
<tr>
<td>Deferred Credits</td>
<td>1064</td>
<td>9.0</td>
</tr>
<tr>
<td>Stockholders' Equity</td>
<td>3357</td>
<td>28.2</td>
</tr>
</tbody>
</table>

1/ includes capitalized leases for aircraft
<table>
<thead>
<tr>
<th></th>
<th>1954</th>
<th>1959</th>
<th>1965</th>
<th>1971</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Ratio</td>
<td>1.39</td>
<td>1.33</td>
<td>1.39</td>
<td>1.18</td>
</tr>
<tr>
<td>Debt/Equity</td>
<td>.39</td>
<td>1.20</td>
<td>1.15</td>
<td>1.56</td>
</tr>
<tr>
<td>Debt/Equity (incl. Leases)</td>
<td>.39</td>
<td>1.25</td>
<td>1.28</td>
<td>2.22</td>
</tr>
<tr>
<td>Times Interest Coverage</td>
<td>13.3</td>
<td>3.1</td>
<td>6.6</td>
<td>1.1</td>
</tr>
</tbody>
</table>
### THE SECOND HALF OF THE DECADE

($ billions)

<table>
<thead>
<tr>
<th>Commitments</th>
<th>1976 - 1980</th>
<th>$20</th>
</tr>
</thead>
</table>

#### Sources of Funds

<table>
<thead>
<tr>
<th>Debt</th>
<th>Insurance Companies</th>
<th>Nominal</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Banks-Existing Credit</td>
<td>$1</td>
</tr>
<tr>
<td>Leasing</td>
<td></td>
<td>Limited &amp; Expensive</td>
</tr>
<tr>
<td>Convertible Debt</td>
<td></td>
<td>Dilution</td>
</tr>
<tr>
<td>Depreciation</td>
<td></td>
<td>$7</td>
</tr>
<tr>
<td>Earnings</td>
<td></td>
<td>?</td>
</tr>
<tr>
<td>Equity</td>
<td></td>
<td>Dependent Upon Earnings</td>
</tr>
<tr>
<td>New Alternatives</td>
<td></td>
<td>?</td>
</tr>
</tbody>
</table>
THE ROLE OF THE EXPORT-IMPORT BANK IN
DEVELOPING THE EXPORT POTENTIAL OF AIRCRAFT SALES

by Chosei Kuge
Export-Import Bank of the U.S.

July 20, 1972

Abstract

A description of the current patterns, terms, and conditions of Eximbank commercial jet aircraft export financing will be given. As time permits, some discussion of the factors affecting export financing will be noted.
Let me make a few basic observations. Number one, Eximbank is a US Government agency. Number two, its principle objective is to facilitate US exports; you can forget about the "Import" in our name. Number three, we are to supplement and not compete with private sources of financing. Number four, any loan that we make must have a reasonable assurance of repayment; in other words, we are supposed to act as a banker and not as an AID-type agency. To give you an idea of Eximbank's authorized size, we can have total outstanding loans, guarantees and insurance of up to 320 billion. We have 31 billion of outstanding capital stock held by the US Treasury Department and 31.3 billion of reserves. We could borrow from the Treasury Department at any given time up to 56 billion. As of June 30, 1971 we have total assets of 35.8 billion. Subtract 32.3 billion net worth from that and our liabilities were about 33.5 billion. In fiscal year 1971 we earned close to 3120 million and paid a dividend to the Treasury Department of 350 million. The balance of our earnings go into our reserve account.

Question: What kind of a return on investment is that?
Answer: The net income is about a 5% return on net worth.

Let me give you an idea of the amount of financing we have been doing for commercial aircraft. In 1957, we financed four aircraft worth about $30 million and loaned 162 million dollars to do that.
Over this period we have been involved in more and more transactions and the dollar volume has been going up. However, the amount of money we actually put up per transaction, on a percentage basis, has gone down. In other words we are utilizing more and more private financing in specific transactions.

On a $10 million transaction, a typical financing pattern would call for a cash payment from the buyer of 10-20%. The buyer raises the cash payment from non-US sources. The other 80-90% of contract price is the financed portion. Eximbank puts up one-half and the other one-half comes from private sources, either in the U.S. or from foreign sources. The repayment term on the financing would be 10 years for a new commercial jet aircraft or anywhere from 5-7 years for used commercial jet aircraft. The amount of cash payment varies somewhat depending on who the buyer is. If you're talking about the major European airlines, cash payment will be 20% or greater. If you're talking about a weaker buyer in Africa, Asia or Latin America, it would probably be closer to the 10% figure.

Question: You require a higher down payment from the Europeans—what's the theory behind that. Usually the better the credit is, the lower the down payment? They are the biggest customers of the US. It seems to me that we should try to figure out some way to encourage greater sales.

Answer: Eximbank has to balance various objectives of the US Government, including the encouragement of greater sales through lower cash payments versus balance of payment improvement through higher cash payments.
We don't require supplier participation any more as a general rule. Supplier participation being Boeing, McDonnell-Douglas, or Lockheed extending credit to the buyer. We used to, and will continue to in a certain number of transactions involving higher risk buyers. Our present interest rate is 6% per annum. We charge a commitment fee on our loans of 1/2 of 1% per annum. If we guarantee the private financing, as we do in many cases, we charge 1/2 of 1% guarantee fee. On loans to strong European buyers, we try to get as much of the private portion from off-shore as we can. In many cases the buyers are able to raise financing equal to 20-25% of total contract price from offshore sources.

Question: When you say 6% interest charge--is that your current rate?
Answer: That's our current rate.

Question: Can you tie that somehow to your own cost of funds?
Answer: Since 1945, Eximbank's lending rate has been consistently higher than its borrowing rate at the U. S. Treasury and has never been lower than the average rate on the total public debt. On a cumulative average, Eximbank's operations have never entailed a subsidy cost.

Question: Wouldn't it be difficult for Pan Am and TWA to compete with foreign airlines against this kind of loan?
Answer: What you've got to take into account is the fact this difference between 6% and whatever Pan Am has to pay for their borrowing is only one element of total cost. There are other national interest reasons
why you would want to keep this rate at 6% and try to sell aircraft abroad. One basic reason is if we don't sell these aircraft abroad, our balance of payments and balance of trade are going to deteriorate and weaken the dollar in the world money markets. This could hurt Pan Am and TWA more than any 6% interest rate we charge the foreign airlines. In addition, this 6% only relates to possibly 40% of the transaction. The foreign buyer still has to pay a market rate on the other half of the financing. Also what you are talking about is 10 year Exim financing in contrast to Pan Am and TWA borrowing at 15-20 years.

Question: That could still be a huge difference though. If you're lending money at 6% to KLM and Pan Am has to pay 10% or 11% and the airlines have a huge part of their capital structure on debt, that's going to be a significant factor.

Answer: We have no reason to believe that Pan Am or any other major U. S. carrier is paying interest rates approaching 10% or 11% for their equipment purchases.

We have other programs to help finance U. S. exports, including guaranteeing aircraft leases. Many small aircraft are financed through our FCIA insurance and commercial bank guarantee programs described in our brochure. We have a cooperative financing facility and a discount loan facility through which many of the small to medium size transactions
are handled on terms up to say five years. Follow-on spares and other airline equipment are financed through these programs. We also finance U. S. goods and services which go into the airport construction and facilities.

Over the ten years I have been working at the Bank, the programs, methods of financing and outlook of the bank have changed, and I believe that is going to be the case in the future. Thus, if you're interested in how Exim is going to change in the next 10 years in financing U. S. exports, you have to keep in mind such factors as balance of trade and balance of payments. When you see them getting bad, greater efforts will have to be made to encourage and increase U. S. exports. If we don't we are going to have to cut back on other things that we are doing abroad or limit imports. International political and economic developments will also affect U. S. export financing. Eximbank's life is extended every five years. Thus, Congressional support in the following years is essential.

Money market conditions, availability of funds, and interest rates are going to affect what Exim does. Some critics say Exim should not finance jet aircraft exports today because ample funds are available at this time from the U. S. commercial banking sector. They fail to consider that U. S. commercial banks have a liquidity situation, resulting in limited funds from this source on repayment terms exceeding 5-6 years. Today it is very difficult to find commercial financing for new jet commercial aircraft on anything like 7 or 10-year terms. On the other hand, the overseas buyer, as well as Boeing, McDonnell Douglas and Lockheed would like to see Eximbank start supporting terms up to 12 years.
Another factor is that Eximbank is a US Government agency subject to annual review of its operations by the Administration and Congress. Eximbank does not operate on annual appropriations, however, and pays all its expenses out of earnings.

Question: What kind of debt security do you take versus commercial banks?
Answer: In typical transactions, we get notes from the buyer. The commercial bank does exactly the same thing. The notes are usually guaranteed by financial institutions or governments. Mortgages are not required in most instances.

Question: Who has first rights to proceeds from foreclosure when mortgages are taken?
Answer: If the mortgages were required to secure all lenders on a pro-rata bases, then the proceeds would be distributed accordingly.

I should also mention that in a 10 year transaction, Exim is prepared to take the last 5 years maturities and allow a commercial bank to take the earlier maturities. In this way, we are able to meet the commercial bank's requirement for liquidity.

Question: Are these figures typical of all transactions or do you differentiate between aerospace and other products?
Answer: When we're talking in terms of large projects and products, the typical transaction would be a 10% cash payment and 90% financing.
of which Eximbank's share would be one-half. As an exception, we have been able to get 20% cash payments from major European carriers for jet aircraft sales because of the competitive advantage of the US aircraft industry in recent years. In other transactions, the typical cash payment is 10%.

Question: Do you know what the Europeans are offering in Latin America?
Answer: Basically, it's 10% cash, 10 year repayment term with a subsidized interest rate. The BAC 111, Caravelle, and A-300B are all offered on those terms.

Question: Are the interest rates comparable?
Answer: The British interest rate is about 6% to 7% to the borrower on the total financing. They will change theirs as time goes along. Eximbank charges 6% on one-half the financing, while the commercial banks usually charge the prime rate plus a mark-up on a fluctuating bases. At this time, the rates are probably reasonably competitive.

Question: You said you had a 6% interest rate, plus a guarantee fee and another fee. Could you explain?
Answer: Eximbank charges a \( \frac{1}{2} \) of 1% per annum commitment fee on the amount of Eximbank's loan from 30 days after authorization until the loan funds are drawn down. The borrower pays a 6% interest rate on amounts which are drawn down. If Eximbank guarantees the private
financing, the Eximbank guarantee fee of 1/4 of 1% per annum is charged on the private financing from dates of draw down until repayments are made.

Question: Could you comment on Russian YAK-40 financing rates being so low?
Answer: It really doesn't make any difference because the Russians can change the price of their product and the interest rate in any manner they want. Profit isn't their main consideration.

Question: Have European manufacturers offered concessionary terms?
Answer: In some instances in the past, British and French manufacturers have gotten soft loan assistance for their buyers. US AID funds have not been used to finance commercial jet aircraft sales.

I think the extent of non-US content in US commercial jet aircraft will require more and more attention. It's becoming more and more difficult to sell aircraft abroad without some non-US content. Also, the prospects of a major new commercial jet aircraft being manufactured with 100% US companies involved may be very difficult. Other factors requiring consideration are (1) the importance of the non-US market to any new aircraft project, (2) exporting US technology, (3) foreign competition and (4) development of foreign aerospace industries.
Question: When you have multi-national interest and foreign equipment, is the bank precluded from loans on the portion that's foreign?
Answer: As a basic policy, Eximbank finances goods and services of U. S. manufacture and source only. If the amount of foreign content is sizeable, it would be deducted from the contract price and all percentages applied to the net U. S. content.

Question: What effect will the proposed Civil Aviation Financing Plan have? Can that help finance aircraft for foreign airlines?
Answer: Dr. James could answer that question better than I, though it is my understanding that the intent of the legislation is to provide capital to make possible the manufacture of new aircraft and not to provide financing for the ultimate purchaser.

Question: Wouldn't a reduction in cash payments increase sales?
Answer: Possibly, but the question is whether a reduction in the cash payment would increase U. S. exports sufficiently to make an appreciable difference and will increased sales be offset by the reduction in balance of payments from reduced cash payments.

Question: How is the policy of the bank established?
Answer: Basic policy is established by Congress and is set forth in our legislation. To carry out that policy, we have a five-man board of directors appointed by the President with advice and consent of the Senate.
Question: Are you prepared to say that you look upon your activities as a benefit as opposed to whether you exist or whether you didn't exist. In other words, you stimulate sales by existing and if you didn't exist you wouldn't.

Answer: I believe the answer is affirmative. There are many cases where US manufacturers, US commercial bankers, and other financial institutions cannot afford to take the risk that's involved in foreign sales. The only source available in the US to take that risk is the US Government. It is a legitimate objective of the US Government to take such political and economic risks. All of the other countries around the world do the same thing. We're in a buyer's market today.
The Market Demand for Air Transportation

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July 11, 1972

Abstract

Although the presentation will touch upon the areas of market for air transportation, the theoretical foundations of the demand function, the demand models, and model selection and evaluation, the emphasis of the presentation will be on a qualitative description of the factors affecting the demand for air transportation. The presentation will rely heavily on the results of market surveys carried out by the Port of New York Authority, the University of Michigan, and Census of Transportation.
The purpose of this paper is to present a basic analysis of the demand for air transportation. The presentation is divided into five areas: the market for air transportation, the factors affecting the demand for air transportation, the theoretical foundation of the demand function, air travel demand models, and model selection and evaluation.

The Market For Air Transportation

At the global level approximately 383 million passengers were carried on the scheduled domestic and international services of 120 airlines of the ICAO Contracting States during the year 1970. This includes the USSR traffic which accounted for almost 58 million passengers in 1970 and most of which was carried on the domestic routes. Of the total world traffic, 170 million passengers or 44.4 percent was carried by the airlines of the United States. Reliable statistics are not available for total world non-scheduled traffic, a bulk of which is generated in Europe and the United States.

The statistics taken from ICAO in Table 1 show the regional distribution of the total world traffic measured in percentage ton-km. performed on scheduled services. This table shows that almost 86% of the world air traffic was accounted for by North America and Europe (including the USSR).
Table 1

Regional Percentage Distribution of Total Ton-km
Performed on Scheduled Airlines of ICAO States

<table>
<thead>
<tr>
<th>REGION</th>
<th>1970</th>
<th>SERVICES</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Domestic</td>
<td>International</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td>North America¹</td>
<td>62.9</td>
<td>33.2</td>
<td>51.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Europe</td>
<td>28.8</td>
<td>44.1</td>
<td>34.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>East and South Asia and the Pacific²</td>
<td>5.6</td>
<td>11.2</td>
<td>7.8</td>
<td></td>
<td></td>
</tr>
<tr>
<td>South America</td>
<td>1.7</td>
<td>4.2</td>
<td>2.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Africa</td>
<td>0.7</td>
<td>3.8</td>
<td>1.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Middle East</td>
<td>0.3</td>
<td>3.5</td>
<td>1.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total ICAO World³</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. Includes Panama and all countries to the north as well as the Caribbean States and territories.

2. Including New Zealand, Australia and neighboring islands.

3. Including USSR statistics for Aeroflot.

Source: ICAO Bulletin, May 1972
These two areas account for almost 30% of the world's population and almost 80% of the world's economic activity. If we measure economic activity by Gross National Product, then the United States accounts for roughly thirty percent of the total world's GNP and almost 45% of the world's air passenger traffic.

The North Atlantic market represents the largest international air traffic flow in the world, accounting for almost a quarter of the total international passengers. In 1970, approximately ten million passengers traveled on this route with roughly three-quarters of these using scheduled airlines. Roughly a third of the passengers using non-scheduled services were transported by the charter operations of the scheduled carriers.

From the statistics collected by the Civil Aeronautics Board on the passenger traffic carried on United States scheduled air system in 1970, 153 million or a little over 90 percent were carried in the domestic operations. Table 2 shows the percentage distribution of the revenue passenger originations by carrier group. Over 70% of the passengers were carried by the eleven domestic trunk carriers and over 46% were accounted for by the Big Four Carriers. The revenue passenger miles of the United States domestic air system represents less than ten percent of the total for all modes.
## Table 2

### U.S. Scheduled Air Passenger Traffic & Distribution

<table>
<thead>
<tr>
<th>Carrier Group</th>
<th>Passengers (000)</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Domestic Operations</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trunks</td>
<td>122,866</td>
<td>72.4%</td>
</tr>
<tr>
<td>Local Service</td>
<td>26,472</td>
<td>15.6%</td>
</tr>
<tr>
<td>Helicopter</td>
<td>573</td>
<td>0.3%</td>
</tr>
<tr>
<td>Intra-Alaska</td>
<td>351</td>
<td>0.2%</td>
</tr>
<tr>
<td>Intra-Hawaii</td>
<td>2,643</td>
<td>1.6%</td>
</tr>
<tr>
<td>Other*</td>
<td>503</td>
<td>0.3%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>153,408</td>
<td>90.4%</td>
</tr>
<tr>
<td><strong>International and Territorial Operations</strong></td>
<td>16,260</td>
<td>9.6%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>169,668</td>
<td>100.0%</td>
</tr>
</tbody>
</table>

* Alaska, Aspen, Tag.

Although private automobile accounts for almost 85 percent of inter-city passenger traffic in terms of passenger miles, the air carriers are the largest form of common carrier transportation.

For passenger travel on the scheduled domestic air system, the 1970 CAB data shows that 42.8 percent of the passengers traveled a distance less than 499 miles while 99.0 percent of the passengers' trip length was 2749 miles or less. The reader is cautioned that these statistics do not include traffic data for the intra-state carriers. These statistics would change significantly if we were including PSA's traffic on the Los Angeles - San Francisco market, the world's largest passenger market.

The distribution of domestic scheduled air passenger traffic is shown in Table 3 for 1970. The top 100 city-pairs account for 33.4 percent of the total traffic while the top 1000 city-pairs accounts for 72.9 percent of the traffic. According to the CAB data, New York - Boston ranks as number one city-pair with a little over two million passengers in 1970. If we include intra-state operations, then a DOT Study, based on a ten percent sample similar to the CAB data, indicates that a total of 5.3 million passengers travelled on the Los Angeles - San Francisco route.

TABLE 3

U.S. Scheduled Domestic Air Passengers

Cumulative Distribution Among City-Pairs

1970

Number of Top City-Pairs In Order of Passengers Rank | Cumulative Percent
---|---
1 | 1.9
10 | 11.1
50 | 24.6
100 | 33.4
200 | 44.2
500 | 60.4
1000 | 72.9
ALL | 100.0

The seasonality of air travel is a very important characteristic. Figures 1 and 2 show the monthly seasonality of the traffic moving through New York. The months of July and August represent peaks for both domestic and overseas travel. The effect of seasonality is more pronounced if we analyze an individual market. Figure 3 shows that on the North Atlantic, the eastbound traffic was almost four and a half times greater in July than in February. Air travel even changes with the day of the week and hour of the day. The peaks in the hourly variation can be explained partially by the preference of the business traveler. The somewhat heavier demand on Thursday and Friday can be partially explained by the preference of the traveler on personal business or pleasure to travel at the end of the week. These demand patterns are seen in Figures 4 and 5.

Part of the seasonality pattern may be artificial. Originally, excursion or discount fares were introduced by the carriers to shift demand from the peaks to the slack periods. However, the black out periods established to reduce peaking have created their own peaking problems.
Figure 1

Seasonality of Air Travel Demand
U.S. Domestic at New York

Total Domestic Passenger Revenue Traffic Handled by New York Airports - by Month

Source: PONYA, Monthly Airport Traffic, January-December 1971
Figure 2

Seasonality of Air Travel Demand

U.S. Overseas at New York

Passengers (millions)

Total Overseas Passenger Revenue Traffic Handled by New York Airports - by Month

Source: PONYA, Monthly Airport Traffic, January-December 1971
Figure 3

Seasonality of the North Atlantic Traffic - by Month

Passengers
\( \times 10^5 \)

--- Westbound scheduled

- Eastbound scheduled

Source: IATA World Air Transport Statistics
Figure 4
Daily Air Travel Demand
by Hour

Sources: New York's Domestic Air Passenger Market, PONYA May 1965
Cleveland-Hopkins Airport Access Study
Survey Results, Regional Planning Commission, Cleveland, Ohio
June 1970
Figure 5

Weekly Air Travel Demand by Day

Source: Phase II Survey (September 8-14, 1969) Cleveland-Hopkins Airport Access Study Survey Results, June 1970 - Regional Planning Commission - Cleveland, Ohio
Factors Influencing The Demand For Air Travel

Factors affecting the air travel demand can be grouped into two broad categories: market related and trip related. The market related variables, also called the socio-economic variables, are those inherent to the general economic, geographic, social and political environment. This group can be further divided into characteristics related to the traveler (income, age, occupation, etc.) and demographic characteristics (population, industrial activity, tourism, etc.). The trip related variables, on the other hand, are those inherent to the transport mode, that is cost, travel time, comfort, safety and convenience. The demand for air travel is influenced by a complex interaction of one or more of these variables. This section contains a qualitative description of some of these factors.

The demand for air travel can be analyzed in two parts: personal travel and business travel. Table 4 shows the distribution of air travel by purpose of trip. In 1967, based on the survey carried out by the Census of Transportation, personal and business travel each accounted for about 50 percent of the air travel market.
### Table 4

Percentage Distribution of Air Travel by Purpose of Trip (1967)

<table>
<thead>
<tr>
<th>Purpose</th>
<th>Person-trips</th>
<th>Person-miles</th>
</tr>
</thead>
<tbody>
<tr>
<td>business</td>
<td>45.8</td>
<td>40.8</td>
</tr>
<tr>
<td>conventions</td>
<td>5.5</td>
<td>6.5</td>
</tr>
<tr>
<td>visits to friends &amp; relatives</td>
<td>23.9</td>
<td>26.0</td>
</tr>
<tr>
<td>outdoor recreation</td>
<td>2.4</td>
<td>2.5</td>
</tr>
<tr>
<td>entertainment</td>
<td>3.4</td>
<td>3.6</td>
</tr>
<tr>
<td>sightseeing</td>
<td>7.6</td>
<td>7.6</td>
</tr>
<tr>
<td>other pleasure</td>
<td>2.2</td>
<td>2.3</td>
</tr>
<tr>
<td>personal &amp; family</td>
<td>9.1</td>
<td>10.7</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100%</strong></td>
<td><strong>100%</strong></td>
</tr>
</tbody>
</table>

Source: 1967 Census of Transportation
Market Related Factors

**Income:** Air travel is strongly determined by income, personal income in the case of personal travel and national income in the case of business travel. The ability to pay however, has to be accompanied by the willingness or the desire to spend. The demand for air travel is unlikely to change, if for example, an increase in income is accompanied by an exact increase in savings. Table 5, taken from Port of New York Authority's survey data for 1967 shows that 94 percent of the passengers surveyed had an annual family income higher than $5000. The data implies that the higher the income, the higher the percentage of travel. A similar survey carried out by the University of Michigan in 1962 showed that in a sample of 5093 respondents, 28 percent of the respondents had family income less than $4000 and accounted for 6 percent of the airtrips, while 17 percent of the respondents with family income of $10,000 and above accounted for 60 percent of the air travel.

There are at least three forms of per capita income that can be used to explain the demand for air travel: national income is equal to domestic product at factor cost plus net factor income from abroad; disposable income is defined as personal income less taxes; discretionary income is that portion of disposable income in excess of the amount necessary to maintain a defined or historical standard of living.
Table 5

Average Family Income of New York's Domestic Air Passenger Market

<table>
<thead>
<tr>
<th>Family Income</th>
<th>Percent of the Survey Population</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1956</td>
</tr>
<tr>
<td>Under $5,000</td>
<td>12%</td>
</tr>
<tr>
<td>$5,000 - $9,999</td>
<td>32</td>
</tr>
<tr>
<td>$10,000 - $14,999</td>
<td>21</td>
</tr>
<tr>
<td>$15,000 - $19,999</td>
<td>10</td>
</tr>
<tr>
<td>$20,000 and over</td>
<td>25</td>
</tr>
<tr>
<td>(Median)</td>
<td>$11,400</td>
</tr>
</tbody>
</table>

Source: Port of New York Authority Reference 2.
This last type of income may be saved or spent with no immediate impairment of living standards. Thus, it would appear that discretionary income would be a better and more consistent predictor of air travel growth than either disposable or national income. However, most studies employ disposable income for the following reasons:

1. unavailability of consistent data for discretionary income.
2. difficulty of quantification of discretionary income.
3. subjective definitions as to the size of discretionary income.

Although data on disposable income per capita for the United States is readily available, similar and consistent data for other countries is not available. For international travel, one can use the data on national income which is published by the United Nations in consistent form for many countries including the United States.

Various studies have shown that a factor which is even more important than the level of personal income is the distribution of family income. Some analysts prefer to use the distribution of family income above a certain base level to explain the demand for air travel. Asher\(^3\) uses a base of $7,500 for international travel; in other words, the traveler's annual income is greater than or equal to $7,500 and the greater the income (above $7,500) the greater the chances of his taking the trip. The use of such a distribution should be viewed with caution since:
1. The base level is a subjective measure and analysts differ in their views of its numerical value. Furthermore, the level would vary by geographic region.

2. The data is very sketchy on the distribution of income in the United States and almost non-existent for some of the foreign countries.

3. The variation in the income distribution is fairly difficult to forecast accurately.

It has been shown previously that the level of income is an explanatory variable which partially explains the pleasure demand for air travel. While higher income families are more likely to travel, it is not income alone that influences them to travel. Now, we will introduce other variables related to income which also influence the pleasure travel demand. Given the relationship between income and the demand for air travel, the relationship between occupation, education, social status, etc., is fairly easy to predict. Travelers in the higher status occupations are usually educated to a higher level, belong to a higher social class and earn a higher income.

Table 6 shows the relationship between occupation and air travel. In 1967, the survey of the pleasure air travelers in New York shows that 19 percent were in the professional and technical category.
### Table 6

**Occupation By Broad Purpose of Trip**

**New York's Domestic Air Passenger Market**

1967

<table>
<thead>
<tr>
<th>Occupation</th>
<th>Visiting Friends or Relatives</th>
<th>Sightseeing or Visiting Resort</th>
<th>Other</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical, Professional</td>
<td>21</td>
<td>20</td>
<td>10</td>
<td>19</td>
</tr>
<tr>
<td>Manager, Official</td>
<td>14</td>
<td>17</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Salesman</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Secretary, Clerk</td>
<td>11</td>
<td>12</td>
<td>3</td>
<td>9</td>
</tr>
<tr>
<td>Mechanic, Craftsman, Factory Worker</td>
<td>4</td>
<td>4</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Armed Forces</td>
<td>2</td>
<td>1</td>
<td>24</td>
<td>7</td>
</tr>
<tr>
<td>Housewife</td>
<td>22</td>
<td>23</td>
<td>19</td>
<td>21</td>
</tr>
<tr>
<td>Student</td>
<td>17</td>
<td>12</td>
<td>32</td>
<td>20</td>
</tr>
<tr>
<td>Retired</td>
<td>5</td>
<td>5</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Other</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

*Source: Port of New York Authority. Reference 2.*
Further, the 1967 Travel Survey shows that for 56 percent of the trips taken, the occupation of the household head was either professional or managerial. The category of factory workers and service workers accounted for only 3% of the sample population.

The level of education attained has a high correlation with income, occupation, social status, human wants, buying habits and attitudes. The educated generally travel more. Even when income is held constant, the better educated population tends to outspend the lesser educated for all goods and services. In addition, the better educated respond strongly to innovations. Therefore, the amount of education is increasingly important in estimating the demand for certain products.

Higher education inspires an interest in and a desire to see other places, and thus affects demand for air travel. Today, there is a phenomenon which is not so much a pressure against heavy spending as a pressure to spend money as educated men are supposed to spend it. This is shown in the National Travel Survey by the fact that in 1967, 66 percent of the air travelers had some college education and 94 percent had high school training. The vital role education plays in the air travel demand is substantiated by many other surveys.
For example, in a 1955 survey of United States Tourists in Europe, 57% were found to be college and university graduates. Life magazine, in a survey in 1960, found that 72 percent of the respondents sampled had some college education (19 October 1960).

Knowledge of the social class with which a consumer affiliates and/or to which he aspires also provides an indication of the likelihood of his traveling. The middle class considers non-business air travel prestigious and a middle class person normally aspires to develop purchasing habits and attitudes similar to those of persons with higher social status.

This phenomenon also takes place within the same social class. For example, having relatives, friends or business associates who traveled and enjoyed their trips appears to be an important determinant of a person's decision to travel. As a result of social pressures such as status-seeking and a desire to conform, the travel decision of the individual may be a reflection of his friends' and associates' spending preferences.

While rising incomes account for part of the increase in the demand for air travel, changes in taste also account for part of the growth. For example, a reduction in income may not be accompanied by a proportionate reduction in travel and visa versa. Tastes change with time and the availability of other goods and services will continually influence the demand for air travel.
It appears that business travel is not sensitive to personal income. Business reasons are not self-selected, and although highly paid senior management executives travel more than middle and lower level staff, income of the business traveler seldom seems to directly influence the frequency or, in some cases, the class of travel.

Business travel in general appears to depend, among other things, on the state of the economy. In individual city-pairs, the demand for business travel will depend on the type and extent of the business activity in each city. On the other hand, the demand for international travel may depend on the level of exports, imports, investment abroad, balance of payments, etc.

Since the economy is correlated to the demand for business travel, it stands to reason that during recessions, the amount of business travel diminishes. Conversely, during an expansion of the economy, business travel increases. During recessions when corporate profits are down and costs are rising, one of the means of reducing corporate costs is to curtail business travel. It can be seen from this that a relationship exists between the fluctuations in the economy and the travel trend. However, this relationship is very general, since fluctuations in the economy do not exactly coincide with fluctuations in traffic. The reason for this is twofold. First, there is never just one factor at play. Every year's traffic is influenced by many factors simultaneously.
Secondly, there is a time lag between the movement in the economy and the influence on traffic. To attempt to predict this time lag accurately would require very sophisticated techniques and numerous statistical data. It has been suggested that a variable time lag should be considered. The variation implied here is twofold. First, the time lag should be different for the pleasure and business markets. Secondly, it should reflect the economy at any given time as being in the state of expansion, recession or normality. Due to the sophistication involved, accuracy is usually sacrificed for simplicity and fixed lags are used.

Population: Although it stands to reason that other things being equal, the demand for air travel would increase in some proportion to the population growth, its influence is seen more clearly from the analysis of geographic concentrations of populations and its distribution by age, income and occupation. The influence of occupation and income has already been shown. Many surveys have shown that the average age of the traveler is declining. Table 7 shows that between 1960 and 1969, the percentage of the United States population in the age group 15-29 years increased from 19.5 percent to 23.4 percent.
Table 7

Population by Age: 1960 and 1969

(Total resident population, excluding Armed Forces abroad)

<table>
<thead>
<tr>
<th>AGE (in years)</th>
<th>Percent Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1960 (Apr. 1)</td>
</tr>
<tr>
<td>Total</td>
<td>100.0</td>
</tr>
<tr>
<td>Under 5</td>
<td>11.3</td>
</tr>
<tr>
<td>5-9</td>
<td>10.4</td>
</tr>
<tr>
<td>10-14</td>
<td>9.4</td>
</tr>
<tr>
<td>15-19</td>
<td>7.4</td>
</tr>
<tr>
<td>20-24</td>
<td>6.0</td>
</tr>
<tr>
<td>25-29</td>
<td>6.1</td>
</tr>
<tr>
<td>30-34</td>
<td>6.7</td>
</tr>
<tr>
<td>35-44</td>
<td>13.4</td>
</tr>
<tr>
<td>45-54</td>
<td>11.4</td>
</tr>
<tr>
<td>55-64</td>
<td>8.7</td>
</tr>
<tr>
<td>65-74</td>
<td>6.1</td>
</tr>
<tr>
<td>75-84</td>
<td>2.6</td>
</tr>
<tr>
<td>85 and over</td>
<td>0.5</td>
</tr>
</tbody>
</table>

* Preliminary

Source: Statistical Abstracts of the U.S. 1970
The influence of varying growth in different sectors of the population has different effects on the demand for air travel. For example, as pointed out by Wheatcroft in his paper on the elasticity of demand for the North Atlantic, the influence of the population growth on the demand for air travel, should include an allowance for the growth of the European immigrant population. This section of the United States population has grown almost twice as fast as the rest of the population. He has also pointed out another demographic factor which has influenced the traffic over the North Atlantic; the tendency of the United States population to shift towards the West Coast and the influence of immigration. Data taken from the United States Abstracts shows that from 1790-1960 the centre of gravity of the United States population moved from a point 23 miles east of Baltimore, Maryland to a point 4 miles east of Salem, Marion County, Illinois, a distance of roughly 700 miles westwards. Besse and DeMars, in their study reported that from 1940-1960 the centre of gravity of the United States population moved 160 km westwards. This might be regarded as an adverse influence for European travel, since it would imply that an increasing proportion of the United States population lives nearer other competitive areas of pleasure travel (Hawaii and the Orient).
Trips Related Factors

Fares: The Marshallian law of demand is applicable to air travel: consumers will buy more at lower prices and less at higher prices, if other things do not change.

Both personal and business air travel demand is dependent upon total trip cost and varies inversely with the trip cost as compared with other prices. Table 8 shows the historical trend of domestic and international fares and its relationship to consumer prices. The fares are represented by yield which is defined as revenue per revenue passenger mile. To compute yield, the accounting procedure is to divide the total passenger revenue for a given time in a given market by the total revenue passenger miles in that time period. Only revenue passengers are counted. The product of one passenger traveling one mile constitutes a revenue passenger mile.

Table 8 shows while consumer prices have increased sharply since 1965, the domestic and international yields have declined. It should be pointed out that a decline in yield does not always imply a change in fare levels. A change in the traffic mix and/or change in the average stage length may cause a change in the average yield. A change in the fare can also be the result of a change in the tax levied on air transportation.
<table>
<thead>
<tr>
<th>Year</th>
<th>Domestic Fare (cents)</th>
<th>Foreign Fare (cents)</th>
<th>Domestic Fare Index</th>
<th>Foreign Fare Index</th>
<th>Consumer Price Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>1957</td>
<td>5.25</td>
<td>6.49</td>
<td>95.5</td>
<td>129.3</td>
<td>84.3</td>
</tr>
<tr>
<td>1958</td>
<td>5.58</td>
<td>6.46</td>
<td>101.5</td>
<td>128.7</td>
<td>86.6</td>
</tr>
<tr>
<td>1959</td>
<td>5.80</td>
<td>6.31</td>
<td>105.5</td>
<td>125.7</td>
<td>87.3</td>
</tr>
<tr>
<td>1960</td>
<td>6.01</td>
<td>6.39</td>
<td>109.3</td>
<td>127.3</td>
<td>88.7</td>
</tr>
<tr>
<td>1961</td>
<td>6.18</td>
<td>6.08</td>
<td>112.4</td>
<td>121.1</td>
<td>89.6</td>
</tr>
<tr>
<td>1962</td>
<td>6.35</td>
<td>5.87</td>
<td>115.5</td>
<td>116.9</td>
<td>90.6</td>
</tr>
<tr>
<td>1963</td>
<td>6.07</td>
<td>5.82</td>
<td>110.4</td>
<td>115.9</td>
<td>91.7</td>
</tr>
<tr>
<td>1964</td>
<td>6.01</td>
<td>5.44</td>
<td>109.3</td>
<td>108.4</td>
<td>92.9</td>
</tr>
<tr>
<td>1965</td>
<td>5.94</td>
<td>5.26</td>
<td>108.0</td>
<td>104.8</td>
<td>94.5</td>
</tr>
<tr>
<td>1966</td>
<td>5.69</td>
<td>5.13</td>
<td>103.5</td>
<td>102.2</td>
<td>97.2</td>
</tr>
<tr>
<td>1967</td>
<td>5.50</td>
<td>5.02</td>
<td>100.0</td>
<td>100.0</td>
<td>100.0</td>
</tr>
<tr>
<td>1968</td>
<td>5.45</td>
<td>4.96</td>
<td>99.1</td>
<td>98.8</td>
<td>104.2</td>
</tr>
<tr>
<td>1969</td>
<td>5.70</td>
<td>4.95</td>
<td>103.6</td>
<td>98.6</td>
<td>109.8</td>
</tr>
<tr>
<td>1970</td>
<td>5.80</td>
<td>5.02</td>
<td>105.5</td>
<td>100.0</td>
<td>116.3</td>
</tr>
</tbody>
</table>

Source: CAB Report - July 1971

"Productivity and Employment Costs in System Operations of the Trunk Airlines and Pan American, from 1957 through 1970"
While the transportation cost is a significant determinant of the demand for air travel, the total trip cost appears to be a more important explanatory variable, especially in the case of international travel. Table 9 shows the historical trend of the total average cost of a transatlantic trip. The declining trend since 1960 is due to the decline in fares and the decline in average expenditures while traveling in Europe. The downward trend in expenditures abroad is explained partially by the growing number of United States citizens with limited funds who are now traveling and partially by the fact that air travelers have been staying shorter periods in Europe and spending less. The average stay declined from about 66 days in 1950 to 45 days in 1963. Data presented in a recent Boeing publication indicates that in 1969 the average stay had further declined to 28 days.

Table 10 compares the major components of the cost of a ten day trip in Europe and a large city in the United States for the years 1958 and 1970. In both cases, the air fare represents a smaller part of the total cost in 1970 compared to 1958. This was accompanied by an increase in the ground costs. This table also shows that in the case of the European trip, almost half of the total cost represents the air fare, while for the domestic trip, the hotel bill accounts for half of the total cost.
Table 9

Average Cost of a North Atlantic Trip

<table>
<thead>
<tr>
<th>Year</th>
<th>Transportation Cost</th>
<th>Expenses While in Europe and Mediterranean</th>
<th>Total Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>1951</td>
<td>$610</td>
<td>$759</td>
<td>$1369</td>
</tr>
<tr>
<td>1952</td>
<td>630</td>
<td>767</td>
<td>1397</td>
</tr>
<tr>
<td>1953</td>
<td>641</td>
<td>812</td>
<td>1453</td>
</tr>
<tr>
<td>1954</td>
<td>628</td>
<td>858</td>
<td>1467</td>
</tr>
<tr>
<td>1955</td>
<td>640</td>
<td>889</td>
<td>1529</td>
</tr>
<tr>
<td>1956</td>
<td>660</td>
<td>867</td>
<td>1527</td>
</tr>
<tr>
<td>1957</td>
<td>666</td>
<td>867</td>
<td>1533</td>
</tr>
<tr>
<td>1958</td>
<td>655</td>
<td>876</td>
<td>1531</td>
</tr>
<tr>
<td>1959</td>
<td>650</td>
<td>850</td>
<td>1500</td>
</tr>
<tr>
<td>1960</td>
<td>660</td>
<td>840</td>
<td>1500</td>
</tr>
<tr>
<td>1961</td>
<td>630</td>
<td>760</td>
<td>1390</td>
</tr>
<tr>
<td>1962</td>
<td>595</td>
<td>705</td>
<td>1300</td>
</tr>
<tr>
<td>1963</td>
<td>550</td>
<td>605</td>
<td>1200</td>
</tr>
<tr>
<td>1964</td>
<td>520</td>
<td>650</td>
<td>1170</td>
</tr>
<tr>
<td>1965</td>
<td>510</td>
<td>610</td>
<td>1120</td>
</tr>
<tr>
<td>1966</td>
<td>487</td>
<td>583</td>
<td>1071</td>
</tr>
<tr>
<td>1967</td>
<td>460</td>
<td>562</td>
<td>1022</td>
</tr>
<tr>
<td>1968</td>
<td>455</td>
<td>510</td>
<td>965</td>
</tr>
</tbody>
</table>

Table 10

Components of Cost of Travel

<table>
<thead>
<tr>
<th>Component</th>
<th>Distribution of Expenses for a 10-Day Trip</th>
<th>In Europe</th>
<th>In a Large City in U.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Fare</td>
<td>75.8%</td>
<td>48.7%</td>
<td>31.6%</td>
</tr>
<tr>
<td>Meals</td>
<td>12.0</td>
<td>25.3</td>
<td>26.2</td>
</tr>
<tr>
<td>Hotels</td>
<td>12.2</td>
<td>26.0</td>
<td>42.2</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Source: Air Transport 1971. ATA, Washington, D.C.
The cause of declining fares when the price of almost everything else has been going up is the continuous reduction in the unit operating costs (both direct and indirect) for the scheduled airlines due to the higher productivity of the successive generations of civil aircraft. The jet aircraft has considerably higher productivity being both bigger and faster than the piston-engined aircraft. Although the new aircraft also have higher operating costs per hour than their predecessors, the gain in productivity per hour was greater than their increase in costs per hour. Therefore, the net effect of their introduction was to produce a fall in the average unit operating costs.

The reduction in the normal air fares has been important in attracting new and repeat travelers. They have made it more attractive for consumers who had never traveled before and others to take more frequent trips. There have also been many special areas, adapted to certain categories of users. The big fare reductions brought about by the introduction of a new class are probably those which strike the public most, but it would be a mistake to underestimate the influence of special fares, which have certainly generated a constant and very substantial increase in traffic. Examples of such fares are:

- Excursion fares, which presupposes a given length of stay, sometimes with departures only on certain days of the week. Often they are limited to certain times of the year which are staggered according to the point of origin of the passengers
- Out-of-season fares, which also tend to lessen the seasonal nature of traffic while permitting certain categories of passengers to go on a trip at a lower price.

- Family fares

- Group fares granted automatically to parties comprising more than a certain number of members.

In addition to the introduction of special fares, Charter has played a very important role in the development of air travel, especially in the international market. Historically, charter operations were started by scheduled airlines using spare (unproductive) equipment at off-peak periods. However, advanced equipment, with higher productivity (increased capacity and speed) and lower unit operating costs brought about by high load factors have made charter operations profitable.

In recent years, charter traffic across the North Atlantic has been growing very rapidly relative to the traffic on scheduled carriers. The supplemental airlines have increased their share of traffic very significantly from less than 2 percent of the total transatlantic passenger traffic in 1963 to over 15 percent in 1969. Charter sales have increased as the price spread between charters and scheduled services has increased. This gap in fares (estimated over $160 average in 1968) from California to Europe has been largely responsible for the growth of supplemental charters in the market.
Supplemental charter traffic refers to the carriers offering charter service only. In the early sixties, several carriers were authorized to supplement the scheduled carriers by concentrating on charters for bona fide groups. However, authorization was not for these carriers to sell individually ticketed, point-to-point, transportation to the general public. It appears that the main reason for the tremendous growth in supplemental carriers traffic is simply that these carriers have misinterpreted their authorization and have carried traffic other than bona fide groups.

Charters, although a small percentage of the total transatlantic market, are very important in several key markets. They account for one-third of the transatlantic traffic originating in California, and almost 85% of these charters are on supplemental carriers. The price spread between charters and scheduled service depends on the length of travel, the ratio of ferry mileage to live mileage and the load factors. In 1968, for example, this spread was about $70 for New York-London roundtrip and about $160 for Los Angeles-London roundtrip.

The impact of lower fares depends among other things on the purpose of the trip. The pleasure traveler who uses charter services, does so to save money and is, therefore, willing to put up with a certain amount of inconvenience.

* Ferry mileage refers to the aircraft flying without revenue load. One reason for the negligible supplemental charter activity on the North Atlantic during off-season is due to the high ferry to live mileage ratio.
Many surveys have shown (TWA on-board surveys, PONYA) that the two categories most attracted to charter travel are ethnic and religious groups and educational and youth organizations. Ethnic groups are often attracted to a particular destination with which they feel they have emotional ties, often a desire to visit the homeland. Their travel is generally for the purpose of visiting friends or relatives. Price in this case plays a very important role. The cost of the stay after arriving at their destination is small. Similarly, students are usually limited by cash, have a specific destination and the cost of their stay is small relative to the cost of transportation. Charters, therefore, are attracted to these groups because they can generate full plane-loads through established organizations.

Charters are also attracted to professional and cultural organizations. These include organizations from the upper income sections of the community, for example, the medical, legal, cultural organizations such as symphony and art societies and political organizations. Charitable organizations are also included in this group.

**Trip Time:** The decision to go by air is mainly a function of trip time. Speed is the primary competitive advantage of air travel over other modes, for the air journey has become both shorter and more reliable with speed improvements in newer aircraft.
Over the years the cruise speed of each generation of new aircraft have increased from about 110 miles per hour for the Ford Tri-Motor to almost 600 miles per hour for the Boeing 747 introduced in service in 1970. The increases in non-stop range of aircraft have also led to shorter point-to-point travel times through the elimination of intermediate stops. A longer-range capability was not necessarily combined with higher cruising speed in newer aircraft.

Reduction in trip time, basically due to the higher speeds of aircraft, has affected both the business traveler as well as the pleasure traveler. Higher speeds have meant that the businessman can reach his destination in less time. Higher speeds also mean that the pleasure traveler can visit more distant places in a given time.

The total demand for air travel (pleasure and business) varies inversely with the time required to complete a given trip. The value placed upon travel time for both pleasure and business purposes would presumedly be related to some measure of the traveler's earning rate. One such measure is the wage rate. There are, of course, many reasons why the value of time spent in travel might be larger or smaller than the traveler's wage rate. To the extent that the business traveler works during part of the flight or the pleasure traveler reads or watches a movie, travel does not take time away from other activities that have value.
In addition, traveling might be sufficiently relaxing, exciting, or prestigious to the extent that travelers would pay for these pleasures by placing a lower rate on their value of time. Conversely, those for whom travel is boring, fatiguing or frightening would value travel time at rates higher than otherwise. Thus, although it is reasonable to expect that the higher the traveler's earnings, the higher the value he would place upon his time, the exact value he places upon his time actually be either greater than or less than his earning rate.³

Comfort, Safety, Convenience: It is extremely difficult, if not impossible, to determine the exact effect of comfort, safety and convenience on the volume of traffic. The difficulty lies in the fact that these variables are difficult to quantify and that their relative numerical value is rather subjective. Nevertheless, they do affect travel demand even if the contribution may be small. It has been suggested that changes in these variables such as comfort and convenience tend to occur more or less evenly over time. It is assumed that while each of these variables may be quite difficult to measure empirically, the net effect of all these factors may be approximated by a time trend function.
Comfort: Improvements in the quality of air travel tends to be of greater importance as a competitive factor rather than in creating new travel. Comfort is related to the comfort in the aircraft as well as comfort at the airport. With respect to comfort in the aircraft, there have been gradual product improvements related to the air trip. The newer aircraft have gradually improved the quality of the air service. Major innovations which have led to greater comfort are the pressurized cabins and the reduction in cabin noise and vibration. Other factors contributing to inflight comfort have been a significant improvement in the quality of food service, items such as special meals, vast quantities and variety of reading material, inflight stereo, multi-channel music and movies. The level of inflight comfort has also been increased due to lower values of seating density, the classical example being the B-747. The distance between seats and their individual width vary with the type of service which the passenger buys.

The comfort level at the airport has also been steadily improving. Modern facilities at the airports, easy and comfortable access to the aircraft (covered ramps, mobile lounges) have increased the level of comfort.

Access times to and egress times from the airports have generally increased around some larger cities. This is partly due to the movement of airports to locations more distant from the city centers but mostly due to the increasing traffic congestion on the roads.
Safety: It is true that a certain percentage of the traveling public will always be diverted to other modes for safety reasons. For this group, fear plays a large role in keeping them away from the airlines. This remains true even though the relative improvement in the safety of airline service, according to the measures usually presented, has been greater than for major surface transport media as shown by Table 11. Of course, the absolute number of passenger deaths due to aircraft accidents has been growing but the number of passengers has been increasing more rapidly.

Table 11 also shows the comparative transport safety record of the United States carriers compared to other countries. It is interesting to note that the record of the United States scheduled domestic, international and territorial airlines is significantly better compared to all scheduled airlines of the ICAO Contracting States.

The attitude of the traveler towards safety is somewhat related to his experience as an air traveler. This was substantiated by the results by a Michigan University survey on the feelings about air safety. The question asked was, "Do you feel that air travel is safer now (1962) than it was 10 years ago?" The results show that 74 percent of the experienced air travelers felt that air travel was safer now, compared to 58 percent of the inexperienced travelers. Fourteen percent of the inexperienced travelers indicated that air safety had in fact deteriorated.
Table 11
Comparative Transport Safety Record

Passenger Fatality Rate per 100 Million Passenger Miles

<table>
<thead>
<tr>
<th>Year</th>
<th>Motor Buses</th>
<th>Rail Roads</th>
<th>Autos</th>
<th>Scheduled Airlines</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>U.S.</td>
</tr>
<tr>
<td>1960</td>
<td>0.11</td>
<td>0.16</td>
<td>2.2</td>
<td>0.76</td>
</tr>
<tr>
<td>1961</td>
<td>0.15</td>
<td>0.10</td>
<td>2.2</td>
<td>0.30</td>
</tr>
<tr>
<td>1962</td>
<td>0.11</td>
<td>0.14</td>
<td>2.2</td>
<td>0.26</td>
</tr>
<tr>
<td>1963</td>
<td>0.26</td>
<td>0.07</td>
<td>2.3</td>
<td>0.23</td>
</tr>
<tr>
<td>1964</td>
<td>0.15</td>
<td>0.05</td>
<td>2.4</td>
<td>0.26</td>
</tr>
<tr>
<td>1965</td>
<td>0.16</td>
<td>0.07</td>
<td>2.4</td>
<td>0.31</td>
</tr>
<tr>
<td>1966</td>
<td>0.23</td>
<td>0.16</td>
<td>2.5</td>
<td>0.07</td>
</tr>
<tr>
<td>1967</td>
<td>0.18</td>
<td>0.09</td>
<td>2.4</td>
<td>0.22</td>
</tr>
<tr>
<td>1968</td>
<td>0.24</td>
<td>0.10</td>
<td>2.4</td>
<td>0.27</td>
</tr>
<tr>
<td>1969</td>
<td>0.22</td>
<td>0.07</td>
<td>(2.3^E)</td>
<td>0.11</td>
</tr>
<tr>
<td>1970</td>
<td>N.A.</td>
<td>0.09(^P)</td>
<td>(2.2^E)</td>
<td>0.001</td>
</tr>
</tbody>
</table>

\(E = \text{Estimated}\)  \(P = \text{Preliminary}\)  \(^* = \text{Includes USSR}\)

Convenience: Factors contributing to greater conveniences have been excess capacity, an increased number of flights in any given market, increasing number of origins and destinations, more direct flights, city-centre baggage check-in locations etc. Excess capacity implies that the passengers are not forced to plan their trips well in advance. This is especially important to the business traveler whose plans cannot be confirmed too far ahead of his departure.

Increased frequency reduces the waiting time at the terminals and provides greater flexibility in making connections. A greater number of origins and destinations also implies a reduction in connecting time and, hence, a reduction in the total trip time. Direct flights also have the same effect. For example, the success of non-stop flights from the United States West Coast to Europe have shown the convenience of direct flights. Where a traffic market does not justify direct flights, the carriers have offered through-plane service. For example, Cleveland-New York-London, Los Angeles-London-Paris and Detroit-Boston-London are specific instances of through-plane service. In these cases, stop-over times are lower than connecting times and passengers are assured of being on the plane and not missing a connection.
City-centre check-in locations save the passenger carrying his baggage to the airport and thus avoid lengthy check-in queues at the airport. It also reduces his pre-flight check-in time at the origin. The net effect of all these factors is to increase passenger convenience and to reduce the total trip time.
Theoretical Foundation of the Demand Function

Although it is not essential, it is useful for the analyst to have some idea of the theoretical background to the formulation of the demand function. In this section an attempt is made to outline in descriptive form some of the basic concepts relating to the theory of demand. Demand is treated as consisting of two parts: the demand for business air travel and that for pleasure air travel. The foundations of the two components are different. The demand for pleasure travel is derived from microeconomic theory, the utility theory to be more precise. The demand for business air travel has not been formalized as yet. However, its foundations lie in the macroeconomic as well as microeconomic theory.

The Demand Function For Pleasure Travel

The theoretical demand function for pleasure travel can be derived from an analysis of the traditional cardinal or ordinal consumer utility theory. An individual's utility can be thought of as satisfaction received from consuming different goods and services. The term cardinal utility refers to the explicit measurement of utility on an absolute scale. In contrast, the ordinal utility theory assumes that an individual is only capable of stating which of the two groups of goods and services he prefers, if either.
The important concept in arbitrarily assigning an absolute scale to the utility measurement is not the absolute size of the utility derived from each commodity, but rather its size relative to all other commodities.

The cardinal utility function relates an individual's total utility to his consumption of a set of goods and services. If we know the prices of each of these commodities as well as the available income of the consumer, then the utility is maximum when the marginal utility per dollar is the same for all commodities in the set. This results in maximum utility because if the marginal utility per dollar was less from consuming service A than from service B, then the individual could increase his total satisfaction, just by rearranging his purchases without spending additional money. This can be shown mathematically. Assume that $x_i$ denotes the quantity of the $i$th commodity consumed in a given time period, then the utility function can be written as

$$U = F(X_1, X_2, \cdots, X_i, \cdots, X_n)$$

where $U$ relates the total utility of the individual to his consumption of a set of $n$ different goods and services such as food, housing, transportation, etc.
If we assume that $P_i$ represents the price of the $i$th commodity and $Y$ denotes the consumer's income, then the total utility of the consumer is limited by his budget constraint

$$ Y = X_1 P_1 + X_2 P_2 + \cdots + X_n P_n $$

(2)

The utility can be maximized through the use of the Lagrangian multiplier method.

$$ L = F(x_1, x_2, \ldots, x_n) + \lambda (Y - \sum_{i=1}^{n} x_i P_i) $$

(3)

The satisfaction of first order conditions will maximize the consumer's utility. The second order conditions or the sign of the bordered Hessian determinant will determine whether the utility is maximum or minimum.

$$ \frac{\partial L}{\partial x_i} = \frac{\partial u_i}{\partial x_i} - \lambda P_i = 0 $$

(4)

and

$$ \frac{\partial L}{\partial \lambda} = Y - \sum_{i=1}^{n} x_i P_i $$

(5)

$$ \therefore \left( \frac{\partial u_1}{\partial x_1} \right) \frac{1}{P_1} = \left( \frac{\partial u_2}{\partial x_2} \right) \frac{1}{P_2} = \cdots \left( \frac{\partial u_n}{\partial x_n} \right) \frac{1}{P_n} $$

(6)
Equation 6 expresses that the marginal utility per dollar of each of the n goods and services is equal. This equation states that for a given marginal utility, the lower the price the higher is the marginal utility per dollar. Thus, as the price of a good increases, the marginal utility per dollar decreases and it pays the consumer to decrease the quantity he buys. The reverse of this argument also holds and this confirms the concept of the downward sloping demand curve.

The solution to Equations 4 and 5 will also provide the consumer's demand function for each of the n available commodities. For example, the consumer's demand function for the i\textsuperscript{th} commodity, say air travel, can be obtained by solving for $X_i$. In general, the demand function for the i\textsuperscript{th} commodity will be of the following form:

$$X_i = X_i (P_{i1}, P_{i2}, \ldots, P_{in}, Y)$$

(7)

If we hold the consumer's income constant and the prices of all other commodities remain unchanged, then the quantity of the i\textsuperscript{th} commodity consumed by an individual will depend on the price of the i\textsuperscript{th} commodity.
Although the exact shape of the demand function for the $i$th commodity depends on the parameters and functional nature of the consumer's utility function, we will assume that the Marshallian law of demand is applicable to air travel: consumers will buy more at lower prices and less at higher prices, all other things being equal.

The Demand Function for Business Travel

There is no formal derivation for the demand function for business travel. However, we can point out the areas of economic theory which can contribute to the formulation of the theory. It is logical to assume that the air travel demand for business trips is related to the economy in general and specifically to the level of investment by the business concerns, the interest rates available, some measure of stock prices, etc. At the same time, it is logical to assume that the air travel demand for business trips is related to the firm's output of products and services. We are, therefore, assuming that an individual firm will treat the business travel by its employees as another input factor to the production activity. In this case, we are hypothesizing that the demand for business air trips can be derived from the demand for the output of all major industries producing goods and services.
Air Travel Demand Models

A market demand model explains the demand of all consumers for a particular good or service. This model can be used to explain the behavior of consumers in a particular market, all markets, a particular class of travel, all classes of travel, the market share of a particular mode, the market share of a particular carrier, or some combination of these. The models used to estimate the demand for air travel can be broadly classified into four categories: aggregate, gravity, modal split and inter and intra modal market share. This section contains a brief description of the models and the basic theoretical assumptions. The problems involved with the statistical specification and the empirical significance of the models is dealt with in the next section.

The Aggregate Models

The most simplistic models used for explaining the demand for air travel are single-equation aggregate market demand models. The aggregate model assumes that the service, air travel, is a homogeneous unit such as revenue passenger miles or revenue ton miles, etc. The index revenue passenger miles is determined by summing over all routes the product of number of passengers and the distance flown by each.
These models usually relate the total demand for air travel, to a selected number of demographic characteristic of the traveler and the market and the trip related factors, that is, factors describing the level of service offered.

There are normally four sets of "independent" variable in the model: some measure of average price of air travel, a measure of price of other commodities such as an alternative travel mode, a measure of the traveler's family income and some form of a time trend to account for factors which have not been included explicity in the model.

The aggregate model assumes that the volume of passenger traffic is related to the same parameters in all markets. This implies that the travel demand in the New York-Bermuda market can be characterized by the same parameters as in the New York-Chicago market. This assumption is weak, since the first is a pleasure market and the latter is mostly a business market. This being the case, although price paid by the traveler may be important in both cases, the impact of price is different in the two cases.

Normally, the single equation aggregate demand models do not contain a supply parameter. This is justified on the grounds that the airlines usually operate with considerably less than full capacity and it is unnecessary to include a supply variable.
Secondly, monopolistic routes are almost nonexistent and insufficient capacity is unlikely due to the market forces. The standard criticisms of excluding the supply factor are, first, that there may be some routes with very high load factors and secondly, that an increase in supply may increase demand.

The price variable is usually taken to be the average yield, that is, average revenue per revenue passenger mile for a given period. In theory, only one price should exist for a homogeneous commodity at any given time in a competitive market. However, in the case of air travel we have different prices. The average yield is a weighted average revenue and as such is subject to change even if the level of fare does not change. A change in the composition of the passenger mix or average length of haul can change the numerical value of yield. Similar arguments can be put forward for the use of an average per capita income.

The demand for air travel cannot be explained by price and income alone. It is generally recognized that some measure of value of time should be included in the model. The increases in aircraft speed relative to other competitive modes of transportation have been a very significant factor in the growth of the air travel. On the other hand, advanced technology has required greater amounts of investments which in turn, have affected the cost and in turn, the price of air travel.
Although there are many reasons for choosing aggregate market-demand models, the most important one is the lack of adequate published data. It is true that a first class revenue passenger mile cannot be added to the one generated by the economy class passenger or that average yield is inadequate, since no one pays the average fare. However, since data does not exist by class of service (other than first class vs. economy), purpose of trip, true origin-destination, by type of fare, etc., the analyst is forced to investigate the demand for air travel on an aggregate basis. The second major problem related to the data is the inability to quantify subjective data such as changes in personal taste. In general, the mathematical formulation of the aggregate demand model can be expressed as:

\[ T_{ij}(t) = K \cdot \alpha \cdot \beta \cdot \gamma \cdot \delta \cdot \delta \cdot S(t) \cdot g(t) \]

where:

- \( T_{ij}(t) \) = traffic between origin i and destination j during time period (t)
- \( K \) = constant
\( F \) = some average price for air travel

\( F \) = some average price for a competitive mode of transportation.

\( Y \) = some measure of the traveler's family income.

\( S \) = representative aircraft speeds.

\( g(t) \) = time function

\( \zeta \) = lag or lead for the variable

This is a multiplicative type of extrinsic model. An extrinsic model is one where, although time can enter the relationship as a predictor variable, it cannot be the sole predictor variable. The left hand side of the demand function contains a small number of variables which are presumably more important, and the net effect of the excluded variables is represented by a stochastic variable, a time trend. This variable accounts for all forces which should be included explicitly in the behavioral demand function but are unquantifiable or subjective. Variation of these forces is, therefore, allowed through the use of a time trend function. The basic assumption is that the effect of the stochastic variable is similar to that observed in the past and, furthermore, on the long-term basis, time function will satisfactorily account for many of the secondary variables. The selection of the predictor variables is limited due to the availability of data and the difficulty of quantification.
The exponents in the model represent partial elasticities, one elasticity coefficient for each factor which may be regarded as an average elasticity over the range of the data. The implicit assumption here is that the partial elasticities are constant. This aggregate form of the demand model contains one term to represent inter-mode cross-elasticity. It does not, however, contain intra-mode cross-elasticities. This is to say that first class traffic is not separated from the economy or excursion traffic and business travel demand is not separated from the pleasure travel demand. These limitations of the aggregate model exist due to the substantial limitations of the data available to reflect the price upon which the traveler makes his decision and the lack of techniques to secure homogeneity so that the price and income effects may be isolated.

The model also includes the flexibility to incorporate the delays with which the socio-economic factors exert their influence on the volume of traffic. For example, the family income in year $t$ may effect the demand for air travel in year $t$, $(t-1)$, or $(t+1)$.

### The Gravity Models

The gravity model for the demand for air travel is based on the gravitational law of physics. The model expresses the relationship between the demand for air travel between two cities as a function of the population of the two cities and the distance between them. The general form of the model can be expressed as:
\[ T_{ij}(t) = K \cdot \frac{\rho_i(t)^{\alpha} \rho_j(t)^{\beta}}{d_{ij}^\gamma} \]

where:

- \( T_{ij}(t) \) = traffic between city i and city j during some time period t.
- \( K \) = constant
- \( \rho_i(t) \) = population of city i.
- \( \rho_j(t) \) = population of city j.
- \( d_{ij} \) = the distance between city i and city j.

The general form of the model does not assume that the population of each city should have equal travel inducing effects, or that the exponent of the distance factor has a numerical value of 2. The basic limitations of this model are:

1. it is difficult to define precisely the population of a city;
2. the model assumes that the population of a city lives at a "node" of a city;
3. city characteristics, such as average income, type of city, etc., are excluded from the model;
4. it is assumed that the same factors characterize the demand for all city-pairs.
It is possible to generalize the gravity model further by including factors such as average income, community of interest, availability of alternate modes of transportation, etc. By definition, then, gravity models are cross-sectional in nature, that is, they are generally used to analyze the demand for air travel between different city-pairs.

The variable "community interest" is an interesting one to analyze. Brown and Watkins represent "community of interest" by the number of international air passengers travelling on the same route. Although it is difficult to prove the significance of these two factors in explaining the community of interest, they appear to provide a reasonable "fit" to the empirical data.

Modal Split Models

A modal split model determines the functional relationship between the share of traffic attracted to a particular mode over a route. The most common form of the modal split model assumes that total trip time and total cost are the two most significant factors which the travelling public will use in determining their choice of a mode of travel.

The mathematical formulation of one form of a modal split model is given in Figure 6. The total trip time includes the times for access, egress, passenger processing and waiting for the next line haul service.
Modal Split Model

\[ MS_{ijm} = \frac{C_{ijm}^\alpha \cdot T_{ijm}^\beta}{\sum_{m=1}^{m} C_{ijm}^\alpha \cdot T_{ijm}^\beta} \]

WHERE

- \( MS_{ijm} \) = SHARE OF TRAFFIC BETWEEN i AND j TRAVELLING ON MODE m
- \( C_{ijm} \) = TOTAL TRIP COST = ACCESS + EGRESS + TRIP FARE
- \( T_{ijm} \) = TOTAL TRIP TIME
  - \( T_a + T_p + T_w + T_b + T_e \)
- \( T_a, T_e \) = TIME FOR ACCESS, EGRESS
- \( T_p \) = TIME TO PROCESS PASSENGER AT STATION
- \( T_w \) = TIME TO WAIT FOR NEXT SERVICE = \( \frac{TD}{2} \)
- \( T_b \) = BLOCK TIME ON MODE m
- \( TD \) = DAILY HOURS OF OPERATION FOR MODE m
- \( f_{ijm} \) = DAILY FREQUENCY OF SERVICE FOR MODE m
- \( \alpha \) = TRIP COST ELASTICITY
- \( \beta \) = TRIP TIME ELASTICITY

Source: Concept Studies For Future Intercity Air Transportation Systems. MIT - FTL, 1970
These factors are taken to account for the "convenience" aspect of the system. The model does not contain factors on comfort, safety, and reliability. In this figure, the time to wait for next service, $T_w$, depends on daily frequency. The total trip cost, again, consists of trip fare and the cost of access and egress.

**Market Share Models**

A market share model shows the relationship between the share of the passenger traffic for an airline in a given competitive market and the factors which describe the quality of service offered in the market by the carrier. Since, for a typical United States airline market, service factors such as fares and the type of aircraft are similar for all competitors in the market, the market share becomes a function of factors such as frequency of service, departure and arrival times, the image of the carrier, etc.

Research in the area of market share estimation in the airline industry has indicated that the most significant explanatory variable of market share is frequency share. More precisely, the empirical evidence shows that market share is an S-shaped curve and its location is a function of the number of carriers in the market. This concept is illustrated in Figure 7.
Figure 7

Market Share - Frequency Share Relationship

Source: N. K. Taneja, Airline Competition Analysis MIT, Flight Transportation Laboratory, 1968
Various studies have indicated that the effects of multi-stop service and preference for various types of aircraft can best be accounted for by assigning weighted values to the daily frequency. Although these numbers have been highly criticized for their numerical and relative value, it should be pointed out that the values of these weighting factors are not extremely critical since services on competitive markets are normally very similar.

Another significant variable in the estimation of market share is the image factor which is usually built on such factors as inflight service, on-time performance, advertising, attitude of personnel, etc.
Model Selection and Evaluation

The selection of a particular model depends on the purpose of investigation, the validity, the simplicity, the accuracy, the cost of operation and maintenance and perhaps personal preference of the forecaster. The criteria for model selection and evaluation becomes significantly complex when there are a number of conflicting factors to consider. Nevertheless, it is necessary for the analyst to sort through the many factors and select a model. The following are a number of factors which can be used as guidelines for model selection and evaluation. It is not claimed that this list is complete or even that the criteria listed are more important than the ones left out.

To begin with, it is necessary for the analyst to be clear of the purpose of the investigation. For example, if the main object of the investigation is to estimate the true numerical value of demand elasticities upon which to base pricing and marketing strategies, then the unbiased estimation of the particular demand elasticity should be the criteria for model selection and evaluation. On the other hand, if the main object of the study is to forecast the demand for air travel, then the criterion for the selection of the model should be based on the forecasting ability of the model or the accuracy of the forecast.
The model selected should produce the smallest standard error of estimate and standard error of the demand coefficients. Similarly, if the purpose of the model is to produce a long-term forecast, then the choice of a cross-sectional model may not be the best one since the parameters in a cross-sectional model are estimated from a sample of observations at a given point in time.

Having narrowed the choice to a particular category of models, the next criterion should pivot on the validity of the model. The validity factor should be investigated in four parts: the theoretical foundations of the model, the underlying assumptions, the statistical validation, and the empirical calibration data in the case of econometric models. Again, these factors are only guidelines to investigate the validity of the model. The analyst can, however, perform very sophisticated and in-depth analysis of each factor. Once again, the effort put in evaluation should not be out of proportion to the development and use of the model per se.

All models should be based on some fundamental theory, may it be economics, engineering or otherwise. For instance, the demand for air travel can be based on economic theory. The analyst can go one step further and relate for example, the demand for pleasure travel to consumer's utility theory, or business travel to the theory of the
firm. In other cases, the analyst can, for example, relate the gravity model to the gravitational law of physics. Unless some background theory can be put forward, it would be difficult to justify a model which, for example, predicts the air travel in the United States based on the amount of tea consumed in England.

Equally important in selecting a model, are the basic assumptions incorporated in the model. One can not justify using an aggregate demand model with constant price elasticity for forecasting the demand on a highly price elastic route. In another case, for example, the analyst can not use a model calculated using subsonic aircraft data, to forecast the potential on the supersonic aircraft. In each case, it is crucial to investigate the fundamental assumptions on which the model is based. The analyst who favors trend analysis is assuming that in the future the impact of factors influencing the market demand to air transportation will be similar to that observed in the past. Even an analyst who does not believe in forecasting, has a model and a set of assumptions. For not forecasting, he is implicitly assuming a state of status quo.

The next area of investigation refers to the statistical validation of models which are known as analytic, regression or econometric.
These models may be subject to statistical problems such as multicollinearity, autocorrelation, heteroscedasticity identification, etc. In each case, if a statistical problem exists, the chances are that the estimated parameters would be biased and the predictive ability of the model is subject to errors. The existence of more than one type of statistical problems complicates the matter further and evaluation of the model becomes even more difficult. The analyst, however, does have a set of statistics to help him determine the existence and in some cases, the extent of the problem. In the case of an econometric model, the analyst is usually provided with statistics such as standard error of coefficient, multiple correlation coefficient, the F-statistic, the Durbin Watson or Von Neuman ratio, the Chow test, etc. A combination of one or more of these statistics and tests can be used to determine the statistical validity of an econometric model.

Closely related to the above is the general validity of the calibration data. In selecting and evaluating a particular model, one must investigate the calibration data which is used to estimate the demand parameters. Again, the data can be analyzed for adequacy, consistency and reliability. Putting it in another way, one must

* For a description of these statistical problems, the reader is referred to standard texts such as Johnston and Wonnacott. References 8 and 9.
examine the data to see if the sample size was adequate, each data point was measured by the same rules and that the data is relatively free of significant errors.

The next set of selection criteria are somewhat interrelated. Simplicity is tied to the ease and cost of operation and maintenance on the one hand, and cost, accuracy and personal preference on the other hand. An historical trend analysis may be simple, cheap and easy to perform, but how accurate is it to forecast the demand for travel in a time period which may have supersonic aircraft, subsonic mass transportation or hypersonic aircraft or none of these? On the other hand, and equally important one has to weigh the marginal predictive accuracy against marginal cost of formulating a sophisticated model. Furthermore, a sophisticated model may not be necessarily more accurate than a simple one and yet for the sophisticated model, the collection and manipulation of the input data may be very expensive.
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TECHNIQUES FOR FORECASTING AIR PASSENGER TRAFFIC

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Abstract

The presentation will cover the basic techniques of forecasting the air passenger traffic. These techniques can be broadly classified into four categories: judgmental, time-series analysis, market analysis and analytical. The differences between these methods exist, in part, due to the degree of formalization of the forecasting procedure. The emphasis will be placed on describing the analytical method.
A key ingredient in the analysis, planning, implementation and operation of any successful transportation system requires accurate and realistic forecasts of traffic volume expected to use the system. Although the planning process involves much more than a forecast of the future traffic statistics, these statistics provide an essential quantitative dimension for the planning process. Forecasts of expected traffic are therefore an essential prerequisite to both long and short-range planning.

This paper outlines the basic techniques of forecasting the air passenger traffic. The differences between the various forecasting methods exist, in part, due to the degree of formalization of the forecasting procedure. Each technique has its special use and the selection of an appropriate technique depends on a number of factors such as particular application, available data, projection period and desired accuracy.

Forecasts can be classified according to the time period they cover. "Short-term" forecasts are normally used for planning current policy, evaluating current developments, and in general are concerned with the day-to-day operations. The time framework can range from one month to a year. "Budget" forecasts normally refer to a fiscal year and are used for establishing basic operating requirements such as determining cashflow and adjusting station employee requirements in line with seasonal movements in traffic.
"Long-term" forecasts normally cover a period of three to fifteen years. They are generally used for fleet planning, market and route planning, etc. Time frame for the forecast will influence the selection of the technique. For example, a long-range forecast of the market potential of a given route requires a different forecasting technique than a forecast of the system traffic for producing next year's financial budget.

One of the most crucial trade-offs in the selection of a forecasting technique is of accuracy versus cost. Although greater accuracy can be obtained at higher costs, there is usually an optimal point beyond which diminishing returns take over. In this context, the cost of the forecast is used in the general sense. It includes such components as time required to forecast, use of computer facilities, the additional cost of acquiring more suitable data, the cost of error in the forecast, etc.

Techniques for forecasting air passenger traffic can be broadly classified into four categories: judgmental, time-series analysis, market analysis and analytical. The judgmental or subjective method relies on the analyst to make an educated guess of the travel demand for the forecast period based on his experience of the past volume of traffic and his intuition of the future.
Although the analyst does not use any specific travel demand model, he intuitively takes into account the factors which influence the demand for air travel and weighs these factors according to his judgment. This method is especially useful in cases where the data sample is small or nonexistent as may be the case requiring traffic forecast on a new market or a forecast of the market acceptance of a new type of aircraft. Although the judgmental method has the advantage of low cost and ease of operation, it is limited to short-term forecasting. This approach has little merit in long-term forecasting since it is natural, although perhaps, unintentional, for the analyst to place greater weight to more recent developments.

The judgmental forecast can be produced by a single analyst or by a committee as with the delphi technique. In the delphi method, a group of experts is consulted through a set of carefully designed sequential questionnaires. The answers to one set of questionnaires are used to design the next set and all members in the group have access to each other's information.

The time-series analysis method assumes that the air passenger traffic will follow its established pattern of growth. This means that the future travel demand is a time function of the past experience. The time-series analysis, therefore, assumes very little causation. The method can be useful for broad long-term projections especially in cases where there is very little knowledge on the cause for growth. On the other hand, the method has little merit for
forecasting detailed long-term patterns. Since the assumption of the future being direct function of the past is more likely to be true in the case of short-term, the trend method can be very useful for producing detailed forecasts on the short-term basis.

The application of time-series analysis varies from the simple extrapolation of historical trends to the use of complex mathematical growth curves, such as the Logistic and Gompertz curves. These are known as intrinsic models, that is, time is taken to be the only predictor variable, reflecting the interplay of economic, industry, and government activities. The difficulty lies in determining accurately the appropriate trend curve. We can use empirical and theoretical considerations to narrow the selection of the growth curve. For example, the very long-term forecast of the air passenger traffic in the United States may be estimated by an asymptotic trend, such as a Gompertz curve, since there are good reasons to place an upper limit on the level of traffic.

The simple extrapolation involves a projection of past observed trend through visual inspection. Although such a method will suffice for certain applications, direct extrapolation, in general, is not considered a satisfactory method of forecasting especially for cases involving turning points. The method merely indicates that parameters exist which have influenced the demand in the past at a rate which is a function of time. It is, therefore, difficult to project the
demand based on time alone unless one knows these time-based parameters and the extent of their influence. It is also difficult to forecast the time at which these influences may cease to operate or their effects will change. For example, it is well-known that the sea traffic on the North Atlantic has been declining steadily. A direct mechanical extrapolation of this trend will produce a total disappearance of the sea traffic on this route after a certain time. A reasonable forecast, on the other hand, would set a minimum on the passenger market patronizing the water mode.

For annual budget forecast, the analyst is usually interested in forecasting monthly traffic which can fluctuate due to trend, cyclical and seasonal factors. In addition, the seasonal traffic pattern may contain random noises. The long-term trend is usually the result of steady and continuous increases in population and technical improvement. The cyclical fluctuations are generally the result of movements in the economy or business cycles and do not usually conform to a set pattern. The seasonal effects occur at a given time in the year and are usually the result of season or custom. The random noise is the irregular or the residual part of the pattern. The time-series forecasting model attempts to project the value of the first three components of the series and sum the results to get the forecast value of the traffic. It is usually impossible to forecast the random noise component.
Various time-series statistical models are available to analyze and forecast values of a fluctuating pattern. Smoothing techniques are the most common means of investigating time-series components. These techniques attempt to cancel out the random effects by using "averages." The normal smoothing schemes are the moving average type and the exponential smoothing. The former scheme calculates averages over a fixed base time period while the latter scheme calculates an average using all past values of the series. The weight given to the individual value of the series is determined by the smoothing constant.

The accuracy of this method depends on the behavior of the traffic pattern. A well behaved pattern with small random variation will be relatively easy to forecast compared to one containing a significant random pattern. Normally the historical raw time-series data is adjusted and massaged to eliminate known distortions caused by ad hoc factors such as strikes, introduction of new aircraft, bad weather and extra ordinary large scale promotion. A forecast of the time-series model can then be used on the clean data to produce a forecast of the seasonal traffic pattern. The experienced analyst would then apply to the predetermined forecast intuitive factors such as expected changes in competitor's traffic, introduction of excursion fares, and movements in economy to obtain a more realistic traffic forecast for budget purposes.
The market analysis method relates the travel patterns of a given segment of the population to its demographic and economic characteristics. The Port Authority of New York and New Jersey has investigated the use of this method based on a series of national household surveys conducted over a period of fifteen years. The results of these surveys indicate a strong relationship between the travel pattern of a group of people and such characteristics as income and occupation. A forecast of the air traffic activity is obtained from a forecast of the demographic and economic characteristics of each of the population segments.

The air travel market is usually divided into a large number of "cells" each defined by a cross-classification of socio-economic characteristics such as age, education, occupation, and income for personal travel and industry, occupation and income for business travel. Once the cells have been established, a relationship is investigated between air trips and these characteristics. This relationship is then applied to a forecast of the segment of population expected to fall under similar cells to obtain the projected number of air passengers for all cells. Projections of population and its distribution with respect to age, labor force, income groups, etc., can usually be obtained through sources such as United States Census Bureau and United States Department of Labor.
There are three critical assumptions regarding the validity of this method. First, an assumption has to be made regarding the stability of the relationship between travel patterns and the socio-economic characteristics. Secondly, a realistic assumption is needed on the projected growth of the traffic group within an individual cell. Third, the model should take into account future expected changes in the socio-economic structure of the population and segments of the population which are not included in the surveys.

Market analysis can be an extremely useful tool in identifying those segments of the population which generated most of the air activity and those which are good future potentials. The weakness of the method is that it does not take into account service characteristics such as fare and trip time. The market analysis method, for example, will not be able to relate the changes in the demand for air travel to changes in the average fare level or introduction of new fares introduced to attract a certain market.

The market surveys can be taken from actual travelers or from households with potential travelers. In the later case, consumers are asked about their travel intentions and the responses are subject to many "errors". The most common of these is due to misin-
terpretation and lack of ability to quantify subjective responses. The common limitations of these surveys are that the respondent may not be the ultimate decision-maker or that he may be unable to state accurately his travel plans. In any case the plans can change due to family circumstances and general economic conditions.

The analytical method attempts to relate the variation in the movement of logically relevant economic variables such as income, demographic variables such as population, and service variables such as fare and trip time. This method explores and analyzes parameters which have affected the historical travel demand pattern and those parameters which may influence the future travel demand. An analytical demand model shows through one or more equations, an economic relationship between demand and a number of predictor variables which can be classified as exogeneous or endogenous. The endogenous variables are determined within the model itself while the exogenous variables are predetermined. It should be noted that although time can enter the relationship as a predictor variable, it cannot be the sole predictor variable. It must also be emphasized, however, that statistical correlation does not always imply cause and effect. In many cases the relationship is empirical or logical at best.
There are basically four steps in building an analytical model: specification, data analysis and collection, calibration, and evaluation. The specification stage involves the formulation of a set of testable hypotheses showing the relationship of volume of air passenger traffic with economic and transport-related variables. It refers to the task of formulating a set of precise mathematical equations. The selection of the variables is based on the considerations of empirical data, economic theory, statistical techniques and computational advantages. Since the relationship cannot be an identity, it is usual to include an error or residual term.

The next step involves the analysis and collection of past data on both the dependent and the independent variables. This is a very critical step since the unavailability of certain types of data can force the analyst to an alternate model specification. The data analysis is usually performed with respect to sample size, reliability, consistency and availability of projected values. The data collection involves not only the gathering of statistics but the adjustment of the data for ad hoc influences such as strikes.

In the third stage of the model development, the parameters of the regression equation are estimated from the past data on both kinds of variables. The calibration of the model is carried out by deriving the appropriate functional relationship through experimentation with the past data and the use of regression techniques.
For a base period, various functional relationships are empirically manipulated. The object is to find the relationship which gives the least variance between the derived demand and the actual demand.

The final step is an evaluation of the model in terms of its effectiveness to explain the volume of traffic. This step may lead to an alternative specification of the model and hence, repetition of the first three steps. In general, model evaluation can be performed in two steps. First, it is necessary to justify the model on theoretical grounds. For example, a travel demand model with positive price elasticity should be questioned on logical ground. The second stage of evaluation is based on statistical validity. The four most common indicators of statistical validity are degrees of freedom, the coefficient of determination, standard error of the regression coefficient, and the standard error of estimates. For greater details on the significance of these tests, a standard text on econometrics can be consulted.

There are three fundamental assumptions underlying the analytical approach. First, it is assumed that most of the variation in the dependent variable can be explained by using a few selected independent variables. This assumption is necessary due to the availability of limited data. Furthermore, in many cases it is difficult if not impossible to quantify all the variables even though we recognize that these variables have influenced the volume of traffic in the past and will continue to do so in the future.
The second assumption is that it is easier and/or more accurate to forecast the independent variables than the dependent variable. Normally the data for the projected values of the independent variables can be obtained directly from external sources, giving the analyst two advantages. First of all, certain external specialists in various branches of the government, private industry, and/or academic institutions are probably better equipped to produce the projections. Secondly, it is important that the assumptions regarding the projections of economic activity should be consistent. The third assumption is that the functional relationship will remain valid throughout the period for which the forecast is required.

Like any other method, the use of analytic technique has its own problems. Again without going into depth, the two most common problems associated with this method are multicollinearity and autocorrelation. The former is caused by the existence of relationships among some of the independent variables. The term autocorrelation is normally used to describe the lag correlation of a particular time-series with itself. This problem can cause the model to systematically "overshoot" or "undershoot" the pattern.

In the past, most forecasts have relied heavily on the use of time-series analysis. In cases where attempts were made to formulate
more sophisticated demand models, the scope was limited due to unavailability of statistical data such as volume of traffic by purpose of trip, discretionary personal income and lack of the ability to measure certain factors, such as taste and the effect of advertising. Current research is devoted to developing models which are analytic, multivariate, behavioral, dynamic and probabilistic.

The analytic formulation offers the advantage of statistical tests of several groups of alternative hypotheses relevant to the demand for air travel. The multivariate characteristic allows the model to contain more than one independent variable. The behavioral model of demand relates the consumer behavior to observable decision-making processes. This approach focuses on rational consumer behavior under insufficient knowledge. The dynamic nature of the model will eliminate the assumption that the demand coefficients, for example, income and price elasticity, should remain constant over time. In the real-world and on "a priori" grounds, it is expected that the long-run partial coefficients of the explanatory variables in the market demand function will vary with time. The probabilistic characteristic allows the analyst to treat the demand for air travel as a random variable and obtain an approximation for its probability distribution together with an estimate of the expected value and
variance. This method is particularly useful when the demand is a random process due to lack of data or insufficient knowledge about the variables which affect air travel.

The model can be expressed as a system of simultaneous equations, thereby lifting the constraint that all of the explanatory variables will be exogenous with virtually zero feedback. For example, there is a feedback relationship between the type of aircraft available and demand. The demand for air travel should be denoted as an explicit function of a small number of systematic variables which are presumably more important and can be quantified fairly easily. The net effect of the secondary variables can be represented by a stochastic variable. This variable can account for all forces which should be included explicitly in the behavioral demand model but are either unquantifiable or subjective. On theoretical grounds, some of the predictor variables may assume a lead-lag structure. The model can also incorporate dummy variables which will relay, for example, the existence or non-existence of SST, sonic boom, etc. In the final analysis, the sophistication and complexity of the model will depend largely on the availability and the degree of quantification of the data.
BIBLIOGRAPHY


Introduction to ICAO

ICAO, the International Civil Aviation Organization, is a specialized agency of the United Nations which came into existence as a result of the 1944 "Chicago Convention". The aims and objectives of ICAO as outlined in the Convention are "to develop the principles and techniques of international air navigation and to foster the planning and development of international air transport..."

ICAO has a sovereign body, the Assembly, and a governing body, the Council. The Assembly normally meets every three years to review the entire work of the Organization in the technical, economic, legal and technical assistance fields and to plan the work programme for the ensuing three year period. There are presently 124 Contracting States and each State has one vote in the Assembly.

The Council is a permanent body responsible to the Assembly and is currently made up of twenty-seven Contracting States elected for a three-year term. The Council provides the continuing direction for the Organization and is aided in its work by various Committees it has established and by the Air Navigation Commission.

A number of international organizations participate in the work of the Organization through their role as observers at many of the meetings of the ICAO bodies. These organizations include the International Air Transport Association (IATA) which is an organization of international airlines, and the International Federation of Airline Pilots Associations (IFALPA) among others.
The work programme of the Organization is carried out by a Secretariat of some 500 headquartered in Montreal and some 125 secretariat in the six Regional Offices in Bangkok, Cairo, Dakar, Lima, Mexico and Paris.

Air Navigation

I think it is fair to say that the main thrust of the work of ICAO has been in the field which we term "air navigation". In this field ICAO deals with the technical standards and practices for all aspects of international civil aviation operations - in the operation of aircraft, aircraft airworthiness and the numerous facilities and services required in their support such as airports, telecommunications, navigational aids, meteorology, air traffic services, search and rescue, aeronautical information services and aeronautical charts.

Recommendations for Standards and Recommended Practices of international air navigation are made by the Air Navigation Commission and are adopted by the ICAO Council as annexes to the Convention on International Civil Aviation.

The work of ICAO in air navigation also involves the detailed planning of facilities and services and the formulation of procedures to support increases in traffic density, new air routes and the introduction of new types of aircraft. This planning function is facilitated by regional air navigation meetings which are held periodically in each of the nine regions of ICAO. The Air Navigation Plans which result from these meetings are reviewed by the Air Navigation Commission and presented to the Council for approval.

Technical Assistance

ICAO has participated in the multinational effort to assist technologically developing nations of the world primarily through its role as the Executing Agency for aviation projects of the United Nations Development Programme (UNDP). The degree of ICAO's participation is determined by the individual requests...
submitted by the Governments of developing countries, which are responsible for deciding what portion of the total assistance made available to them by the UNDP should be used for civil aviation.

ICAO's work in the field of technical assistance covers a number of different activities. One of the most important activities is to supply aviation experts to developing countries to carry out the aviation component of their country programme. Our work in technical assistance also includes operating training courses for civil aviation personnel, such as the Civil Aviation Safety Centre in Beruit which provides training in air navigation and in air transport economics. ICAO currently has a roster of some 165 experts engaged in technical assistance around the world. While much of the aid provided by ICAO has been of an advisory nature, some projects have called for assistance of an operational nature, involving the actual discharge of executive functions within the departments of civil aviation. To give you an idea of the scope of our activities in this field, current ICAO projects include among others: development of STOL operations for a domestic airline, initial operation of air navigation and aeronautical meteorological services at a new airport, design of an air terminal complex, and establishment of remote communications switching centres.

Legal

The Legal Committee of ICAO advises the Assembly and Council on the interpretation of the Chicago Convention; it studies and makes recommendations on other questions of public international law brought to it by the Assembly or the Council; and it also considers problems of private law affecting international civil aviation.

Although the Legal Committee has a number of items on its general work programme, an item of major concern currently is the problem of unlawful interference with civil aviation - including the subject of hijacking. As early as 1963 the Aviation Community adopted the Tokyo Convention on offenses and certain other acts committed on board aircraft. This Convention contains some limited but nevertheless useful provisions on unlawful seizure of aircraft. However, due to the sharp increase in the number of incidents of unlawful seizure of aircraft in later years,
a detailed convention concerning unlawful seizure was developed at the Hague Conference of 1970. This Convention is concerned with acts performed by a person on board an aircraft and while it does not contain specific penalties, it does contain an undertaking by each Contracting State to make the offence of unlawful seizure of aircraft punishable by severe penalties. The States however, were unwilling to make provision for automatic extradition of the suspected hijacker.

In Montreal in September 1971 States adopted the Convention for the Suppression of Unlawful Acts Against the Safety of Civil Aviation. The Montreal Convention is intended to supplement the Tokyo and Hague Conventions and is aimed at suppressing such acts as sabotage, armed attacks, or any act which could endanger the safety of an aircraft or damage or destroy an aircraft.

Work in ICAO on these problems is continuing. For example, on the 19th of June the Council directed that a special sub-committee be established to look into the question of multilateral action to eliminate havens for hijackers.

Air Transport

ICAO's work in air transport covers a wide range of subjects including: facilitation, the joint financing of air navigation services, airport economics and the economics of en route navigational facilities, air transport statistics and air transport studies.

Our work in facilitation is aimed at simplifying the entry and departure of international civil aviation traffic. Broadly speaking, the facilitation programme aims at 1) eliminating all unessential documentary requirements, 2) simplifying and standardizing the remaining forms, 3) providing certain minimum facilities at international airports and 4) simplifying handling and clearance procedures at airports.

Although each State normally provides air navigation facilities and services in its own territory there are cases where States cannot afford to provide these services (which are frequently very costly) or where these services must be
provided in regions of undetermined sovereignty and on the high seas. These are cases where the joint financing of facilities becomes necessary and there are currently several agreements in effect, administered by ICAO, which provide for this.

ICAO periodically reviews the financial situation of airports and has issued studies on significant individual items of airport finance - such as landing charges and non-aeronautical revenues. ICAO also publishes annually a manual of airport and route facilities charges levied by States. The organization has also become involved with on route facility costing and charging and has attempted to establish guidelines in this area.

Our work in statistics is probably best known to those outside the organization through those blue and grey Digests of Statistics we publish. These digests cover data on traffic, traffic flows, finances and fleet and personnel of the airlines, and also airport traffic and the civil aircraft on register in different countries. Recently, we have expanded our programme to begin collecting statistics on non-scheduled operations.

Over the years our air transport studies have covered a wide variety of subjects. This range includes studies on international air mail and those on the development of passenger and freight transport in various regions such as Africa, Latin America, the Middle East, Europe and, most recently, South and East Asia and the Pacific. We have also published studies on cooperative efforts in air transport and periodic reviews of the economic situation of air transport. Recent work in this area includes the publishing of a manual on air traffic forecasting which I will describe in some detail a little later on, and an examination of the feasibility of undertaking studies on fares and rates in international air transport. Our future programme of air transport studies includes the continuation of the series of regional studies on the development of international air passenger and air freight transport, and the preparation every three years of a new Review of the Economic Situation of Air Transport.

Most of the substantive work described above is carried out by the Secretariat of the Air Transport Bureau at Headquarters. However, by the end of the year we will have an Air Transport Officer stationed in each of the six Regional Offices I listed earlier. The main functions of these officers is to lend general air transport assistance to States in each region and to serve as a liaison between civil aviation administrations and ICAO Headquarters in Montreal.
In a further effort to give assistance to Member States in air transport we have arranged a number of small, informal workshop meetings on such subjects as statistics and airport economics in an effort to bring civil aviation personnel into direct contact with the specialized staff at Headquarters.

ICAO has also lent assistance in the creation of regional civil aviation bodies – notably the European Civil Aviation Conference (ECAC) and the African Civil Aviation Commission (AFCAC). These organizations, which are independent of ICAO but work closely with it, consider the problems of international air transport from the point of view of their respective regions.

**Brief Description of ICAO Forecasting Activities**

Now that you have a general idea of the work we do, I would like to give you a brief description of our forecasting activities to date in the fields of air navigation, technical assistance and air transport.

In preparing for the regional air navigation meetings which I mentioned earlier, the Secretariat normally prepares a five year forecast showing the frequency of service over each of the routes in the given region. These short term forecasts are derived from information provided both by States and by the carriers on their anticipated future operations. Two forecasting groups – the EUM Traffic Forecasting Group and the NAT Systems Planning Group – have been created by some of the States in the European and North Atlantic regions, respectively, to prepare long-term forecasts of the peak traffic demands. These forecasts are then used in establishing the long-term systems requirements for air navigation facilities and services in the region.

In the technical assistance area the forecasting work being done is really an integral part of the work of the technical assistance experts. What frequently happens is the developing country requests a technical assistance expert, usually an aerodrome engineer, to give them some guidance on planning for their future airport facilities. Of course, one of the necessary prerequisites for this type of planning is the preparation of a traffic forecast for the airport in question so that the requirements for such items...
as passenger and cargo handling facilities, runway length etc., can be developed. Although we do have air transport economists among our technical assistance staff, there is such a great demand for their services relative to the number we do have, that it is frequently the aerodrome engineer who must prepare the forecast. This coupled with the factor that the data are frequently faulty, incomplete or even non-existent and that the time in which the work must be completed is frequently very short, makes this work extremely difficult. There does not seem to be any simple solution to these problems in the short-run, at least.

Prior to producing our Manual on Air Traffic Forecasting (which I will describe in a moment) the bulk of the forecasting work of the Air Transport Bureau was done in conjunction with our other studies, some of which I mentioned earlier. An exception to this was the circular we prepared in 1966 on traffic forecasts for the North Atlantic covering the period to 1975. This study, which included forecasts for passengers, cargo and mail, was based on trend analysis modified by some explicit assumptions we made regarding relevant economic parameters such as price elasticity, fare changes and the timing of the introduction of new aircraft types.

Our studies of passenger, cargo and mail development in the different regions normally contain a discussion of the forecasts made by others for the given region. For example, in our latest study of the East and South Asia and Pacific region, we discuss four recent forecasts made for the area by Boeing, McDonnell Douglas, the Economist Intelligence Unit and by Curtis Greensted Associates. In addition, we present some information supplied by the States in the region estimating the probable growth of airport and airline traffic through 1980.

Our triennial reviews of the economic situation of air transport have presented our own work in forecasting the future volume of passenger, freight and mail traffic. These forecasts are based on trend projections coupled with explicit assumptions regarding the development of key economic variables; a procedure we used in our North Atlantic forecasts.
From this you can see that we are certainly not newcomers to the field of air transport forecasting. On the other hand, I think we would be the first to admit that, in the past, we have concentrated on extremely simple forecasting techniques.

Currently, as a result of a recent Assembly resolution, we are beginning to strengthen our forecasting capabilities. An initial step in this direction is the recent publication of our Manual on Air Traffic Forecasting which I would now like to describe for you in some detail.
The ICAO Manual on Air Traffic Forecasting

The Assembly of ICAO, at its sixteenth session held in Buenos Aires in 1968, set up two requirements for the Organization's work in forecasting - one was the preparation of medium- and long-term forecasts of future trends and developments in civil aviation, both on a global and on a regional basis, and the second was the development of material on current forecasting methods to be used in the Organization's own forecasting work and to be disseminated to member States for guidance in their own forecasting.

As a partial fulfilment of the second requirement the Secretariat developed a Manual on Air Traffic Forecasting, which was published and distributed to member States in the spring of this year.

The manual is primarily addressed to directors of civil aviation as well as to others in civil aviation administrations and to planners of airports and route facilities. The purpose of the manual is to provide a survey of the techniques currently in use in medium- and long-term forecasting and to give practical guidance on the application of these techniques. Discussion of theoretical problems or of methods which are not readily and quantitatively applicable has been avoided to the greatest possible extent.

Our objective at this stage is certainly not to advance the state of the art but rather to make more effective use of what has already been developed and our manual is the initial step in this process.

The manual is divided into two basic parts - the first part deals with forecasting by trend projection, the second part with methods of traffic forecasting based on studies of the factors governing traffic development. The second part includes a chapter on the technique of formulating mathematical relationships between the traffic variable and the underlying factors which we have called "Econometric Forecasting". Other techniques included in the second part of the document are based on specific studies of individual sectors of the air transport market or on studies of plans and expectations of the parties engaged in the air traffic activity.
Trend Projection

In the material dealing with forecasting by trend projection the various types of trend curves such as the linear, exponential, modified exponential, Gompertz and Logistic are described both mathematically and geometrically and the methods of fitting trend curves to observed data are described. One appendix describes and illustrates a simple method of fitting a Gompertz and a modified exponential curve to observed data. The least square method for curve fitting is demonstrated in another appendix using, as an example, the passenger traffic development at Geneva airport. While the method and rationale for calculating both regression coefficients and the coefficient of determination are described in the appendix, readers are referred to standard statistics textbooks for a more complete discussion of significance tests and confidence intervals. It was felt that a discussion of probability theory which, of course, is necessary for an understanding of these two topics, went beyond the scope of the manual.

Econometric forecasting

The bulk of the material in the manual deals with what we call the econometric technique in forecasting. In addition to describing the different models which have been developed in this area, practical guidance is given regarding the problems of applying this technique.

Whether applied to passenger air transport, freight transport, general aviation or other aspects of civil aviation, the conduct of an econometric forecast comprises, in principle, four phases: first, there is the identification of the underlying factors (independent variables) to be taken into account in forecasting the air traffic activity (dependent variable); second, the determination of the type of functional relationship existing between the dependent and independent variables; third, there is the empirical testing of the relationship between the dependent and independent variables, including the evaluation of coefficients and exponents; and fourth, the forecasting of the values for the independent variables and the subsequent derivation of the traffic forecast.
In an attempt to provide a summary of the independent variables most frequently used in econometric forecasts, we developed a table which showed, for each type of influence on traffic (e.g. size and spending ability of the market), the different variables used to represent that influence (e.g. population, disposable personal income). The list was not intended to be exhaustive but rather to indicate the range of variables that can be used.

In determining the type of functional relationship between the dependent traffic variable and the independent variables, emphasis is placed on judgment and experimentation, taking into account the experience gained from earlier forecasting work. In order to give the reader an idea of the range of models already in use in forecasting, we present a dozen different models under four headings: non-directional passenger forecasts (i.e. those dealing with the overall volume of traffic generated at a certain place or in a certain region), directional passenger forecasts (i.e. those concerned with traffic on specified routes or between specified regions), a model for non-directional air freight forecasts, and a model for forecasting general aviation activity. While we have nearly 400 documents on forecasting in our files, it should be stressed that the list of models included in the study is far from exhaustive - some of the comments we have already received on this study, amply demonstrate this point.

Six different models for forecasting non-directional passenger traffic are presented. The first model, developed by the Air Transport Association in 1969, was used to forecast domestic passenger traffic in the United States. It is a very simple model - it makes passenger revenue a multiplicative function of Personal Consumption Expenditure in the United States. Testing the model on U.S. data gave an elasticity of passenger revenue to Personal Consumption Expenditure of about 2.0.

The second model was developed by the Institut du Transport Aérien (ITA) in 1971 for predicting future growth rates for a country or a region or between countries or regions. The model was intended to be used for three to five year forecasts. This model relates the traffic in a given year to the traffic in the initial year in a multiplicative fashion through a series of three coefficients. The first coefficient reflects the changing propensity of the market to travel due to exogenous factors; the
second reflects changes in the air transport services available; and the third reflects the changing penetration of air transport into the overall travel market. Although the future values of these coefficients are left more or less to a subjective judgment, ITA gives some guidance as to how they might be calculated. The first coefficient - representing the influence of exogenous factors - is presented as a function of the growth rate of a general economic indicator (such as Gross Domestic Product) and of the growth in the proportion of consumption devoted to travel. The second coefficient - representing the availability of air services - is presented as a function of the change in air fares during the forecast period and the relevant price elasticity which, for the domestic traffic cases studied, was found to be between -0.6 to -1.7. The third coefficient - representing the penetration of air transport - could be estimated by estimating the total potential travel market and through a subjective evaluation both of the development of surface/air competition and of political factors.

The third model for forecasting passenger traffic volume was prepared by Bo Bjorkman for the European Civil Aviation Conference (ECAC) in 1970. This model makes the dependent variable, passenger-kilometres a multiplicative function of disposable income, disposable income per capita, and yield (average revenue per passenger kilometre). Using data on European air travel Bjorkman obtains a price elasticity of -1.5 and an income elasticity of 0.6. This model was also tested against U.S. domestic and international air travel from 1962 to 1968 and gave elasticities of similar magnitude to those for European travel.

The fourth model, intended for forecasts of long-term developments of long-distance international air travel demand in the United States, Europe and elsewhere was presented by the National Planning Association (NPA) in 1971. This model makes the dependent variable, total air passenger miles, a multiplicative function of discretionary income and an index of the cost of air travel which is defined by the level of fares plus the value of elapsed air travel time. The NPA tried alternative models, which included time and a variable reflecting the business cycle, but these models were found no better than the simpler model they adopted.

The values for income elasticity were developed from cross-sectional data (i.e., studies of the frequency of air travel in different income groups at a certain time). The income elasticities were found to be between 1.2 and 1.6.
To determine the price (cost) elasticities, the value of time was equated to a typical hourly wage rate for air passenger. The resulting price (cost) elasticities were between -0.8 and -1.8.

The fifth model was developed by Sam Brown and Wayne Wathins of the CAB in 1968. In this model the dependent variable, the change in annual passenger miles per capita, is a multiplicative function of the change in the average fare per mile, the change in disposable personal income per capita and a residual term representing time. This model differs from the others in that it relates the change in traffic to the changes in the independent variables while the other models related traffic levels to the levels of the independent variable. One result of this difference is the fact that the intercept value in this model represents a time influence on travel while this is not so for the other models.

The coefficients developed by applying the model to U.S. data for the 1946-1966 period imply that if fares and income had been constant in constant money value, the traffic would have increased by something less than 5 per cent per year. The coefficient on the time variable was negative, implying that this "automatic" growth rate tends to decrease over time.

The final non-directional passenger forecast model was developed in 1968 by Wallace and Moore of the Boeing Company. The dependent variable in this model is an unusual one - revenue passenger miles per unit of Gross National Product - and its percentage change is given as a function of the percentage change in the quality of service plus the percentage change in fare multiplied by the fare elasticity. A notable feature of this model is, of course, the use of a quality of service variable in the formulation. The quality of service is defined as a weighted index of a number of items - among them are the number of seat departures, schedule reliability ("on time"), flight time, cabin noise and ride comfort. In total there are nine quality items.

There is a peculiarity regarding the price elasticity in this model since it is given a different value for price increases than for price decreases. For price increases the elasticity was given as -1.0 while for price decreases the value was -2.0. The measure of "quality" in this model was developed through judgment and specifically
related to U.S. traffic. For this reason, and because data on a number of quality elements might be difficult to obtain, we felt the application of the model precisely as it was presented might prove difficult.

The section on directional models of passenger traffic starts off with a somewhat detailed description of the classic gravity model where the number of travellers between two points is positively related to the product of the populations in the two cities and inversely related to the distance between the cities. It is pointed out that while the basic gravity model is not really applicable to medium-or long-term forecasting, modified versions of this model have found rather widespread use. Since the variety of modifications to this model have been so great it was only possible to give a general indication of the range of these modifications.

A model for forecasting air travel between pairs of countries which is based on the gravity model, as well as on the non-directional model developed by Bjorkman previously described, was presented by the European Civil Aviation Conference in 1970. This model includes as independent variables: the populations of the two countries, the Gross National Products, a typical fare for air travel between the two countries and the price elasticity of demand. Coefficients for this model were developed using data on intra-European traffic. It was found that the value for price elasticity which best explained the distribution of traffic at a certain point in time among different European States was 2.0, whereas a representative value for predicting the development of traffic over time for one pair of States was 1.6. Regarding the applicability of the model, it was found that this model, which does not take into account competition from surface transport, tends to over-estimate the traffic on short distance routes.

A method for forecasting the total travel by public transport between two cities, as well as the air transport share was developed by Eric Culley and presented by the Canadian Transport Commission in 1970. This method was intended for application in Canada but it can be applied wherever there is significant competition between surface and air transport. The method takes into account the time and cost involved in using the various modes as well as their frequency of service. It also includes the populations of the cities involved and the different income levels of the cities. Finally the model takes account of the linguistic similarities of the two cities.
Use of this model involves two separate estimating procedures. One is to estimate the total traffic between the two cities regardless of the mode used and the other to estimate how the total traffic is to be split among the various modes (bus, rail and air in this model).

The modal split model estimates the share of each mode on the basis of what the author calls their "level of service". For a given mode, the level of service is a multiplicative function of a constant (which differs for each mode with the lowest value for bus and the highest for air), the average trip time, the average trip cost, and the daily frequency.

The model for estimating the total traffic between two cities regardless of mode includes seven independent variables: the product of the populations of the two cities, an index of linguistic community of the cities, the percentage of families above $12,000 income, highway driving time between the cities; both average trip time and average trip cost by public transport (weighted according to the modal split), the perceived total trip cost by automobile (approximately 1.5 cents per mile per person) and finally, the level of service (as defined in the model split) for the entire public transport system. Since the exponents were developed for transport in eastern Canada it is likely they would have to be adjusted for application elsewhere.

Another model, intended for use on routes with effective surface competition, was presented by Abraham, Baumgart and Blanchet in 1969. This model, which originally was applied to French domestic traffic, is more micro-econometric in character than the other models presented in the sense that it deals with the market on a route as a spectrum of users, each of whom behaves in accordance with his economic status.

The basic assumption is that the traveller's time can be assigned a value which is directly related to his income and that the traveller will choose that mode which minimizes the "generalized" cost of the trip where cost is defined as the fare plus this value of time in transit. The model further assumes that the frequency of travel is directly proportional to the individual's income (raised to a certain power) and inversely proportional to this "generalized cost" to the 2nd power.
A further factor determining the number of travellers on a route is the product of the populations raised to a certain power. Finally the model assumes that the income distribution, and therefore the value of time distribution, in a developed country like France can be approximated by Praeto's law.

As I stated earlier, we presented only one model for forecasting freight traffic. This is due to the fact that there have been relatively few econometric models developed for forecasting freight perhaps because the factors governing both the demand and supply for air freight capacity are so complex. However a model for predicting the development of domestic air freight in the United States was developed by Irving Saginor and David Richards of the CAB which is similar to the other CAB model we presented in that it relates changes in traffic to changes in the independent variables. This model makes the change in annual freight-ton-miles a multiplicative function of the change in the rate per ton-mile and the change in the gross national product. The results of the application of this model to the 1946-1969 air freight experience in the United States imply that if freight rates and GNP had remained constant over the period the volume of air freight would still have grown by about 6.7 per cent per year under the influence of factors not accounted for in the model.

We presented one example of the use of the econometric approach to the problem of forecasting the number of general aviation operations in a district. This approach was developed by Baxter and Howrey in 1967 and consisted in testing different combinations of five independent variables against the dependent variable—the number of general aviation operations. The independent variables tested were: the population of the district, the per capita income of this population, the number of airports in the district, an index of the quality of those airports and the proportion of the employment in the district being in agriculture.

Different models were tested by cross sectional analysis of the general aviation activities in 485 countries in Eastern United States. In general, the multiplicative rather than additive function proved superior. Generally, models including all the independent variables mentioned except agricultural employment were found to explain the differences between general aviation operations in the countries reasonably well.
We point out in the manual that this model could also be used for forecasting the effect of building a new airport in a district or for medium- or long-term forecasts of general aviation at existing airports if time series data is used.

After presenting these forecasting models we discuss the application and testing of econometric models and the forecasting of independent variables. It is pointed out that every forecasting problem is to a certain extent, unique, and that a good deal of care and judgment should be exercised before attempting to apply these results to a different set of circumstances.

Once the model has been selected and the independent variables are defined, it is necessary of course to evaluate the constants and coefficients in the model. Although the forecaster is not entirely in the dark since he can develop some expectations regarding the range of values of these coefficients based on the examples given, the uniqueness of each forecasting situation requires a new estimation of these values. We point out that since the relationship between the dependent and independent variables can frequently be expressed by a linear equation (e.g. a multiplicative relationship which is linear in its logarithms) the coefficients can be developed through multiple regression. An appendix explains the concepts behind multiple regression and gives a step-by-step demonstration of the calculations involved. Because of its complexity, tests of significance are described in very brief terms and the reader is referred to standard statistics textbooks for further elaboration.

In discussing the testing of models we covered a number of problem areas including the importance of sample size, time series vs. cross-sectional analysis and the problems created by omitted variables and misspecification. We try to caution the reader against placing too great a faith in the accuracy of any model and point out that, in fact, there is just no adequate substitute for good judgment.

The final section of our manual describes two approaches to forecasting which do not involve the formulation and testing of mathematical models.
The Port of New York Authority in 1957 carried out an air traffic forecast of U.S. domestic traffic which was based on a detailed market study. This approach was chosen because of the availability of abundant information on the characteristics of air travellers. For the purpose of the forecast, all air travel was divided into personal and business travel. To analyse personal travel, the entire population was divided into 160 different groups, each characterized by a certain combination of age, occupation, income and education. To analyse business travel the total labor force was similarly divided into 130 groups, each characterized by a certain combination of occupation, income and type of industry.

All the 290 groups were so chosen that the travel habits with respect to personal travel or business travel according to travel surveys were uniform within each group. Travel surveys had further shown how the travel habits tended to develop within each group and on this basis, as well as on the basis of forecasts of future numbers of people in each group, the forecast for the total volume of air travel could be derived for the period 1957 to 1975. The actual traffic development up to 1970 confirmed that the forecast was fairly accurate.

An example of a market analysis approach to air freight forecasting was outlined in an ICAO study of air freight in the Europe-Mediterranean region issued in 1970. It was shown there that in North Atlantic trade, the share of a commodity group carried by air was fairly closely related to the average value per unit weight. Above a certain average value per unit weight, the use of air transportation increased rapidly. Using available information on the distribution of all trade with respect to value per unit weight, and assuming that the values above which air transportation tends to be competitive will decrease if the air transport rates also decrease, it was possible to estimate the potential future demand for air freight capacity. In the ICAO study, the analysis was not aimed at actually preparing a forecast but rather at verifying that other forecasts were plausible. However, the approach may serve as an example of a possible avenue for air freight forecasting through market studies.

A second approach to forecasting discussed in the manual is that based on the opinions or plans of qualified experts in the field.
ICAO uses this approach for forecasting the future requirements for the air navigational facilities and services of international civil aviation. ICAO periodically collects information from States and operators on their anticipated future operations, consolidates this information, and forecasts the future level of activity at different airports.

The International Air Transport Association also uses a similar approach in providing a forecast service for airport authorities to assist them, at their request, in developing master plans for their airport development. In preparing these forecasts, IATA circulates a number of questionnaires to member airlines serving the airport requesting information on their future services and their requirements for airport facilities and services.

This information is consolidated by IATA and used to establish forecasts of essential aspects of airport activity required for airport master planning.

Future Forecasting Work in ICAO

As the forecasting work of the Organization in the past has been fragmentary and limited, it is the firm intention of the Organization to make a much more solid and consistent contribution in this field in the years to come.

In accordance with the directives given to us by the Assembly, the future activities in civil aviation forecasting will serve three objectives:

1) a more extensive and improved treatment of forecasting aspects in studies carried out by the Organization;

2) as a service to our Member States, a systematic collection and dissemination of material on aviation forecasting;

3) a contribution to the science of forecasting by organizing meetings where forecasting experts can exchange views on methods and techniques.
The first of these objectives will be met primarily by involving our forecasting officer in most of the economic and other studies being carried out as part of the regular ICAO work programme and particularly in our studies of the development of international air transport in various regions of the world. A special effort will also be made to take a close look at the overall prospects for international air transport in connection with the general Reviews prepared every three years for the Assembly.

The second objective will be met partly by periodically updating and improving the Manual I already described to you. In addition to this, we are also envisaging a great increase in ad hoc requests for guidance material which can be used for forecasting work by national administrations in our Member Countries.

The third objective we will try to meet by organizing about once every year informal meetings where a limited number of people active in aviation forecasting will get an opportunity to discuss matters of principle and techniques in forecasting work. The Organization has had experience with such informal international meetings in other fields and we hope that this type of meeting will also prove fruitful in fostering a better and wider application of good and sensible forecasting techniques.

You will see from this that our ambitions for the future are quite high compared with what we have accomplished in the past. We do, however, realize that our resources are very modest and that our muscle may not be quite compatible with our ambition, but we will do our best.
ROB RANSONE:

"American Airlines' Propeller STOL Transport Economic Risk Analysis"

When American Airlines evaluated STOL Transports, we received 13 proposals for our state-of-the-art-technology Propelled STOL Transport (PST) that could be available by 1975. We evaluated these, cut the list back to 3 airplanes on which we did a detailed risk analysis. It is this risk analysis I'm going to talk about today. The studies that have been made by various people on market demand and modal split did not provide the information that American needed, because they started off with assumptions that people would pay a certain fare premium for STOL, and then calculated the size of the market. American had no doubts whatever that there was a large market. Their question was, "Would passengers pay a STOL premium fare?" The real question was completely opposite from the data that was provided. Furthermore we wanted to look at specific rather than hypothetical areas and hypothetical airplanes, because we were afraid that you would end up with hypothetical people and hypothetical profits that way. We felt that
STOL was necessary in the New York area because the demand was for the city center operation rather than for an RTOL operation at the suburban airports. Furthermore we had reason to believe that you could put a city center STOLport in Manhattan, although not in Chelsea. The Chelsea reaction was not because it was a city center STOLport, but because it was a residential STOLport. There is an area at Hunters Point, on the East River (Queens) that is not a residential area and could be expected to have no community reaction against a STOLport. We looked at the market share: I'll explain later how we got this. Where we had numbers with a fair amount of confidence, we used those numbers. Where there was uncertainty we used a probability analysis. For instance, we determined a most likely value for the O&D market, a pessimistic value and an optimistic value. In the analysis 80% of the data came from the most likely level, 10% from the pessimistic and 10% from the optimistic. We looked at the spares cost in a similar probabilistic fashion. Other uncertain economic factors were the size of the O&D market, the direct operating cost, and the indirect operating costs. Values of which we were confident or were fixed values were fare levels, the available seat
miles offered, the aircraft cost, the aircraft resale value, the investment tax credit rate and the interest rate. We assumed 50% equity, and financing for 50% at a 10% interest rate. These were fully allocated costs. We developed the internal rate of return on investment. We used internal rate of return because we felt it was more representative of the actual profit and loss of the operation. The usual measure, return on investment, has to assume a certain depreciation rate of the aircraft, but internal rate of return is a function of discounted cash flow. It tells you whether you are making profits this year or next year and is therefore of more interest. We ran 3 airplanes (the Canadair CL-246, the McDonell 188 and the DeHavilland DHC-7) through the computer 100 times each, on a Monte Carlo risk analysis. Monte Carlo is a type of gambling procedure where the computer with random access selects values that you give it. It can select these values with certain probabilities. In this case it was directed to select 80% of the O&D share out of the most likely value and 10% out of each of the pessimistic and optimistic. You never know whether it is going to pick a number from
the top here and the bottom there or something else, but in the long run you end up with a probability distribution which shows that the probability of making a certain expected internal rate of return is predictable. The 10% bound indicated that 90% of the cases were above this value and therefore there was a 90% probability of making this level of internal rate of return, or better. We plotted a mean and the 10th and 90th percentile. This was plotted versus fare premium over CTOL, and number of seats offered.

Now, I will discuss some of the input functions. There was a typical mission profile. You start the engine in Washington. There was a fixed climb and maneuver to get on the flight path below 1500 feet, then climb and cruise, a 5 minute hold at 5000 feet which was a delay factor built in, and then landing at New York. There was a 10 minute time in New York, no refueling, just change passengers, and takeoff, and climb. And return to Washington, five minutes hold and either descend and land or divert. There was a half hour spent on the ground here to service the airplane for the round trip. The total non-cruise allowances were 10 minutes
regardless of where you flew. The initial assumption was that there would be two STOLports in Manhattan, one downtown STOLport and one in the suburbs. Immediately it was discovered that since no one really wanted to go to the suburbs the airplanes would be empty, and therefore the STOL airplane would have to deadhead over to the suburban STOLport. Even if it is a 10 minute flight over there, if you have a 10 minute system time, it becomes a 20 minute flight to the other STOLport. If the time from Washington to New York was roughly 40 minutes of flying plus 10 minutes system time, or a 50 minute total flight, and if we add the other 20 minutes deadhead, the total is 70 minutes of cost time but only 40 minutes of revenue time. This is right back where we started now with the 70 minute block time scale for B-727s between New York and Washington. Thus we assumed that there would only be one city center STOLport in New York and one in Washington. The range is 180 nautical miles between New York and Washington. We set up a schedule with these airplanes by chasing tail members back and forth between New York and Washington. We assumed that there would be no market sensitivity due to the frequency because the frequencies
were from every half hour, every 20 minutes, every 15 minutes and every 10 minutes; and because of this very high frequency no one really cared whether they missed one airplane or not.

We calculated realistic block speeds, realistic winds and temperatures for takeoff and landing performance. The ground distance each way was 180 nautical miles. We used the highest speed cruise because fuel cost was of no consequence; time was more valuable. The 85% probability winds for the winter and for the summer were known. Because of the effect of winds on cruise performance you do not subtract 24 knots if you are going downwind, you can only subtract a certain portion of it. There's a Boeing analysis that we used for this. We ended up with equivalent air distances. These then are reflected in the times. For the DHC-7, the block time was 70 minutes (and this includes the 10 minute system time) from New York to Washington and 59 minutes from Washington to New York. We used the winter winds because this is conservative, providing the greater cycle time. If you look at the actual times, then the DHC-7 would depart from the Washington STOLport and it would arrive
in New York City 59 minutes later. It has to stay on the ground a minimum of 10 minutes. It ended up staying on the ground 11 minutes here which was fine. Now, if it had arrived at 61 minutes instead of 59 minutes, it would have had to stay on the ground a whole cycle and could not have left at 70 minutes, for example; it would have to wait over. Similarly, it ended back at Washington after 140 minutes elapsed time, 30 minutes later it could leave at 170 minutes. If this happened to turn out to be 9 o'clock for example, it could leave at 9:30 and it would be the 9:30 flight. If it happened to arrive at 9:05, it could not leave at 9:30, it would have to leave at 10 o'clock, so there was wasted time. This shows the effect that just a small difference in cruise speed can have on the value of an airplane in its productive time and utilization. This is quite important.

Looking at the market, we tried to determine where the market was coming from. We did not assume any market generation or any market stimulation. We figured that from New Jersey, roughly 25% of the people would fly from Newark, perhaps 25% of the people would keep going to LaGuardia. No one was going to go out to Kennedy to fly
to Washington; but 50% would probably go to the STOLport in Manhattan. From Manhattan we figured no one would go to Newark, 10% to La Guardia, none to Kennedy, but 90% would go to the STOLport in Manhattan and so on across. Remember, 90% is the probable value. Looking at the optimistic value everyone in Manhattan would go to the STOLport, and pessimistically only 2/3 would go. We did a similar thing for the Washington area and when we got through, we added these things up. Furthermore, based on the market data, more people fly from New York down to Washington then go from Washington up to New York. Perhaps, this is because in Washington we say if you want to talk to us, come in and see us. At any rate, we figured 2/3 of the people were originating from Manhattan and only 1/3 from Washington, and so this means that we ended up with about 60% of the people who wanted to fly using the STOLports, optimistically 70% and pessimistically only 43%.

The Pan Am fare sensitivity assumption input into the CAB Northeast corridor VTOL investigation says that STOL will capture 83% of the market at a CTOL fare but only 45% of the market at a CTOL fare plus a $7.00 premium. We did not necessarily agree with this but we
did not have anything better to use, so we used it. If you extrapolate historical market data you will find that in 1975, supposedly 4 million people will be flying between New York and Washington. American was a little more conservative than that. They said instead of using this 9% growth rate we will use a 4% growth rate. We predicted 2.8 million. Now, at the 83% penetration that would move the probable STOL to 2.3 million at a CTOL fare. Using the data from above about who would actually go to the STOLports for the mean dropped it down to 60%. We have the optimistic case and the pessimistic case also.

Market assessment is a pretty slippery thing to get hold of, but using the fare sensitivity then we could determine the size of the market vs. the people who pay the fare. There is another factor here which we did not put in. That was the inelasticity because of convenience. People may pay a $2, $4 or $6 premium to save some time. We ignored this to be conservative. Also, this is just the air fare which does not take into consideration any savings which the traveller might have from higher cab fares going to airports further away.
Looking at the costs, we used the CAB in 1970 dollars. We did not look at 1975 dollars because we felt that if you start looking at 1975, you have to figure out not only the inflation and the cost but also the increased air fares themselves and then what is the dollar worth then to the traveler. We felt that if it could be made profitable in 1970, then it would be similarly profitable in 1975.

We did not use American Airlines' usual overhead burden. We set this up as either a subsidiary airline or a separate airline entirely. The STOL costs had no bearing on the American Airlines costs other than just as a point of departure. The pilots' salaries are conservative in that they are the levels of the BAC-111 pilots, which would be high for a DHC-7. We felt that if the source of the pilots was American Airlines, the pilot would have to make at least as much salary as he was making already. On direct maintenance, we did not accept the numbers of the manufacturer. Instead, our maintenance people looked at the airplane, system by system, and compared it to the Electra on which we had operational data and determined the relative complexity. This then
gave them a basis on which they could estimate the direct maintenance and maintenance labor overhead.

On depreciation, we did not use the CAB rate but estimated how long we could use the airplane and what would they be worth when we sold it. We felt that if these airplanes were available in 1975, they would have a useful life of only 5 years, because we would have to sell them as soon as the jet STOL's came in, for competitive reasons. We felt that the DHC-7 would have a very high resale value based on the Twin Otter experience and with discussions with 3rd level operators and so, we felt that a 5 year depreciation to 50% was reasonable for that airplane. That approximated the CAB allowance for a 4 engine turbo prop of 12 years to 5%. On the other aircraft, however, because they are more complex, the 3rd levels could not be counted on to buy them. The market there would be in South American countries where they need an aircraft that has high performance for operation in the mountains and we felt that a million and a half was all these people could afford. Those aircraft were the McDonell 188, and the Canadair CL-246. They were depreciated in 5 years to 1½ million dollars, which was a
variable rate depending on their initial cost, but was roughly double the CAB rate.

Now this was not what you normally see for DOC, this was cash DOC because this is cash flow accounting. The depreciation is added later so the total of $353/block hour is not the total DOC. You have to add the depreciation, which varies from 130 to 137 dollars/block hour for the DHC-7, depending on its utilization. Utilization varied because we were flying on different frequencies. You could add the cash DOC and depreciation for a total DOC of roughly $500/hour.

Looking at the indirect operating costs, this is an annual cost, not per hour. There are certain things that are a function of just getting started. The stewardess training for example, and the advertising and publicity. Our marketing people felt that it took quite a bit of advertising to let anybody know you are around, so there was a big initial effort. For the recurring cost, some things were fixed, some things were a function of the round trips per day and the number of passengers per aircraft. We came up then with an indirect operating cost in dollars per year in a formula to which we added a 10% contingency.
factor. These factors were all figured out based on the specific type of operation that was being considered. For example, with the food, there were savings because we were only loading one end. The type of service provided was not meal service but rather liquor, which would be sold, and soft drinks and coffee; very austere service. Furthermore, a savings was realized because there was no baggage checking. If you provide baggage checking for one then you must have someone there to handle all of the baggage and you then have the whole system. There would be room on the airplane for someone to put his bag, but no baggage checking. Landing fees were based on an analysis of STOLports which we had made and felt that a 65¢ per passenger was reasonable.

What did all of this come up to be? Looking at the internal rate of return as a function of the annual seats and the flight frequency, it looked like Figure 10. The numbers in parentheses are the load factors. We restricted load factors to greater than 45% and less than 80%. 80% is a little high, but the American Airlines' Jet Express average load factor between New York and Washington is 70%. We felt that since this was running back and forth, and since we had the option with this high frequency
of cutting out a flight, or a round trip at off peak times, we could maintain a higher load factor. 80% was the cutoff point. The value of the internal rate of return (IRR) that you see is a little bit higher than you see normally for return on investment (ROI). ROI is not directly relatable and not really convertible. If you have a 10 to 12% ROI you might say that that is roughly equivalent to maybe 24 or 26% IRR, but you have to be cautious because it is not really the same thing. Note that the size of the market varies and that we have airplanes of different sizes in here competing in a way. This method of analysis was able to handle this. Figure II is the internal rate of return vs. the fare premium. There is a 10th percentile line probability of making at least this return on the investment. The large spread was caused by the fact that there was considerable variation in the pessimistic and optimistic values that were put into the analysis. The little numbers in parentheses are the load factors, 44% up to 74%. This shows that even with the conservative costs, the DHC-7 had a 90% probability of breaking even at a CTOL fare. This is quite interesting. If you charge a little fare premium then you can make more but it starts dropping off at.
A higher level. The question comes up of course then, what happens if you cut fares; does IRR continue to increase? This would of course be interesting. Figure II shows the data for the DHC-7. The CL-246 was above this and the McDonnell 188 was below this. This was mainly caused by the input costs for the airplanes.

Now this is where the economic analysis stops but that is not where the decision process stops, because other factors enter into it. The McDonnell 188 and CL-246 could not go into production on the basis of this one market. These airplanes will not be available because there is not enough justification. The DHC-7 is likely to go into production and therefore could be available, but this is not the size of airplane nor the image that American Airlines wanted to get involved in. If you put on a very conservative hat and look at the return on investments and the money that is already obligated for DC10s and the B-747s, it just does not make sense to buy a prop airplane. Therefore, the decision was made to terminate further study of the propeller STOL transport and concentrate on maintaining the option for jet STOL operation when it is available in the '80's. If I were a
regional carrier, or someone who can offer this type of airplane, I think that the airplane would work and be very good. At American Airlines it did not work for us and so I recommended against.

The next step would be to look at a jet STOL transport and run through this same type of analysis. The prop airplanes were small, they were too small for the market. The jet STOL would be a much better size.
STOL RISK ANALYSIS

Market Share (% QBD Market)

Spares Cost (% A/C Cost)

Other Uncertain Economic Factors
1. QBD Market
2. Direct Operating Cost
3. Indirect Operating Cost

Values of Given Economic Factors
- Fare Level
- ASM Offered
- Aircraft Cost
- Aircraft Resale Value
- ITC Rate
- Interest Rate

Develop IRR Estimates

IRR Probability Distribution

Inter-Aircraft Comparisons

Figure 1
**Allowances:**

- 1 minute - Takeoff
- 5 minutes - Ground delay
- 1 minute - Climb maneuvering @ 1500' 
- 2 minutes - Approach man. land & taxi in
- 10 minutes

**Note:** 5 minute congestion hold at 5000' is used to figure fuel reserves only, and it is not used to compute block fuel or block time.

---

**Missions:**

I. Round Trip Segment (unrefueled)
   - (a) Range = 180 n.m.
   - (b) Range = 50 n.m.

II. One Way Segment
   - (c) Range = 50 n.m.
   - (d) Range = 100 n.m.
   - (e) Range = 200 n.m.
   - (f) Range = 300 n.m.
### Equivalent Air Distances

<table>
<thead>
<tr>
<th>Description</th>
<th>DHC-7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground distance (DCA-NYC) each way - n.mi.</td>
<td>180</td>
</tr>
<tr>
<td>High speed cruise true airspeed - knots</td>
<td>235</td>
</tr>
<tr>
<td>85% January winds (NYC-DCA) - knots</td>
<td>-44</td>
</tr>
<tr>
<td>(DCA-NYC) - knots</td>
<td>+6</td>
</tr>
<tr>
<td>85% Summer winds (NYC-DCA) - knots</td>
<td>-24</td>
</tr>
<tr>
<td>(DCA-NYC) - knots</td>
<td>-1</td>
</tr>
</tbody>
</table>

Equivalent Air Distances:
- **Winter NYC-DCA** 221
- **DCA-NYC** 176
- **Summer NYC-DCA** 200
- **DCA-NYC** 181
## PST BLOCK TIMES

<table>
<thead>
<tr>
<th>Season</th>
<th>Route</th>
<th>Time (minutes)</th>
<th>DHC-7</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter</td>
<td>NYC-DCA</td>
<td></td>
<td>70</td>
</tr>
<tr>
<td></td>
<td>DCA-NYC</td>
<td></td>
<td>59</td>
</tr>
<tr>
<td>Summer</td>
<td>NYC-DCA</td>
<td></td>
<td>65</td>
</tr>
<tr>
<td></td>
<td>DCA-NYC</td>
<td></td>
<td>60</td>
</tr>
</tbody>
</table>
## PST Schedule Times

(Accumulative Minutes)

<table>
<thead>
<tr>
<th></th>
<th>DHC-7</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Depart DCA</strong></td>
<td>0</td>
</tr>
<tr>
<td><strong>Arrive NYC</strong></td>
<td>59</td>
</tr>
<tr>
<td><strong>Depart NYC</strong></td>
<td>70</td>
</tr>
<tr>
<td><strong>Arrive DCA</strong></td>
<td>140</td>
</tr>
<tr>
<td><strong>Depart DCA</strong> (repetitive cycles)</td>
<td>170</td>
</tr>
<tr>
<td></td>
<td>(etc.)</td>
</tr>
</tbody>
</table>
### 1975 PST MARKET SHARE @ CTOL FARE

#### DCA-NYC-DCA

<table>
<thead>
<tr>
<th>From:</th>
<th>New Jersey</th>
<th>Manhattan</th>
<th>New York &amp; Conn.</th>
<th>Long Island</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>LGA</td>
<td>25%</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>6%</td>
</tr>
<tr>
<td>JFK</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>STCL (Probable)</td>
<td>50%</td>
<td>90%</td>
<td>66%</td>
<td>50%</td>
<td>64%</td>
</tr>
<tr>
<td>STCL (Optimistic)</td>
<td>60%</td>
<td>100%</td>
<td>75%</td>
<td>60%</td>
<td>74%</td>
</tr>
<tr>
<td>STCL (Pessimistic)</td>
<td>30%</td>
<td>66%</td>
<td>50%</td>
<td>35%</td>
<td>45%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>From:</th>
<th>Virginia</th>
<th>Washington</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCA</td>
<td>50%</td>
<td>10%</td>
<td>50%</td>
</tr>
<tr>
<td>STCL (Probable)</td>
<td>10%</td>
<td>50%</td>
<td>50%</td>
</tr>
<tr>
<td>STCL (Optimistic)</td>
<td>20%</td>
<td>60%</td>
<td>60%</td>
</tr>
<tr>
<td>STCL (Pessimistic)</td>
<td>0</td>
<td>60%</td>
<td>40%</td>
</tr>
</tbody>
</table>

Assume About 2/3 of Total CID From NYC:

- **Probable** 1/3 \((64 + 64 + 50) = 59\) say: 60%
- **Optimistic** 1/3 \((74 + 74 + 60) = 69.3\) say: 70%
- **Pessimistic** 1/3 \((45 + 45 + 40) = 43.3\) say: 43%
PST MARKET PREDICTION
NYC-DC O&D
1975

NOTE:
FARE SENSITIVITY BASED ON PAN. AM. ESTIMATE, WHERE:
83% @ CTOL FARE
45% @ CTOL FARE + $7

Figure 7
# PST Direct Operating Cost

(1970 $ @ 200 n.mi. Stage Length)

<table>
<thead>
<tr>
<th>Description</th>
<th>DHC-7</th>
</tr>
</thead>
<tbody>
<tr>
<td>5100 - Flying Operations</td>
<td></td>
</tr>
<tr>
<td>2 pilots</td>
<td>82</td>
</tr>
<tr>
<td>Fuel &amp; Oil</td>
<td>33</td>
</tr>
<tr>
<td>Insurance (@ $7.70 per $ mil flyaway cost)</td>
<td>17</td>
</tr>
<tr>
<td>5200 - Direct Maintenance (60% labor)</td>
<td>106</td>
</tr>
<tr>
<td>5300 - Maintenance Burden (1.8 x maint. labor)</td>
<td>115</td>
</tr>
<tr>
<td>7000 - Depreciation and Amortization</td>
<td></td>
</tr>
<tr>
<td>Total Cash DOC - $/block hour</td>
<td>353</td>
</tr>
</tbody>
</table>

*Note:* Depreciation was added separately during the risk analysis since it was a function of aircraft utilization. It varied from $130/B.H. to $137/B.H. for the DHC-7.
## PST INDIRECT OPERATING COST

(Annual Cost in 1970 $)

<table>
<thead>
<tr>
<th>Item</th>
<th>One time</th>
<th>Recurring (add 10% contingency)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fixed</td>
<td>f(R.T.) (day)</td>
</tr>
<tr>
<td>5500 - Stewardesses</td>
<td>2,460 (R.T.) day</td>
<td>6,730</td>
</tr>
<tr>
<td>Stew. Training</td>
<td></td>
<td>409</td>
</tr>
<tr>
<td>Stew. Uniforms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pax Food</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pax Supplies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6100 - Aircraft Servicing</td>
<td>29,750</td>
<td>3,660</td>
</tr>
<tr>
<td>Landing Fees</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Facilities Costs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6200 - Traffic Handling</td>
<td>5,040</td>
<td></td>
</tr>
<tr>
<td>6300 - Servicing Admin.</td>
<td>62,000</td>
<td></td>
</tr>
<tr>
<td>6500 - Res. &amp; Sales</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6600 - Adv. &amp; Publicity</td>
<td>350,000</td>
<td></td>
</tr>
<tr>
<td>6800 - G&amp;A (Public Liability)</td>
<td>35,000</td>
<td></td>
</tr>
<tr>
<td>Total IOC</td>
<td>$350,000 +</td>
<td>$131,790</td>
</tr>
<tr>
<td>- $/year</td>
<td>$2,460 (R.T.) day</td>
<td></td>
</tr>
</tbody>
</table>
DHC-7 VARIATION IN IRR AND ITS RISK WITH CHANGES IN CAPACITY OFFERED AT TWO LEVELS OF FARE PREMIUM AND MARKET SIZE

Fig. 10

Load Factor -% (70)

90%

PST Fare = CTOL Fare + $7

Passengers = 890,000

90% CTOL Fare + $0

Passengers = 1,630,000

Expected Value of IRR (54)

(74)

10%

(66)

Annual Available Seats (Millions)

Frequency
Minutes Between Departures

-20 -40 -60

0 0

0.5 1.0 1.5 2.0 2.5 3.0

20 15 12 10
DHC-7 VARIATION IN IRR AND ITS RISK WITH CHANGES IN FARE PREMIUM
(Available Seats Fixed at 2,040,000 Annually)
TRANSPORTATION SYSTEMS EVALUATION

by

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TRANSPORTATION SYSTEMS EVALUATION

1.0 INTRODUCTION

For a number of years, the Operations Research/Management Sciences staff of Boeing Computer Services, Inc., a wholly owned subsidiary of The Boeing Company, has been actively engaged in the development of analytical tools for analyzing transportation requirements and associated systems. The purpose of this paper is to present a framework for analyzing transportation systems which accounts for the interaction between demand and system performance. This framework is applicable to systems ranging from intraurban Personalized Rapid Transit System (PRT) networks to trunk airlines. It has evolved from and been used in studies of inter and intra urban air, ground, and water transportation systems to move both commodities and people.

In order to illustrate the flexibility of this methodology, intra and inter problems will be discussed in what follows. In Section 2 the framework is presented; Section 3 consists of a lengthy example showing how the approach was used to study an intraurban commuter air system. Finally, in Section 4 a proposed study using the approach to investigate Personalized Rapid Transit (PRT) is described.

2.0 ANALYTICAL FRAMEWORK

The steps required to analyze a transportation system are shown in Figure 1. The procedure begins with the calculation of travel demand. Then, based upon assumed performance, the demand is split between travel modes. Next, the system is simulated and performance is calculated. This performance level is fed back and a new modal split is calculated. When assumed performance and calculated performance are equal, the cost and revenues of the system are calculated. Capital costs and non-revenue benefits are also calculated. Finally, the system is evaluated based upon accurate estimates of service level, capital costs, non-revenue benefits and operating costs and revenues. Each of the above functions will now be described in more detail.
TRANSPORTATION SYSTEMS ANALYSIS

TOTAL TRAVEL DEMAND ANALYSIS

MODEAL SPLIT ANALYSIS

SIMULATION OF SYSTEM OPERATION

SYSTEM WORTH EVALUATION

CAPITAL INVESTMENT ANALYSIS

NON-FARE BENEFIT ANALYSIS

FIG. 1
2.1 TOTAL TRAVEL DEMAND ANALYSIS

The first step of the analysis is to calculate total demand for travel for the region under study. Past and forecasted demographic and geographic characteristics of the study areas together with current travel patterns form the basis of the analysis. In particular, land use forecasts may enter the analysis at this stage.

To begin the demand analysis for the intraurban problem, the study region is broken into analysis zones by the analyst. Information describing each zone is fed to the program. Base year travel information from a travel survey (if available) is also given to the model. The model calculates total travel (by all modes) between all zone pairs. The analyst produces time of day and day of week distributions of demand.

The intraurban demand model consists of two parts; Trip Generation and Trip Distribution. The former creates a forecast of total trips produced in and attracted to each analysis zone. The trip distribution portion spreads the trips (calculated in the trip generation phase) over all zone pairs. It is this trip table which is needed by the modal split model.

Demand forecasts for the airlines are based upon the CAB traffic surveys and econometric forecasts of basic economic variables. For the domestic trunks, for example, the first step is to calculate total RPM for the desired year from the forecast of GNP and other economic variables. Next, the demand is assigned to city pairs. The assignment for a given city pair depends upon the share of the total RPM carried by that city pair in the past. Different growth rates are forecast for different city pairs depending upon whether the market is new or mature. The result of the assignment is total origin and destination travel for each city pair.

2.2 MODAL SPLIT ANALYSIS

The function of the modal split module is to apportion the total demand, previously calculated, to the various travel modes available. Required
inputs are user costs and times for each mode to be considered, and users attitudes towards the competing modes. Output of the module is a market share forecast for each mode. This forecast is based upon assumed performance levels and hence is a preliminary estimate of market shares. After the system is simulated and true performance calculated, a new modal split must be performed.

2.2.1 INTRAURBAN MODAL SPLIT

A marginal utility approach forms the basis of the intraurban modal split model. The utility of a mode to a given user is calculated as a function of its time and cost and the income of the user. Attitudes toward travel modes can be incorporated into the model. The marginal utility of one mode over another is simply the difference between the two utilities. The percentage of travellers taking one mode instead of another is calculated from this marginal utility.

To calculate the market share for each mode, the marginal utility analysis is applied to each zone pair separately. Access and egress times and costs, waiting times, parking costs, line haul times and costs are all calculated for each zone pair. From these, the utilities of each mode and hence the market shares can be determined. In addition to market share, the model calculates demand for transit by station pair. This is the information needed by the simulation model. This approach is used for intraurban systems as well as short haul air systems in which auto, bus, and train are significant competitors. For long haul air systems a different approach is taken.

2.2.2 INTERURBAN MODAL SPLIT - PASSENGER PREFERENCE ANALYSIS

For nearly all interurban markets the total demand for air service can be calculated from the CAB surveys, as was described in the demand analysis section. The modal split problem in this case involves assigning demand to the competing airlines. Historically this was done according to number of frequencies offered. With the advent of significant differences between equipment (e.g. 737 and narrow bodies) simply using relative frequencies to calculate market share produced incorrect answers. Our
technique involves carrying out surveys to obtain passenger reaction to the equipment and then calculating market share from these ratings, airline image and frequency. To finish the demand calculation, the market share must be multiplied by the true O & D traffic previously computed, to obtain daily O & D traffic for each airline for each city pair. The final step is to convert the O & D into segment flow.

In order to calculate the type and effects of passengers equipment preferences, we have carried out several surveys. These include in-flight as well as mock-up surveys on several different airlines. Over 14,000 people have responded to these surveys.

The basic tool we have used to quantify peoples' subjective feelings is a survey form which asks a respondent to rate certain aspects of his trip on a scale from 1 to 9. Descriptors are furnished for each aspect to define the scale. For example, when rating seat comfort, a rating of 1 is defined to mean narrow, cramped and hard, 5 means moderate width and leg room and 9 means ample width and leg room. The resulting ratings are amenable to statistical analysis. This technique has been used in situations other than travel surveys. For example the Air Force uses it for personnel evaluation, as does BCS, and it has been used in the white goods industry.

Our surveys have covered a wide range of equipment, both wide and narrow aircraft in many configurations. The mock-up surveys tested reaction to characteristics such as seat comfort, spaciousness, and cabin appeal as well as many other aspects of an aircraft. The in-flight surveys tested these reactions as well as the reaction to flight experience variables such as smoothness and service.

The mock-up and in-flight surveys produced similar results. The relative importance of the characteristics common to both sets of surveys were the same. In particular, it was found that seating comfort, spaciousness, and cabin appeal ratings were sufficient to predict overall flight ratings in the mock-up survey. To these, service and flight smoothness need to be added to predict overall ratings for the in-flight survey.
In order to rate equipment for which no survey has been conducted, relationships between physical characteristics and passengers' attitudes have been produced from survey data. For example, for a given pitch, seat comfort ratings corresponding to various seat widths used in the surveys are used to produce a curve of rating as a function of width. Such curves can be produced for several pitches. When a new airplane is being considered, its seat comfort rating can be obtained from its seat width and pitch by using the curves.

One of the questions asked on the in-flight surveys requested the time interval within which a passenger was willing to re-schedule his flight in order to fly on the particular aircraft he chose. From the responses to this question we produced curves showing the percent of people willing to re-schedule their flights as a function of the deviation from the desired departure time. Different curves apply to different aircraft. These curves allow one to predict flight loads for different equipment given the schedule and the passengers' arrival rate curve.

One main purpose of the surveys was to produce data allowing more accurate market share calculations. A computer program was written including time of day demand, variations, equipment preferences, and airline image in the market share calculations. This program gives roughly the same answer as the simple formula shown in Figure 2. In the formula $P_A$ is the preference for flight $A$, including the equipment rating and airline image.

The formula and simulation model were both applied to a market (JFK-LAX) for which on board load data was available. Both the simulation and the formula gave answers which differed from the observed loads insignificantly.

Using either the formula or the computer simulation one calculates the market share for each airline in each market. These percentages are multiplied by the total O & D air travel, previously calculated, for each city pair. The resulting O & D demand can then be converted into segment flow (on board loads) using our segment flow model.
TO DETERMINE MARKET SHARE

* FOR COMPETING AIRLINES WITH SIMILAR IDENTITY & ABOUT EQUAL SCHEDULE ADVANTAGE:

\[
\text{MARKET SHARE} = \frac{P_A}{P_A + P_B}
\]

FOR ONE FLIGHT OF TWO

\[
\text{MARKET SHARE} = \frac{P_A}{P_A + P_B + \cdots + P_N}
\]

FOR ONE FLIGHT (A) OF SEVERAL (A) OF SEVERAL

* IF CLOSEST FLIGHT SEEKERS (C%) ARE INCLUDED:

\[
\text{MARKET SHARE} = (1 - C) \frac{P_A}{P_A + P_B + \cdots + P_N} + C
\]

FURTHER CORRECTIONS CAN BE MADE USING AIRLINE IDENTITY FACTOR

FIGURE: 
2.3 SYSTEM SIMULATION

So far we have shown how demand can be calculated and split between competing transport modes for a variety of transportation systems including intraurban transit and airlines. The process described produces an interim estimate of modal split based upon assumed system performance. The system must be simulated to get actual performance. This information is then given back to the modal split module. The process ends when assumed and actual performance coincide.

The market share forecast produced by the modal split module, in addition to the specifications of the system are the inputs required by the simulation module. For a new system, the simulation must be done by actually having the computer assign passengers to vehicles, move the vehicles to their destination, etc. For existing systems, an analytical approach may be satisfactory. The result of the simulation is a set of operational data showing how the system performed. This includes vehicle requirements, loads, and utilization. Another result is the cost and revenue information required to calculate operating profit. The average time a passenger was forced to deviate from his desired departure time is also calculated. This "average passenger waiting time" must be compared with that assumed in the modal split calculation.

Once the simulation has been run, complete information regarding system operation is available. This information includes: average vehicle utilization, number of vehicles used and vehicle loads, among other operational statistics. For a transit system, labor requirements are calculated from the operational data and then labor and non-labor costs are calculated. Finally, G & A costs are added to get full system operating costs.

For an airline, the routing and scheduling done by the simulation model allows accurate cost calculations. Cash DOC (excluding hull insurance and depreciation) is calculated from the ATA or some similar formula for each flight. Depreciation and insurance are calculated for each aircraft. Thus no utilization assumption is required. Further, having all details
of the system operation (e.g. number of peak hour movements at each airport) allows one to base the IOC calculation upon system elements which actually cause IOC.

2.4 CAPITAL INVESTMENT

The capital investment module determines the cash required for debt service for each year the system operates. The vehicle requirements have been determined by the operating simulation. Other capital expenses, (e.g., guideway construction, computers, station construction) are required inputs to the model.

For a municipally owned transit system, this module balances capital requirements against available funds. During the construction phase, any capital expense not covered by specified grants is assumed to require municipal bonds. The capital investment module "issues" such bonds when needed. For the operating period, the module calculates yearly operating surpluses necessary to cover debt service. The module also calculates the present value of this stream.

For an airline we have available a financial analysis program which treats taxes, fleet additions and retirements, investment tax credit and all other financial aspects of airline operation.

2.5 SYSTEM WORTH EVALUATION

The results of the previous four modules together with the results of the non-fare benefit analysis come together in the system worth evaluation. This process is not computerized. It requires an analyst and must be specially tailored to each application. Usually several different transportation systems are compared with respect to some criterion, e.g., maximum profit, within certain constraints, e.g., adequate service level and sufficient transit ridership. The aim is to find a balanced transportation system for the study region. Usually many systems need to be processed through the model before an adequate system worth evaluation can be made.
The economics of a transit system don't tell the full story. In some cases community values will be better served by a system with poorer economics but better non-fare benefits. In some cases the non-fare benefits are directly measurable economically, e.g., taxable real estate retained rather than lost to parking. In some cases the economic benefits are harder to measure. Where possible, these benefits are evaluated economically by the non-fare benefits module.

Figure 3 shows how the results of the capital investment and simulation modules interact. The capital investment module gives the operating surplus required, whereas the simulation module shows the operating surplus achieved. If an insufficient operating surplus is achieved, some aspect of the system must be modified, e.g., fare level, number of vehicles, size of vehicles, station locations. This modification will effect modal split, so that an entire new analysis is required.

2.6 SUMMARY OF FRAMEWORK

Figure 4 shows the structure of the entire model. Any transportation study must cover all the elements shown in this chart. The major advantage of TSEM (Transportation System Evaluation Model) is that all the elements are linked together so that interactions between the elements is considered. The fine level of detail treated by TSEM allows accurate systems evaluation, which in turn makes possible intelligent transportation planning.

3.0 EXAMPLE - INTRAURBAN AIR SYSTEM

A study which Boeing performed for NASA shows clearly how the methodology described previously can be applied. The purpose of the study was to test the feasibility of using V/STOL aircraft in commuter service. All aspects of the system were to be studied. In addition to the base case results, many sensitivity studies were to be conducted. Important areas for future research were to be identified.
FIGURE 4
The study covered the nine county San Francisco Bay area. Two time periods, 1975 and 1985 were studied. In each time period 2 STOL and 2 VTOL concepts were investigated.

The scope of the study was quite broad covering all aspects of an air transportation system. Aircraft design, travel demand, modal split, aircraft operation, and economic evaluation were the major tasks of the study.

These are also the basic blocks in the methodology presented earlier. Vehicle design wasn't mentioned in the methodology, but in order to choose a design the analytical procedure must be applied to each candidate.

In some respects the intraurban system resembles a domestic trunk airline. Characteristics of a typical intraurban system are listed below:

- Daily Passengers Carried: 48,551
- Total Daily Flights: 2,292
- Average Passenger Trip Distance: 23.4
- Aircraft Required: 73
- Average Load Factor: .45
- Number of Terminals: 24
- Number of One Way Segments: 65

Both in passengers carried and daily flights the system rivals such an airline. Of course, the fleet size is much smaller than that of an airline, showing the large number of daily flights made by each aircraft. The largest difference between the intraurban and trunk airline is, of course, the average segment length.

Figure 5 is a picture of one of the STOL aircraft designed for the study. Its most interesting feature is the large number of doors. The plane is configured like a European train without any aisle. Each compartment has a door on each side of the aircraft. This design came about as a result of simulations showing that gate time was a critical variable in the system. The weight penalty caused by multiple doors was more than paid for in the reduced gate time they allowed.
AUGMENTOR WING STOL

FIGURE 3
3.1 MODEL STRUCTURE

Since little historical data exists for intraurban air systems, a detailed simulation of the system was required. A demand/modal split model was built to calculate station pair demands. A routing and scheduling model was produced to simulate the operation of the aircraft within the system. An economic module was created to take the routes, schedules, and flight loads and calculate revenues and costs. This is exactly the process described in the preceding general discussion.

Figure 6 shows some of the data flow within the model. The traffic generator for this study was a set of input demands. The modal split will be described later. Note that the waiting time assumed in modal split (as part of the trip time) is compared with the waiting actually achieved by the scheduling module. If they don't match, a new modal split is performed and a new schedule produced. Once the two are equal the economic evaluation takes place.

The zoning of the study region and total demand for travel by all modes for each zone pair in the Bay area had been forecast by the Metropolitan Transportation Commission before our study began. These forecasts of total travel were used in our study. They had also conducted a home survey of transportation. From this survey we developed time of day demand curves.

A plot of demand by time of day was made for each zone pair from data collected in the home surveys. However, since there were only about 100,000 trips to distribute in more than 2 1/2 million time slots (using 1/2 hour intervals for each zone pair), most zone pairs had very sparse curves. A pattern emerged, however. One curve was used from all zone pairs to downtown S.F., a second was used from downtown S.F. to all other zones, a third curve was used between all other zone pairs. These 3 curves adequately represented the survey data.
The demand (properly speaking modal split) model calculated demand for V/STOL between each port pair. The model works exactly like the intra-urban modal split model described earlier. Each zone pair is treated in order as follows: nearest V/STOL ports to the centroid of origin and destination zones are found, costs and times for auto and V/STOL trips are calculated and a diversion curve is entered with the cost and time differences to calculate the percentage of demand choosing V/STOL. This percentage is multiplied by the total zone pair demand and the result is added to the appropriate V/STOL station pair demand.

The diversion curve used in this study was a plane, with cost difference and time difference as independent variables, percent diverted the dependent variable. Of course, negative diversion and diversions of over 100% were excluded.

The demand model calculated travel demand between all V/STOL port pairs. Figure 7 shows the length distribution of these trips for the base case (1975 augmentor wing STOL aircraft with 49 seats). Also shown is the demand fed to the simulation model. This consisted of all port pairs with traffic of 250 passengers per day. The demand actually carried during the simulation is also plotted. The model only carries demand when it makes some sense to do so. The requirement was that all aircraft achieve at least two hours of utilization per day.

Because the system was being simulated, all aspects of the operation were calculated. This allowed the IOC to be assigned to variables which caused IOC to be incurred such as number of gates. For each cost category (e.g., aircraft servicing, ground facilities) coefficients were determined for each independent variable (terminals, departures, gates, etc.). The cost for each category was the sum of these coefficients multiplied by the variables. Total IOC is the sum of all cost categories. Cash DOC curves were produced for each design to be evaluated.
TOTAL TRIPS (All modes)

AIR MODE DEMAND (Trip per hour)

PASSENGERS CARRIED BY AIR MODE

FIGURE 7
3.2 RESULTS AND SENSITIVITIES

The results for the 1975 aircraft are shown in Figure 8. The small STOL aircraft make an operating profit but the debt service requirements cause substantial losses. The helicopters lose less because of the reduced land requirement for ports.

Figure 9 shows cash flows for the best aircraft. Profits from concessions located in V/STOL ports have been included in revenues. In 1980 both VTOL and STOL aircraft require subsidies, 19 million per year for the helicopter and 25 million per year for the STOL. By 1990 the STOL subsidy is 16 million and the VTOL makes a profit.

A number of simulations were run using time of day demand curves with different peaking characteristics. The results show that both fleet size and profit are quite sensitive to the peaking characteristics. A flat time of day demand curve led to a requirement for 51 aircraft and an operating profit $23,000 per day. The standard case required 76 aircraft and produced an operating profit of $2,000 per day. If the peaking were three times as severe as in the standard case, 82 aircraft would be needed and a $5,000 per day operating loss would be sustained.

The demand and simulation models were run for several different fare levels. The demand grows rapidly as fares are reduced and the loss per passenger decreases. The total loss increases slightly as the fare is reduced. At 70% of the base fare the system carries 173,000 passengers instead of 49,000 and the loss per passenger is $1.53 instead of $4.05.

The 1975 aircraft were flown in the 1990 market and the results compared with the 1985 aircraft in the market to measure the effect of technology change. Both the 1975 and 1985 STOL aircraft experience the same demand; a slight reduction in loss per passenger is achieved by reduced DOC in the 1985 aircraft. The 1985 helicopter has a faster block speed than does the 1975 vehicle and hence attracts more demand. This in addition to the lower DOC of the 1985 vehicle more than offsets its higher purchase price. The 1985 helicopter loses almost half of what the 1975 vehicle loses per passenger.
CONCEPT ECONOMIC COMPARISON
NEAR TERM

Vehicle | Augmentor wing STOL | Helicopter

<table>
<thead>
<tr>
<th>Passengers</th>
<th>49</th>
<th>95</th>
<th>153</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net loss per day</td>
<td>$194,000</td>
<td>$190,000</td>
<td>$248,000</td>
</tr>
<tr>
<td>Loss per passenger</td>
<td>$4.05</td>
<td>$4.70</td>
<td>$5.89</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>50</th>
<th>98</th>
<th>150</th>
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<tr>
<td>$128,000</td>
<td>$163,000</td>
<td>$147,000</td>
</tr>
<tr>
<td>$2.42</td>
<td>$3.55</td>
<td>$3.85</td>
</tr>
</tbody>
</table>

FIGURE 8
-20-
ANNUAL CASH FLOW

- Air fare revenue
- Concession profit
- Local subsidy
- IOC
- DOC depreciation
- Bond interest
- Debt
- Aircraft
- Terminals

Cash in flows
Cash out flows
Sinking funds

No local subsidy required

---

FIGURE 9
Simulation model runs were made using different gate times (turnaround times). The results were quite dramatic: going from 3 to 8 minutes of gate time increases the loss per passenger from 4 to 5 dollars. This effect is due to the lower peak period utilization of the aircraft which requires larger fleets to serve the same demand. The need for short gate times led to the multi-door design of the aircraft.

One run through both demand and simulation models was made including the BART system as well as the automobile as a competitor to V/STOL. Because of its low fare EART is a tough competitor. The demand for STOL shrinks and the loss per passenger climbs from $4.05 to $6.93.

Many sensitivity studies similar to those just described were carried out. Some of the results of the sensitivity studies were:

- Low gate time is critical to the system
- Cruise speed is important up to 250 KN
- Commuter type peaking increases costs substantially
- Downtown ports contribute most to the system
- System cannot compete over the same segment with BART
- Costs are lowest at very short field lengths
- Lower fares (to a point) reduce the loss per passenger

Both the base case results and the sensitivity studies required the use of the demand and simulation models. This example shows the need for using the methodology described in Section 2, including all the interactions between elements. Had the analysis for this study been done in aggregate form, the base case results would have been suspect and the sensitivity studies could not have been performed.

4.0 APPLICATION OF TSEM TO A MAJOR CITY

A proposed study for a major U.S. city shows application of the methodology described in Section 2. In this case TSEM (Transportation Systems Evaluation model), our integrated intraurban model, will be used.
The objectives of the study involve preliminary design, evaluation of a PRT system, and a comparison of PRT and non PRT solutions to the transportation problem. Several transportation studies of this city have already been made. Zones have been created and 1985 trip tables (total demand) have been produced. The study will be based upon this data.

The first function of TSEM will be to aid in the preliminary design. A base case will be designed and run and then many modifications (different vehicle sizes, station locations, station capacities, headways, vehicle speeds) will be tried. The modal split and simulation modules will be cycled for each modification until convergence is obtained. All these runs will be made at a base fare level.

Once the system has been adequately refined, several fare structures will be tried. The service levels, ridership and operating profits will be calculated. The "best" fare will be chosen and the resulting system evaluated, including the non-revenue benefits.

Next, the service level, costs, and benefits of a freeway solution will be calculated and compared to the PRT solution.

The demand module will then predict demand for the future time periods. Modal-split and simulation modules will calculate system performance and costs in those years. The capital investment module will predict debt service requirements. Non fare benefits will be analyzed for each evaluation year. Finally, cash flows over the life of the system will be determined and this will permit final system evaluation.
5.0 SUMMARY

We have presented a methodology for the analysis of transportation systems consisting of five major interacting elements. The analysis begins with the causes of travel demand: geographic, economic, and demographic characteristics as well as attitudes toward travel. Through the analysis, the interaction of these factors with the physical and economic characteristics of the transportation system is determined. The result is an evaluation of the system from the point of view of both passenger and operator. Service levels, economic and non-economic aspects of the system are ascertained.

The methodology was shown to be applicable to the intraurban transit systems as well as major airlines. Applications of the technique to analysis of a PRT system and a study of intraurban air travel were given. In the discussion several unique models or techniques were mentioned: i.e., passenger preference modeling, an integrated intraurban transit model and a series of models to perform airline analysis.
WORLD AIR TRAVEL DEMAND
1950-1980

By

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Massachusetts Institute of Technology

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INTRODUCTION

The Lockheed Aircraft Corporation, as a manufacturer of commercial air transports, is vitally interested in following the development of air travel throughout the world. Reasonable expectations as to the future developments are required as planning inputs for Lockheed's Commercial Air Transport Programs. Lockheed's air travel forecast requirements range from overall projections of world traffic by major areas for broad market planning to more detailed forecasts of individual carriers' city-pair peak traffic to determine each airline's aircraft needs. Generalized area forecasts, for example, U.S. domestic, transatlantic, intra-Europe, serve as the basis for specific airline and city-pair forecasts, while the city-pair forecasts provide feedback to the more generalized area forecasts.

This discussion will cover total world traffic as distributed over broad major flows. We, at Lockheed, usually forecast total world scheduled traffic as reported by the International Civil Aviation Organization (ICAO). While ICAO statistics are available on a global basis, these show domestic and international traffic by country of airline registration and do not reveal the actual traffic flow. For example, traffic between Taipei and Hong Kong carried by TWA would show up under U.S., while passengers carried by Japan Air Lines over the same route would show up under Japan.

Lockheed has compiled a twenty-year history of the actual world's major air traffic flows as a basis for forecasting the future of world air travel. In addition to the basic data sources (ICAO, IATA, EARB, OAA, airport and civil aviation authorities, immigration and tourist organizations), individual airline traffic statistics have also been used to help allocate traffic over specific flows.

Since the environment within which the airline industry operates is very dynamic, you can see how essential it is to continuously evaluate and update the various forecast results. In this current updating of Lockheed's ICAO world forecast, our goal was to identify and measure all major air traffic flows and still be consistent with ICAO reported traffic data.

SUMMARY

Total World

Total world scheduled air passenger traffic carried by the airlines of the International Civil Aviation Organization (ICAO), excluding the USSR, increased from 17.4 billion passenger miles in 1950 to 237.4 billion in 1970. This represents an average annual growth rate of 14% during the past two decades. The USSR became a member of ICAO in 1970, and Aeroflot - the only Russian airline - reported 49 billion passenger miles for 1970. This traffic, which encompasses both domestic and international travel as well as some non-scheduled flights, is not included in the ICAO world totals shown in this report.
Based on air traffic development over the past two decades and expected changes in future air travel service in the many areas of the world, including the continued expansion of non-scheduled services, world scheduled air traffic will grow at a somewhat lower rate than in the 1960's. Lockheed's forecast of ICAO world scheduled-revenue passenger miles amounts to 650 billion in 1980; this represents an average annual increase of 10.6% for the 1970 to 1980 period.

Significant shifts between scheduled and non-scheduled traffic are occurring in various traffic categories. While it is difficult to measure non-scheduled traffic in many areas of the world, we estimate that it amounted to some 50 billion passenger miles in 1970, with about half composed of European inclusive tour traffic and transatlantic traffic. Most of the other traffic is composed of U.S. domestic and military charter.

Assuming the present type of non-scheduled service continues, as well as a decrease in military charter, Lockheed forecasts that non-scheduled passenger traffic will grow at an annual rate of 15% during the 1970's, totaling about 200 billion passenger miles by 1980. Non-scheduled traffic by scheduled, supplemental and charter airlines is expected to increase its share relative to scheduled from 21% in 1970 to 31% by 1980.

Major Flows

For the first time, all major world air traffic flows were analyzed, including those areas for which no systematic traffic statistics are available.

Actual 1970 traffic has been utilized as a base for those areas regularly reporting traffic (ICAO, IATA, EARB, OAA, the U.S. CAB). Estimates have been made for all other major traffic flows on the basis of other available data, such as airport and civil aviation authorities, immigration and tourist organizations and airlines.

Lockheed's forecast of world scheduled traffic was developed by preparing forecasts for about 48 unique traffic flows; these were then combined into 13 major flows. Every effort has been made to reflect realistic traffic growth patterns for these regions based on their own particular characteristics.

FORECASTING METHODS AND PHILOSOPHY

I would like to continue this presentation with a discussion of various techniques used in forecasting. These techniques are applicable to air travel anywhere in the world; and, in fact, most of these techniques are applicable to forecasting in general, regardless of whether it is for travel or other consumer items.
Philosophy of Forecasting

Before discussing the alternative methods of forecasting, I would like to discuss the "philosophy" of forecasting. The question I would like to introduce is: Can we forecast the future? Can we really know in advance what will happen tomorrow, next week, next summer or even ten or twenty years out? Furthermore, what can we know about the future? In what detail can we know about it, and to what degree of certainty can we foresee the future?

There are several aspects to cover before giving my views. First, there is the role of the forecaster - whether it be an individual, or a group, or some organization that wants knowledge of the future. This plays a very significant role, especially in analyzing and predicting the behavior of people as individuals or in groups. Since the analyst is part of the process that is being analyzed, he cannot detach himself from the analytical process. This is unlike the detachment possible in analyzing and trying to predict physical phenomena, such as the movement of stars or the moon, or experimenting under controlled conditions in a laboratory. The biases, the self-interests, the motivation of the analyst make it almost impossible to be 100% objective.

Another important consideration is that a forecast can be self-fulfilling. Once a forecast is made, if the decision-making officials in the various organizations that are affected plan on the basis of this forecast, it can well be that this forecast will be realized. Forecasts are usually based on certain assumptions of the future; and one of these has to be the required policies that must be undertaken for a forecast to be realizable.

When it comes to forecasting any event involving human behavior, I have come to the conclusion after many years of involvement in this endeavor, that the best we can do is predict what can potentially happen in a broad degree under a given set of circumstances - a given set of assumptions. The greater the detail that we would like to know, the greater the probability of being wrong in the future.

For example, if we want to forecast the number of tourists or air travelers to certain parts of the world, we must first make certain assumptions relating to the general social, political, economic environment, the climate, that is required to make these events potentially happen. Secondly, there must also be assumptions regarding specific policies that are required for certain events to happen.

The former set of assumptions which deal with the broader social, political conditions are usually beyond the control of any one airline or any one single government agency. The latter, however, are subject to the control of an airline or a government agency and something can be done about them.

Therefore, what we ought to strive for are not forecasts, but goals. In other words, let us establish what we want to happen in the future and then determine what we must do to make these things happen. For instance, an airline might determine that it wants to have so many passengers between two cities in a certain time period. Projections of the total traffic potential between these
points would be made on a basis of the most likely economic conditions that would prevail in the time period under consideration. And these assumptions would also need to include fare levels at which this potential demand could be realized.

These factors are usually beyond the control of any one airline, so a very realistic approach must be taken. Nevertheless, given this assumed environment the airline can set up realistic goals of traffic that it would like to achieve within this environment. It would have to establish the proper schedules, service patterns, advertising policies, marketing strategies to achieve this potential, so that the goal they would like to have could be realized.

It may seem that I am taking a very negative attitude with regard to our ability to forecast accurately. However, I would prefer to be positive in stressing that forecasts disguised as goals can be attained with the realization as to the extent to which we can control our own destiny.

Moreover, to be able to determine the impact of our actions on the development of future air travel is no easy task. It requires not only analytical insight into cause and effect, but the ability to measure these effects with some precision.

Regardless of all the hazards of forecasting — and there are many — we must forecast the future. In fact, any decision that is made has an implied forecast associated with it, even though no explicit forecast is made.

I believe, however, that setting up goals enables us to go from the present to the future in a more orderly and efficient manner.

**Forecasting Techniques**

I would next like to cover some of the forecasting techniques. There are about as many techniques as there are forecasters. Since everyone in the world is a forecaster, there are millions of forecasting techniques. However, I believe these can be put into about four broad groups.

**Trend Analysis.** The first method of forecasting is trend analysis, or extrapolating from the past into the future. It can be as simple as drawing a line on a piece of graph paper, or it can become more complicated through the use of computerized programs using second and third degree relationships.

**Regression Analysis.** The next method is regression analysis, in which we try to ascertain the relationships between a dependent variable (the one which you are trying to explain or forecast) and independent variables. In this approach broad economic indicators and service factors have been used to forecast the future of air travel. Again, this method can range from very simple linear relationships of the dependent variables to one independent variable...
to a very complex system of multi-correlation techniques using non-linear relationships. However, regardless of how complex any regression analysis is, any form of regression analysis is basically a very sophisticated form of trend analysis. Furthermore, regression analysis, or correlation analysis as it is often called, does not determine cause and effect relationships. It merely says that certain things happen together, and from that we imply that there are cause and effect relationships.

Market Analysis. A third general type of forecast which is a little more sophisticated than regression analysis, I lump under the category of market analysis approach, in which detailed socio-economic characteristics of the population, its income, age, education and occupation are used to determine the future patterns of travel. This method attempts to determine to some degree cause and effect relationships. It also requires, however, a continuing body of detailed survey data.

Simulation Analysis. Finally, the fourth group, which I call simulation analysis, is an attempt to duplicate mathematically the various forces affecting tourism - air travel, or whatever you are trying to forecast. This method is also called econometric techniques, and perhaps it may be a better term, because almost any method that we now use does use to some extent mathematical formulas, and so almost any technique can be called econometric.

Evaluation of Alternate Techniques

An evaluation of these four methods has been made in terms of data requirements, advantages and disadvantages and ease of computerization.

Trend analysis is the simplest. You don't have to have much data. All you need is five or ten years of data on the item you are trying to forecast. It is very fast and very inexpensive, but it is very subjective. In other words, the way you feel today will influence your forecast today. You go home and have a good night's sleep and feel rested and come in tomorrow and you might feel a little cheerier - the sun is shining, the world is well, and you look at it and say, "Gee, why was I so pessimistic yesterday?" and you change the forecast. Also, it can be readily computerized too if you have a long time period of events.

The regression analysis is a little more sophisticated. A little more detailed data is required. In addition to historical data on your dependent variables, you also need historical data on your independent variables. Also, you need forecasts of your independent variables, and this is quite difficult to achieve sometimes. For example, if you have to forecast traffic related to the Gross National Product of a particular country and if that forecast is wrong, obviously, even though your relationship may be perfect, your forecast is not valid. In fact, this was one of our problems in trying to forecast U.S. domestic traffic last year. Most of our forecasts of U.S. domestic traffic
are tied to the economic conditions of the country, and our own forecasters and the government had difficulty in telling us when the turnaround was going to come. So, when the economic upswing lagged, the traffic forecasts associated with it lagged. The problem then is that you have to have good forecasts of independent variables.

The regression method is still subjective in that the years you choose to analyze can significantly affect the results. If you choose ten years which happen to be part of an upswing, you would have one kind of result. If you broadened your base and included fifteen years in which there were several early years of lower growth, you would have a different result. Therefore, even in these mathematical techniques, there is a considerable bit of judgment as to what data to use and how to use it.

Again, I would have to point out that here there is no explicit cause and effect relationship, though we feel that the factors used are likely candidates. We only observe in the past that these various variables reacted to each other in certain ways. Cause and effect relationships are not certain. They are just implied.

One good thing about this method is that you can perform some sensitivity analysis. If I were unsure of what GNP were going to be in the next five years, I could take two or three different growth rates and see the impact on my forecast. This way, at least, we have a band of what the probabilities of reaching the forecast can be. Finally, computer programs for this technique are readily available. In fact, if you buy a computer, they will give you the programs with it.

The market analysis method has tremendous data requirements. Travel survey data are required to get the socio-economic characteristics of travelers and non-travelers over a period of time. A nation's population distributed among the same characteristics must also be available for the survey periods as well as for the future.

These data are not always available and are expensive and time consuming to obtain. Thus, it can take quite a few months to do a forecast for just one area.

This method does have certain advantages in that the data and analyses can be used in determining marketing strategies and advertising policies.

To my knowledge, this method has not been computerized, although I think it could be done relatively easily. Because the data problem is so enormous, it has not been worth the effort to computerize this method.

The simulation technique has not been successfully used to forecast traffic. The question is not only one of techniques or computers. It is primarily the complexity of the real world and the difficulty in attempting to duplicate all the decision-making processes that are involved when people take a trip: Should they take a trip, or spend their income some other way? Where should they go? When? With whom? For how long? Which mode? — ad infinitum.
This process would also have to be followed sequentially by time period, with all the lead and lag relationships. As you can see, the simulation method is at present way beyond us.

LOCKHEED FORECAST OF WORLD TRAFFIC

So much for the discussion of alternate techniques and the problems related to their use. How did we arrive at our world forecast?

As I mentioned earlier, we analyzed all major traffic flows throughout the world. In fact, some 48 different flows were analyzed. In my discussion today, I will cover our total world forecast and several of the major area forecasts, including U.S. domestic, transatlantic and intra-Europe.

Factors Affecting the Development of Air Traffic 1950-1970

Based on the analyses of past air traffic, we feel that the most important factors which influence the growth of air travel are economic conditions, price of air travel and the quality of air service. Specific variables utilized in our forecasts include:

- **World's Economy** - Constant dollar Gross Domestic Product (GDP) for the major nations.
- **Standard of Living** - Constant dollar GDP per capita for the major nations.
- **Price of Air Travel** - Revenue per passenger mile, in constant U.S. dollar prices.
- **Quality of Air Service** - Average speed, aircraft size and fatality rates.

The rate of growth of the world economies, as measured by various indices, provides the most important factor affecting the rate of growth of air travel. The price of a ticket, especially in relation to other goods and other modes of travel, is also an important and easily measurable factor.

For any given route or market, other factors, such as competitive pressures from other modes of travel, are important in deciding whether a traveler will fly. For predominantly business markets, various factors which reflect how well businesses are doing, such as profitability and rate of production, are reliable for forecasting.

Although these quantitative factors are important in developing suitable air travel forecasting models, it is important to realize that subjective factors,
which may bear heavily on the environment within which the industry operates, must also be included.

During the past two decades, the factors which have had a significant impact on air traffic growth have developed quite rapidly. The world's economy, in constant prices, grew at an annual rate of almost 5% and per capita income at 3%. At the same time, markedly improved air service was offered at considerably lower fares.

World Gross Domestic Product grew at an annual rate of 4.9% between 1950 and 1960. The 1960's showed an identical annual growth rate increase. The U.S. economy grew at an average annual rate of 3.3% from 1950 to 1960 and 4% from 1960 to 1970. GDP of other major industrialized nations grew at a faster rate, with Japan showing a remarkable growth of almost 10% per year for these two decades.

Per capita GDP varies greatly among the world's nations. This measure of the standard of living varies widely among the major industrialized nations, ranging from almost $3900 for the U.S. to about one-third of this amount for Japan. The world average is only $680.00.

The average fare throughout the world decreased by 9% between 1960 and 1970. After adjusting for consumer price level increases, the average fare in 1960 constant dollars decreased a substantial 31%, or an average annual decrease of 3.6%. Some selective fares, such as on the North Atlantic and the Pacific, fell even faster. Comparatively, the 1950's showed general fare level increases, although fares held generally steady on a constant dollar basis.

While the price of an airline ticket decreased substantially, the quality of service, as measured by the speed, size and comfort of the aircraft, has increased with the introduction of jet aircraft. ICAO carriers' average seats per aircraft have increased 7% in the 1960's, from 59 to 101 seats. Speed increased almost 60% for the average aircraft mile flown. This translates into shorter travel times, especially on the longer segments. Together, these two factors - speed and size - result in an aircraft productivity some 2.7 times greater in 1970 than in 1960.

Added comforts and conveniences to the passenger cannot be quantified. In general, the kind of service which the carriers have provided to the passengers during the first decade of jet aircraft has improved. In addition, longer range jet aircraft have opened new markets for non-stop flights, thus reducing total trip time even more.

Safety, a very important psychological factor in air travel, has also shown significant improvement, as measured by the number of fatalities per 100 million RPM's.

In summary, during the past two decades, people's incomes have increased at a fast rate, while fares have gone down substantially (especially in relation to other goods) making air travel more attractive. At the same time, the quality of service has improved, as shown by significant reductions in flying time, added passenger comforts and a significantly greater number of non-stop flights.
Air travel is dominated by Americans and Europeans. From the subsequent discussion of the major factors that influence air travel, this is understandable since the technologically developed areas of the world account for about 90% of world air traffic. These developed areas account for over 80% of the world's economic activity, as measured by the Gross Domestic Product, while accounting for only approximately 30% of the world's population. These areas are characterized by industrialization, high income levels, a high degree of literacy and urbanization. They include most of North America, the temperate part of South America, Europe (including the USSR), Japan, Australia and New Zealand.

The relationship between air travel and population and economic activity may be easily illustrated. The illustrations show that the rate of growth of the world economies provide the most important factor affecting the rate of growth of air travel. Economic activity of a country, measured by Gross National Product, correlates highly with that country's generated air traffic. On the other hand, a large population alone is not the basic requirement in achieving high airline travel. For example, India, the second largest country in terms of population, is substantially smaller on the basis of both GNP and air travel.

The United States, substantially smaller in population than India, is by far the largest in terms of both GNP and air travel generated. The GNP of the U.S. accounts for almost one-third of the total world's GNP. U.S. domestic air traffic plus U.S. citizens traveling outside of the U.S. account for about 55% of the world's air passenger miles.

Forecast of World Air Traffic 1970-1980

Scheduled world traffic is expected to increase 10.6% per year for the 1970 to 1980 period, from 237.4 billion passenger miles to 650 billion. In 1975 it is expected that 390.0 billion passenger miles will be flown, an average increase of 10.4% per year over the 1970 level. The second half of the decade is projected to grow at 10.8% per year.

Scheduled traffic by the world's airlines during 1970's is expected to continue at a fast pace under the impetus of a growing world economy and the introduction of wide-bodied jet aircraft. This rate will be lower than experienced in the 1960's, reflecting our assumption of the continued expansion of non-scheduled air services.

World Gross Domestic Product (GDP) is expected to reach almost $4 trillion (measured in 1964 U.S. dollars) in 1980 compared to the 1970 base figure of almost $2.5 trillion. Thus, we see that world wide economic growth during the 1970's will continue the pattern of the 1960's. The major change is a partial slowdown in Japan's phenomenal growth; despite this slowdown Japan's rate will still be twice the U.S. growth rate. Despite growth in other parts of the world U.S. will still be the dominant economic power, as shown in the pie chart comparison.
As a result of the anticipated expansion of the Japanese economy, together with a low birth rate, Japan's GDP per capita in 1980 will be 40 percent greater than that of Western Europe. However, Japan's GDP per capita will exceed Europe's, equal Australia's but will still be less than 60 percent of the U.S. GDP per capita. Average world GDP will increase 3% annually from $680 in 1970 to $912 in 1980.

While service factors will continue to improve, these will be at a lower rate than during the 1960's. Passengers will increase; speed will not increase significantly until supersonic aircraft are available for service. The improvement in technology will result in aircraft that are better and cleaner engines, and the increased capacity will ameliorate airway and airport congestion.

Although aircraft productivity will continue to increase, it will not increase at the rate experienced with the initial introduction of jet aircraft. As indirect costs are expected to increase at a faster rate than direct, fares in current prices will not decrease as during the past decade. Fares, in constant prices, however, are expected to decline. The fatality rate during the past decade decreased to an extremely low level; however, continued emphasis will be placed on improvements in air traffic control procedures, airport landing aids and emergency facilities.

The biggest unknown is the future of non-scheduled traffic including inclusive tour packages. If the scheduled carriers elect to compete with non-scheduled services by reducing fares on scheduled services, our forecast will fall short of actual future scheduled traffic. If, on the other hand, the scheduled carriers elect to compete by substantially increasing their charter operations, our forecast of scheduled traffic will be too high as non-scheduled travel exceeds the forecast 15% growth rate.

Considering these factors, world airline scheduled traffic will continue to grow at a somewhat lower rate than the 13.4% experienced during the 1960's. There are many positive factors that will contribute to the continued growth of air travel throughout the 1970's. At present, a large portion of the adult population has never flown. The continued increase in worldwide real income per capita, more leisure time, and higher levels of worldwide education will spur air travel demand. Pleasure travel is expected to show the most rapid growth in the next decade. Increasing GNP and international trade also will provide a strong impetus to air travel among businessmen. In spite of improvements in communications, there will continue to be no substitute for personal meetings and face-to-face contact in the conduct of business. Highly competitive ground transportation is not expected in the 1970's except for Japan.

The technologically underdeveloped areas of the world (Africa, Asia (except Japan), Central America and the non-temperate areas of South America) will increase their share of the world's population during the
next decade. Even though economic productivity in the underdeveloped areas will be growing at a faster rate than in the developed areas, increases on a per capita basis will be smaller. The bulk of the world's economic activity, and hence air traffic, will continue to be accounted for by North America and Europe, even though air traffic growth rates in the less developed areas will be greater. For this reason, only U.S. domestic, transatlantic and Intra-European traffic will be discussed in detail.

U.S. Domestic Traffic

U.S. domestic traffic during the 1960's increased 12.3% with continental traffic growing at about 12% and mainland to Alaska and Hawaii growing at about 15.5%. This average hides tremendous variations in growth during the past two decades. The past 20 years of domestic traffic, may be broken up into four distinct periods, each with its unique annual average growth rate:

<table>
<thead>
<tr>
<th>Period</th>
<th>Annual Average Growth Rate</th>
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<tbody>
<tr>
<td>1950-1957</td>
<td>17.8%</td>
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<tr>
<td>1957-1961</td>
<td>5.2%</td>
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<tr>
<td>1961-1968</td>
<td>16.0%</td>
</tr>
<tr>
<td>1968-1971</td>
<td>4.9%</td>
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1950-1957

The period between 1950 and 1957 was one of uninterrupted growth in passenger traffic. Although there was an actual decline in economic activity in 1954, the airlines were unaffected. During this period, fares in constant dollars (deflated by the Consumer Price Index) fell 17 percent; simultaneously, service improved as represented by a 38 percent increase in average air speed. Direct operating costs per available seat mile declined, and the trunk carriers actually averaged a rate of return equal to or greater than the 10.5 percent standard set by the CAB.

1957-1961

The rate of economic growth slowed down during the 1956-1957 period, and in 1958 GNP actually fell. The result was that, for the first time since 1948, air traffic (in 1958) showed no growth. In addition to the slowdown in the nation's economy, air fares began to increase. Between 1957 and 1961 the airlines increased air fares 11 percent in order to offset rising costs. Costs had increased, despite improved productivity of aircraft, due to the greater capacity required to serve the many new routes awarded CAB. Load factors fell as the airlines continued to increase seat miles, even though traffic growth slowed down. During this period, operating costs were fairly constant; but, due to the decline in the rate of traffic increase, the return on investment dropped sharply, reaching a low point in 1961 with barely more than a 1 percent return, despite a continuing increase in yields.
With the strong upturn in the nation's economy from 1961 onward, traffic grew rapidly, achieving about the same levels of growth as in the early and mid-1950's. As jets became the dominant aircraft, operating efficiencies increased, better service was offered, and direct operating costs per seat mile dropped 16 percent between 1962 and 1968. Air yield, which reached a peak in 1962, started to drop rapidly; the passenger tax was reduced from 10 percent to 5 percent in 1962. As a result, real fares dropped 28 percent. The rate of inflation was less than 2 percent per year during this period of rapid growth. The rate of return started climbing, reaching 10 percent by 1964 and exceeding it in 1965 and 1966.

As airlines achieved high ROI's, the CAB increased competition by putting three carriers on most major routes. Between the increased productivity of the jets and increasing competitive scheduling resulting from the new route awards, available seat miles doubled in the four years between 1964 and 1968. To fill up the seats, the CAB exerted pressure on the airlines to reduce fares, especially through special discount and promotional fares. These fare discounts were probably greater than they should have been; for, while direct operating costs per seat mile were falling, indirect costs began to increase as airlines improved ground facilities and offered better inflight service (movies, improved meals, etc.), and costs associated with congestion began to appear. Airline profits and ROI started falling - the latter falling to 5.5 percent by 1968, even though traffic was growing rapidly.

The slowdown in domestic air traffic from which we have just emerged began during the last half of 1969, even though the year ended up 9.2 percent ahead of 1968. New and often excessive route awards (e.g., nine carriers serving the U.S. mainland to Hawaii) continued into 1969. Seat miles increased 16 percent compared to the 10 percent growth in passenger miles. Economic activity slowed markedly in 1969, and GNP showed only a 2.8 percent increase for the year as a whole. GNP, during the 4th Quarter of 1969, actually fell below the prior quarter for the first time since the 1961-1962 recession. Consumer price increases continued to accelerate during the late 1960's, reaching over 5 percent in 1969. Real passenger fares, ending their six-year declining trend, remained constant as fare increases granted by the CAB roughly equalled the rate of inflation. Nonetheless, airline profits decreased 5 percent and the ROI slipped under 5 percent.

Early in 1970 it had been anticipated that there would be a moderate economic recovery during the second half of the year. In actuality, there was no recovery during 1970; GNP actually declined. Inflation continued unabated; airline costs continued to escalate; real fares increased slightly, and the passenger tax was increased from 5 to 8 percent to pay for airport and airways improvements. Airline profits turned into losses.

Domestic traffic remained virtually static during 1970 and 1971. Trunk carrier traffic actually declined in 1970. The industry was also plagued by strikes of airline personnel as well as air traffic controllers, which
cost the industry about 1 billion revenue passenger miles. In fact, traffic got worse during the second half of 1970, paralleling the pattern of economic activity.

Ironically, the 1970-1971 period resembles the 1958-1961 period when the first generation jets were introduced into service. A slowdown in the economy reduced traffic. Capacity increased, not only due to great competition from new route awards but also due to increased aircraft productivity as B747's were introduced into service. One major difference is the current high level of inflation, a rate of over 5%. Airline costs increased at an even greater rate. Due to reduced traffic growth, the CAB was slow to award further fare increases. The airlines, thus, were squeezed between falling revenues and soaring costs, resulting in their present poor financial condition.

Forecast 1972-1980

The economy finally turned around during the latter half of 1971. Air traffic during the first half of 1971 fell below 1970. Despite the 6% fare increase granted in May 1971, summer traffic was about the same and traffic finally began increasing during the last quarter. The domestic traffic recovery has continued into 1972. The first half is up about 12%, and this rate is expected to continue the rest of the year.

As may be seen from the foregoing analysis, the two most important variables influencing air traffic are the condition of the nation's economy (as measured by GNP) and the price for air service - passenger yield - measured in average revenue (including tax) per passenger mile.

These two independent factors are relatively simple to project on a long-term basis - GNP reflects the general trend of the economy and passenger yields reflect the long-term cost of providing the service.

However, projecting short-term values for these factors is extremely difficult, as to a great extent they reflect Government policy. It is next to impossible to predict the exact timing of various governmental actions.

Nevertheless, our view is that the economy will continue improving through 1973 and 1974. Passenger yields will increase to keep up with inflation, which is expected to continue through the end of 1973. Air traffic will continue a strong upward trend through 1973 and 1974. In the last half of the decade it is expected that traffic will increase at about 9.5% per year.

Our current forecast was prepared using regression analyses. Many independent variables were considered, including: GNP (in both current and constant dollars), disposable personal income (both current and constant dollars), population, unemployment trends, current and constant dollar yields, corporate profits, savings rates, stock prices, retail sales and a quality service index. The variables yielding the best fit of the past were current dollar disposable personal income, constant dollar yields, corporate profits and unemployment,
Our forecast through 1980 is based on a 6.9% annual increase in disposable income, a 7.8% annual increase in corporate profits, a steadily decreasing unemployment rate (e.g., 5% in 1974, 3.8% by 1980) and a yield that remains the same in constant dollars.

Beyond the analysis of past history, there are positive factors which may be expected to contribute to the continued growth of air travel in the decade of the 1970's. Paramount among these is the real need for such service. Gross National Product will increase by over 50 percent in the next ten years. The volume of business resulting from such an increase will provide a strong impetus for air travel among businessmen. In spite of improvements in communications, there will continue to be no substitute for personal meetings and face-to-face contact in the conduct of business. The continued increase in acceptance of air travel by the U.S. population will be accelerated by larger numbers of young people who have been exposed to air travel, either through military service or by youth discount. While about 50 percent of the U.S. population has flown commercially today, this percentage will continue to increase over the next few years.

The influence of increased GNP will be more pronounced when viewed from a per capita basis. With population growing at about 1 percent per year, and GNP in real terms anticipated at 4 percent, one can visualize the increase in disposable income which will result. This increased income, coupled with the push for more leisure time, will spur air travel demand. It is in the area of increased pleasure travel that the most rapid growth in air travel demand will result.

Transatlantic Traffic

Transatlantic scheduled air traffic from the U.S. and Canada to Europe has been one of the fastest growing travel markets in the world. During the 1950's it grew at an average annual rate of over 19%, virtually knocking out sea travel. During the 1960's under the impetus of expanded jet service which not only decreased travel time but lowered fares 36% in constant prices, transatlantic air traffic increased at an average rate of almost 16%.

During the latter part of the 1960's, charter traffic by both scheduled and supplemental carriers grew rapidly. During the 1960's charter traffic averaged 30% annual growth, reaching 26% of the total transatlantic market. The combined scheduled and charter market grew at an annual rate of 18% almost as high as the 19% experienced by scheduled traffic in the 1950's, when the market was first developing.

Our transatlantic scheduled traffic forecast for 1980 of little over a 10% annual growth rate reflects a continuing switch to charter travel. Charter traffic, on the other hand, is expected to grow at an annual rate of almost 17% with the expectation that charter will account for almost 39% of total transatlantic air travel by 1980.

The forecast is based on current types of scheduled and charter services. Continued relaxing of restrictive charter policies would result in an
even faster charter growth rate and in a lower growth rate for scheduled
traffic. The new combined scheduled/charter traffic would be higher than the
present 12% forecast.

This forecast of scheduled traffic is based on a separate analysis of U.S.
and European originating traffic. U.S. originating traffic was found to be
related to U.S. consumer expenditures (in constant dollars), total trip cost
(including hotels, meals, tours and transportation) and charter traffic.
European originating traffic was found to be related to an index of Western
Europe GNP (OECD countries) in constant Western European currencies, a weighted
index of trip costs in constant currencies and charter passengers.

Our analysis indicates that European originating traffic will grow at a
substantially higher rate than U.S. originating traffic. Thus, European
originating traffic which represented 36% of the total in 1970 will climb
to 45% by 1980. This should go a long way in moderating the directional
imbalance that has plagued this market for many years.

Intra-Europe Traffic

Traffic within Europe is the third largest world market. The geographic
definition of Europe is that used by the European Air Research Bureau; thus,
it includes the entire Mediterranean Basin (i.e., Africa north of the Sahara
and the Middle East countries). European traffic to the USSR is included,
but the USSR itself is excluded. Also, it includes both domestic as well as
international passengers.

Some 28 billion passenger miles were accommodated during 1970, or almost 12% of
ICAO total scheduled passenger miles. During the 1950's, this traffic
grew at almost 16% per year. During the 1960's, this traffic grew at only
12.5% per year. This drop reflects competition from low-fare inclusive tour
charters (IT Charter) that developed rapidly in the United Kingdom, West
Germany and in the Scandinavian countries. This traffic is holiday travel
destined to the Mediterranean area, primarily to Spain.

European IT charter traffic grew from virtually nothing in 1960 to almost 12
billion passenger miles in 1970, or almost 35% per year; it now represents
about 47% of intra-Europe international traffic by Western European carriers.
While charter service has generated new traffic, it has also diverted some
scheduled traffic in certain markets. Our estimate is that two-thirds of IT
traffic was generated and about one-third was diverted from scheduled service,

Charter traffic is forecast to grow at 15.5% during the decade of the 1970's,
compared to a 10.5% growth rate for scheduled traffic. On this basis, charter
traffic will exceed scheduled traffic in the near future.

It is interesting to speculate what the impact of this kind of service on U.S.
domestic traffic would be if it were encouraged within the U.S.
Other Areas

Traffic in the three areas — U.S. domestic, intra-Europe and transatlantic — represents about two-thirds of the world's scheduled traffic and most of the world's charter traffic.

Other important area markets are the U.S. to the Caribbean, transpacific, Europe to the Far East, and within Asia (Japan domestic and intra-Orient) and Australia. It would be too time consuming to go over these in detail at this time. If there are any questions relating to traffic in these areas, I will be glad to answer them.

ONE LAST THOUGHT

Let me sum up briefly, giving a few highlights.

If the future were a simple extension of the past, it would be very easy to forecast; if the future were completely different from the past, it would be impossible to forecast. Fortunately, the future includes both elements; thus, we do have the potential of peering into the future.

I believe that, in spite of all the hazards involved in forecasting and all the negatives that I have given in certain areas of my talk, we can still know the future in broad terms. However, the future can also be made to our liking. I believe we can, by conscious policies, translate goals into actuality. We need broad forecasts of the future to give us the framework to give us the reference of events that are likely to happen. However, what will really happen depends on what we do. We are makers of our own destinies. I really believe that, and I think that is what planning and forecasting are all about. This is to say, you must decide beforehand what you want to do and why you want to do it; then use your analysis in order to determine the impact of what you do.
## WORLD NON-SCHEDULED AIR PASSENGER TRAVEL 1960-1980

(Billions of Passenger Miles)

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<tbody>
<tr>
<td>EUROPEAN IT</td>
<td>0.6</td>
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<td>11.9</td>
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<td>50.0</td>
<td>34.8</td>
<td>15.5</td>
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<td>TRANSATLANTIC</td>
<td>0.8</td>
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<td>50.0</td>
<td>29.5</td>
<td>16.9</td>
</tr>
<tr>
<td>OTHER</td>
<td>NA</td>
<td>NA</td>
<td>27.6</td>
<td>53.0</td>
<td>100.0</td>
<td>-</td>
<td>13.7</td>
</tr>
<tr>
<td>TOTAL NON-SCHEDULED</td>
<td>NA</td>
<td>NA</td>
<td>50.0</td>
<td>105.0</td>
<td>200.0</td>
<td>-</td>
<td>14.9</td>
</tr>
<tr>
<td>ICAO*</td>
<td>237.4</td>
<td>395.0</td>
<td>650.0</td>
<td></td>
<td></td>
<td>13.4</td>
<td>10.6</td>
</tr>
<tr>
<td>NON-SCHEDULED AS A % OF ICAO SCHEDULED</td>
<td>21.1%</td>
<td>26.6%</td>
<td>30.8%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* EXCLUDES USSR
### ICAO World Air Passenger Travel

**Distributed Among Major Traffic Flows**

Billions of Passenger Miles in Scheduled Service

<table>
<thead>
<tr>
<th>AIR TRAFFIC FLOWS 1/</th>
<th>ACTUAL 1960</th>
<th>ACTUAL 1970</th>
<th>FORECAST 1980</th>
<th>AVERAGE ANNUAL GROWTH 2/</th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S. DOMESTIC</td>
<td>32.6</td>
<td>104.2</td>
<td>255.0</td>
<td>12.3</td>
</tr>
<tr>
<td>OTHER NORTH AMERICA DOMESTIC</td>
<td>2.1</td>
<td>6.0</td>
<td>15.5</td>
<td>13.4</td>
</tr>
<tr>
<td>U.S./CANADA-LATIN AMERICA/CARIBBEAN</td>
<td>4.2</td>
<td>15.9</td>
<td>42.0</td>
<td>14.2</td>
</tr>
<tr>
<td>NORTH AMERICA – EUROPE</td>
<td>6.9</td>
<td>30.0</td>
<td>80.0</td>
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<td>NORTH AMERICA – ASIA/OCEANIA</td>
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<td>10.0</td>
<td>41.0</td>
<td>18.7</td>
</tr>
<tr>
<td>INTRA EUROPE</td>
<td>8.7</td>
<td>28.3</td>
<td>79.0</td>
<td>12.5</td>
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<tr>
<td>EUROPE – SOUTH AMERICA</td>
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<td>3.4</td>
<td>9.5</td>
<td>15.7</td>
</tr>
<tr>
<td>EUROPE – AFRICA</td>
<td>1.2</td>
<td>4.0</td>
<td>8.6</td>
<td>12.8</td>
</tr>
<tr>
<td>EUROPE – ASIA/OCEANIA</td>
<td>2.8</td>
<td>10.6</td>
<td>32.8</td>
<td>14.2</td>
</tr>
<tr>
<td>AFRICA</td>
<td>1.2</td>
<td>2.4</td>
<td>6.8</td>
<td>7.2</td>
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<tr>
<td>ASIA</td>
<td>2.3</td>
<td>12.5</td>
<td>51.0</td>
<td>17.9</td>
</tr>
<tr>
<td>OCEANIA</td>
<td>1.8</td>
<td>4.5</td>
<td>13.7</td>
<td>9.6</td>
</tr>
<tr>
<td>SOUTH AMERICA</td>
<td>2.1</td>
<td>4.8</td>
<td>11.6</td>
<td>8.1</td>
</tr>
<tr>
<td>OTHER</td>
<td>0.2</td>
<td>0.9</td>
<td>3.5</td>
<td>16.3</td>
</tr>
<tr>
<td>TOTAL – ABOVE</td>
<td>68.7</td>
<td>237.5</td>
<td>650.0</td>
<td>–</td>
</tr>
<tr>
<td>TOTAL – REPORTED BY ICAO</td>
<td>67.8</td>
<td>237.4</td>
<td>–</td>
<td>13.4</td>
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</tbody>
</table>

* EXCLUDES THE USSR
1/ SEE PREVIOUS PAGE FOR DEFINITION.
2/ SEE APPENDIX FOR DETAILED FORECASTS FOR EACH MAJOR FLOW.
## Comparison of Alternative Techniques

<table>
<thead>
<tr>
<th></th>
<th>Trend Analysis</th>
<th>Regression Analysis</th>
<th>Market Analysis</th>
<th>Simulation Analysis</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Data Needs</strong></td>
<td>- History of item to be forecast</td>
<td>- 7-10 years historical data independent &amp; dependent variables</td>
<td>- Detailed socio economic data of population &amp; travelers</td>
<td>- Precise data requirements for specific time periods</td>
</tr>
<tr>
<td><strong>Advantages</strong></td>
<td>- Fast</td>
<td>- Relatively simple math concepts</td>
<td>- Analysis of who does and does not travel</td>
<td>- &quot;What If&quot; analyses</td>
</tr>
<tr>
<td></td>
<td>- Little effort</td>
<td>- Quick</td>
<td>- Marketing strategy</td>
<td>- Once computerized fairly rapid results</td>
</tr>
<tr>
<td><strong>Disadvantages</strong></td>
<td>- Not analytical</td>
<td>- Cause &amp; effect uncertain</td>
<td>- Time consuming</td>
<td>- Time consuming to develop model</td>
</tr>
<tr>
<td></td>
<td>- Subjective</td>
<td>- Years chosen affects analysis</td>
<td>- Difficult to forecast future population characteristic in detail</td>
<td>- Analytically difficult</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- More complex but readily available</td>
<td>- Advanced mathematics</td>
<td>- Complex</td>
</tr>
<tr>
<td><strong>Computerization</strong></td>
<td>- Simple programs</td>
<td></td>
<td>- Difficult</td>
<td>- Extremely complex</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>- Has not been done</td>
<td></td>
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</tbody>
</table>
## GROSS DOMESTIC PRODUCT

(BILLIONS OF 1964 U.S. DOLLARS)

<table>
<thead>
<tr>
<th>YEAR</th>
<th>U.S.</th>
<th>CANADA</th>
<th>WESTERN EUROPE</th>
<th>JAPAN</th>
<th>AUSTRALIA</th>
<th>TOTAL WORLD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>389.4</td>
<td>24.8</td>
<td>242.9</td>
<td>22.0</td>
<td>12.3</td>
<td>949.4</td>
</tr>
<tr>
<td>1960</td>
<td>537.2</td>
<td>36.4</td>
<td>389.9</td>
<td>50.5</td>
<td>17.8</td>
<td>1,535.5</td>
</tr>
<tr>
<td>1970</td>
<td>796.0</td>
<td>66.3</td>
<td>598.6</td>
<td>140.0</td>
<td>27.3</td>
<td>2,466.3</td>
</tr>
</tbody>
</table>

### AVERAGE ANNUAL GROWTH RATE (%)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>3.3</td>
<td>4.0</td>
</tr>
<tr>
<td>CANADA</td>
<td>3.9</td>
<td>6.2</td>
</tr>
<tr>
<td>WESTERN EUROPE</td>
<td>4.8</td>
<td>4.4</td>
</tr>
<tr>
<td>JAPAN</td>
<td>8.7</td>
<td>10.7</td>
</tr>
<tr>
<td>AUSTRALIA</td>
<td>3.8</td>
<td>4.4</td>
</tr>
<tr>
<td>TOTAL WORLD</td>
<td>4.9</td>
<td>4.9</td>
</tr>
</tbody>
</table>
## GROSS DOMESTIC PRODUCT PER CAPITA

(1964 U.S. DOLLARS)

<table>
<thead>
<tr>
<th>YEAR</th>
<th>U.S.</th>
<th>CANADA</th>
<th>WESTERN EUROPE</th>
<th>JAPAN</th>
<th>AUSTRALIA</th>
<th>TOTAL WORLD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>2,557</td>
<td>1,810</td>
<td>792</td>
<td>265</td>
<td>1,500</td>
<td>375</td>
</tr>
<tr>
<td>1960</td>
<td>2,973</td>
<td>2,034</td>
<td>1,164</td>
<td>542</td>
<td>1,728</td>
<td>513</td>
</tr>
<tr>
<td>1970</td>
<td>3,879</td>
<td>3,098</td>
<td>1,624</td>
<td>1,353</td>
<td>2,184</td>
<td>680</td>
</tr>
</tbody>
</table>

### AVERAGE ANNUAL GROWTH RATE (%)

<table>
<thead>
<tr>
<th>PERIOD</th>
<th>U.S.</th>
<th>CANADA</th>
<th>WESTERN EUROPE</th>
<th>JAPAN</th>
<th>AUSTRALIA</th>
<th>TOTAL WORLD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950/1960</td>
<td>1.5</td>
<td>1.2</td>
<td>3.9</td>
<td>7.4</td>
<td>1.4</td>
<td>3.2</td>
</tr>
<tr>
<td>1960/1970</td>
<td>2.7</td>
<td>4.3</td>
<td>3.4</td>
<td>9.6</td>
<td>2.4</td>
<td>2.9</td>
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</table>
# AVERAGE FARE LEVELS
(U.S. CENTS PER PASSENGER MILE)

<table>
<thead>
<tr>
<th>YEAR</th>
<th>CURRENT $</th>
<th>CONSTANT $ 2/</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960</td>
<td>6.34</td>
<td>6.34</td>
</tr>
<tr>
<td>1965</td>
<td>5.99</td>
<td>5.62</td>
</tr>
<tr>
<td>1970</td>
<td>5.75</td>
<td>4.39</td>
</tr>
<tr>
<td>1960 TO</td>
<td>-9%</td>
<td>-31%</td>
</tr>
<tr>
<td>1970 CHANGE</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>YEAR</th>
<th>U.S. DOMESTIC</th>
<th>TRANS. ATLANTIC</th>
<th>TRANS. PACIFIC</th>
<th>INTRA-EUROPE</th>
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</thead>
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<tr>
<td>1960</td>
<td>6.06</td>
<td>7.08</td>
<td>7.47</td>
<td>7.96</td>
</tr>
<tr>
<td>1965</td>
<td>6.03</td>
<td>5.43</td>
<td>6.31</td>
<td>8.19</td>
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<tr>
<td>1970</td>
<td>6.00</td>
<td>4.53</td>
<td>5.40</td>
<td>8.42</td>
</tr>
<tr>
<td>1960 TO</td>
<td>-1%</td>
<td>-36%</td>
<td>-28%</td>
<td>+6%</td>
</tr>
<tr>
<td>1970 CHANGE</td>
<td></td>
<td></td>
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<td></td>
</tr>
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</table>

1/ EXCLUDES THE USSR
2/ IN 1960 U.S. DOLLARS
<table>
<thead>
<tr>
<th>YEAR</th>
<th>SIZE SEATS PER AIRCRAFT</th>
<th>SPEED MILES PER HOUR</th>
<th>SAFETY FATALITIES PER 100 MILLION RPM'S</th>
<th>AVERAGE FARES REVENUE (¢) PER PASSENGER MILE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>CURRENT</td>
</tr>
<tr>
<td>1960</td>
<td>59</td>
<td>225</td>
<td>1.25</td>
<td>6.34¢</td>
</tr>
<tr>
<td>1965</td>
<td>86</td>
<td>291</td>
<td>.56</td>
<td>5.99¢</td>
</tr>
<tr>
<td>1970</td>
<td>101</td>
<td>357</td>
<td>.40</td>
<td>5.75¢</td>
</tr>
<tr>
<td>PERCENT CHANGE</td>
<td>71%</td>
<td>59%</td>
<td>-68%</td>
<td>-9%</td>
</tr>
</tbody>
</table>

*EXCLUDES U.S.S.R.  
**1958 U.S. DOLLARS
WORLD POPULATION BY COUNTRY, 1970

POPULATION (ESTIMATES MID-1970)
- 70 MILLION INHABITANTS
SOURCE: ESCO (WORLD BANK)
WORLD GROSS NATIONAL PRODUCT (GNP) BY COUNTRY, 1968

(BILLIONS OF U.S. DOLLARS OF 1960)
Figure 3
WORLD AIR TRAFFIC FLOWS
BILLIONS OF PASSENGER MILES
IF SCHEDULED SERVICES
1970
# Gross Domestic Product

(Billions of 1964 U.S. Dollars)

<table>
<thead>
<tr>
<th>YEAR</th>
<th>U.S.</th>
<th>CANADA</th>
<th>WESTERN EUROPE</th>
<th>JAPAN</th>
<th>AUSTRALIA</th>
<th>TOTAL WORLD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>796.0</td>
<td>66.3</td>
<td>598.6</td>
<td>140.0</td>
<td>27.3</td>
<td>2,466.3</td>
</tr>
<tr>
<td>1975</td>
<td>963.8</td>
<td>85.5</td>
<td>734.0</td>
<td>210.0</td>
<td>34.0</td>
<td>3,124.5</td>
</tr>
<tr>
<td>1980</td>
<td>1,178.0</td>
<td>111.8</td>
<td>904.0</td>
<td>300.0</td>
<td>41.0</td>
<td>3,946.4</td>
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</table>

**Average Annual Growth Rates (%)**

<table>
<thead>
<tr>
<th>Period</th>
<th>GDP Growth</th>
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<tbody>
<tr>
<td>1960/1970</td>
<td>4.0%</td>
</tr>
<tr>
<td>1970/1980</td>
<td>4.0%</td>
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</table>
## GROSS DOMESTIC PRODUCT PER CAPITA
(U.S. 1964 $)

<table>
<thead>
<tr>
<th>YEAR</th>
<th>U.S.</th>
<th>CANADA</th>
<th>WESTERN EUROPE</th>
<th>JAPAN</th>
<th>AUSTRALIA</th>
<th>TOTAL WORLD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1970</td>
<td>3,879</td>
<td>3,098</td>
<td>1,624</td>
<td>1,353</td>
<td>2,184</td>
<td>680</td>
</tr>
<tr>
<td>1975</td>
<td>4,429</td>
<td>3,638</td>
<td>1,921</td>
<td>1,974</td>
<td>2,482</td>
<td>793</td>
</tr>
<tr>
<td>1980</td>
<td>5,069</td>
<td>4,235</td>
<td>2,280</td>
<td>2,727</td>
<td>2,770</td>
<td>912</td>
</tr>
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</table>

**AVERAGE ANNUAL GROWTH RATES (%)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>U.S.</td>
<td>2.7</td>
<td>2.7</td>
</tr>
<tr>
<td>CANADA</td>
<td>4.3</td>
<td>3.2</td>
</tr>
<tr>
<td>WESTERN EUROPE</td>
<td>3.4</td>
<td>3.5</td>
</tr>
<tr>
<td>JAPAN</td>
<td>9.6</td>
<td>7.3</td>
</tr>
<tr>
<td>AUSTRALIA</td>
<td>2.4</td>
<td>2.4</td>
</tr>
<tr>
<td>TOTAL WORLD</td>
<td>2.9</td>
<td>3.0</td>
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</tbody>
</table>
PER CAPITA GROSS DOMESTIC PRODUCT
WORLD AND MAJOR AREAS

1964 U.S. DOLLARS

* INCLUDES EASTERN EUROPE AND USSR
** EXCLUDES MAINLAND CHINA, NORTH KOREA AND NORTH VIETNAM
## NORTH AMERICA-EUROPE
### SCHEDULED AND CHARTER PASSENGER MILES (BILLIONS)

<table>
<thead>
<tr>
<th>YEAR</th>
<th>SCHEDULED</th>
<th>CHARTER</th>
<th>TOTAL</th>
<th>PERCENT CHARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ACTUAL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1960</td>
<td>6.9</td>
<td>.8</td>
<td>7.7</td>
<td>10.4</td>
</tr>
<tr>
<td>1965</td>
<td></td>
<td>2.8</td>
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<td></td>
</tr>
<tr>
<td>1970</td>
<td>30.0</td>
<td>10.5</td>
<td>40.5</td>
<td>25.9</td>
</tr>
<tr>
<td></td>
<td>FORECAST</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1975</td>
<td>49.5</td>
<td>25.0</td>
<td>74.5</td>
<td>33.6</td>
</tr>
<tr>
<td>1980</td>
<td>80.0</td>
<td>50.0</td>
<td>130.0</td>
<td>38.5</td>
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</table>

### AVERAGE ANNUAL GROWTH RATE

<table>
<thead>
<tr>
<th>PERIOD</th>
<th>GROWTH RATE</th>
<th>CHARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>1960/1970</td>
<td>29.5%</td>
<td>18.1%</td>
</tr>
<tr>
<td>1970/1980</td>
<td>16.9%</td>
<td>12.4%</td>
</tr>
</tbody>
</table>

1/ CHARTER TRAFFIC OR IATA AND U.S. PLUS EUROPEAN CHARTER AIRLINES.
# INTRA-EUROPE TRAFFIC

**SCHEDULED AND I.T. CHARTER (BILLIONS)**

<table>
<thead>
<tr>
<th>YEAR</th>
<th>SCHEDULED 1/</th>
<th>CHARTER 2/</th>
<th>TOTAL</th>
<th>PERCENT CHARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ACTUAL</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1960</td>
<td>4.4</td>
<td>.6</td>
<td>5.0</td>
<td>12%</td>
</tr>
<tr>
<td>1965</td>
<td>7.7</td>
<td>3.2</td>
<td>10.9</td>
<td>29%</td>
</tr>
<tr>
<td>1970</td>
<td>13.6</td>
<td>11.9</td>
<td>25.5</td>
<td>47%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>FORECAST</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1975</td>
<td>23</td>
<td>27</td>
<td>50</td>
<td>54%</td>
</tr>
<tr>
<td>1980</td>
<td>37</td>
<td>50</td>
<td>87</td>
<td>57%</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td>AVERAGE ANNUAL GROWTH RATE</td>
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<td></td>
</tr>
<tr>
<td>1960/1970</td>
<td>11.9%</td>
<td>34.8%</td>
<td>17.7</td>
<td></td>
</tr>
<tr>
<td>1970/1980</td>
<td>10.5%</td>
<td>15.5%</td>
<td>13.1</td>
<td></td>
</tr>
</tbody>
</table>

1/ SCHEDULED INTRA-CONTINENT INTERNATIONAL TRAFFIC OF THE WESTERN EUROPE SCHEDULED CARRIERS.

2/ INCLUSIVE-TOUR INTRA-CONTINENT INTERNATIONAL TRAFFIC OF THE WESTERN EUROPEAN I.T. CARRIERS.
Abstract

This lecture explores the general economic determinants of market structure with special reference to the airline industry. Included are the following facets: absolute size of firms; distributions of firms by size; concentration; entry barriers; product and service differentiation; diversification; degrees of competition; vertical integration; market boundaries; and economies of scale. Also examined are the static and dynamic properties of market structure in terms of mergers, government policies, and economic growth conditions.
I would like to talk about the classical economic tradeoff: efficiency vs. equity. In order to try to say something we try to set up models. One of the areas in which we do this is industrial organization: the structure, conduct and performance of one industry or a group of industries. There is quite a bit of work done here, but I don't think it's all quite applicable to the airline industry.

Now, all these models begin by assuming a) that we're dealing with firms, b) that these firms produce a homogeneous product that is not really subject to much quality variation. As a consequence of that the only attribute of this product which the firm controls is the price. Now these are sort of zeroth order assumptions, but they beg a lot of questions, particularly: What's the firm? What's the homogeneous product? and What's the price?

The firm I think is best defined implicitly: we say that it is the decision making center. Someone makes decisions controlling inputs and producing outputs. Somebody takes information (basically assumed to be prices from particular markets) and makes decisions combining these factors by taking in the inputs and produces outputs. We assume this decision maker, whoever he is, has some goal and the goal is usually that he maximizes profit, defined as the difference
between revenue and cost. Now this is obviously a somewhat strained definition: between the economic firm and American Airlines there is obviously quite a bit of difference. The firm is related to the modern concept of the profit center. But you seldom have a particular group of people who make one product, control one price, and take the other prices in from the market, and produce an output.

In defense of the economics of a firm it is true that we do try to practice profit maximization. The perennial argument that the firms don't maximize profits is really rather spurious because we don't really have to claim it for most of the conclusions that we reach. We don't need the fact that the firms have a profit function where they set all of the first derivatives to zero and find a maximum. For most of the conclusions all we really need is that the firm strives for the maximum in profit. There are some questions as to how fast they get there.

The difference is between analytically maximizing the function against numerically maximizing it. The outcome is the same. All we really need to postulate is that the firm is trying for this goal; it is not necessary to reach it right away.

As we set up this kind of world we can distinguish two
determinate market structures which Professor Tideman talked about earlier; these are competition and monopoly. Now I'm certain that nobody here really believes that either of these serves as a realistic model. But again, that's not really their purpose: their purpose is to provide a standard, to provide an ideal. If we had such and such a situation, we would have the resulting outcome which would have certain properties. We can then compare existing situations to these standards and try to infer from that something about the properties. In competition we end up with a long run equilibrium situation in which the only sustainable price is equal to the long run average cost which in turn is equal to the marginal cost. This is because of the requirement that the only sustainable condition occurs when each firm is producing at its minimum long run average cost. This situation appeals to the economist as it is the most efficient solution: there's no way to make you better off without making somebody else worse off.

The contrast to this is a monopoly situation in which we can't say very much about price or quantity but we can say that the firm, if it's going to maximize profits, will balance off the gains to revenue from any action against the additional costs incurred. When these are equal, profits will be at a
maximum. Again this raises all sorts of questions like the term over which the firm is thinking about: short or long run profits. Things may be very destructive to profits in the short run and very crucial to profits in the long run.

Most of these questions, however, are ignored and the more realistic models all deal with the world of imperfect competition. The reason that we don't talk much about the problems I guess is because you really can't say very much. You must begin to assume that the firm is really behavioral, that after all, a firm is managed by a group of individuals. The individuals have various goals: they have stock in the company, or they do not have stock in the company. The stock may be a small part of the company's net worth; but it may be a very large part of the Chief Executive's net worth, so he would be interested in maximizing capital gains. A variety of circumstances are going to affect the behavior in the top managements: status and prestige, particularly. The results of these influences are something that we can call slack.

This again is particularly important. When we talked about the production policies that each firm was following, we assumed the firm ended up on the production function, and so it was getting the most possible output from any given set of inputs. Well, it's doubtful that the firms are always there
and the question really is how close they are. There has been a lot of argument that in fact we have quite a lot of slack in the U.S. economy. Big firms do not get the most out of their inputs. Workers could produce more, and machinery could be used more heavily. This, of course, is a very hard thing to talk about because we don't have any measures. There's no way of telling how much a firm could have produced unless you find a more efficient firm that is really identical and find they're producing 10 times as much output as you are from the same input. Then you're inefficient. Unfortunately you seldom have those comparisons. This means is if there is slack and you have a management that's composed of people who have a variety of goals, they aren't necessarily bound to the market. If demand falls off a little bit, they can still keep profits up by becoming a little better managers. At the same time, if the demand is really soaring, managers may take more leisure time and may not worry so much about the office. They take trips to Waterville Valley or something like that. This type of play in the system is not really talked about, and we don't really have a role for it in the competitive model at all: we assume it isn't there.

Managers also have control over quality. In the airline industry, as we will talk about a little bit later, there is really enormous control over the various other attributes
in terms of the size of the steak, the size of the salads, and things like this. In a big firm you have tremendous capacity to alter the quality of the product that you produce. Related to quality is advertising. Firms compete to a large extent by different selling of their wares in the media. This helps to distinguish their product. A product which is sold only by television advertising is a lot different than a product sold by somebody who never has any access to television. It's not surprising that certain industries, particularly the drug industry or household product industries, prefer to spend 150% of the first 2 or 3 years' revenues in advertising. A good example is Comet Cleanser.

Again, this really doesn't effect the economic models because in the competitive situation the firm has to be on its long-run average. It if isn't, it is going to go out of business.

In a monopoly there's no need to advertise, because you are the entire industry so that if anybody wants to buy your product, they have to buy it from you. In this area of imperfect competition there's one strain of views which is associated with Professor Galbraith, who is probably not the most popular economist in the profession. He has stressed one point, which I think today most people are willing to accept: in this area of imperfect competition goals are
important. We talked about the group which he calls the technostructure, which is just his name for the group at the top which runs the company: the management. He stresses that they have goals and that probably the foremost goal is corporate autonomy (protecting yourself). This mandates certain economic criteria: minimum acceptable profit rates and minimum growth rates (Exactly what the tradeoff is between them nobody knows.). There are such situations and these kinds of goals are formulated.

Then we have a variety of other behavioral models, satifying models. Firms don't try to maximize profits, they try to maximize some other function. In other words, they simply try to get at least a 5% increase in profits over last year. The problem with all these models is that there is very little we can say in terms of determining the outcome. In fact, we can't say whether this is going to be efficient or inefficient; we don't know. It's possible to have a firm in imperfect competition that is producing a very good product of high quality, at low cost, doesn't spend much money on advertising, and has all the nice economic attributes. Equally so we could have an opposite firm that produced a horrible product, bad quality and high prices; it was able to maintain a position by very wasteful advertising.

How do we apply this to the airline industry? Well, I
decided what we really wanted to do was to try to answer five questions:

1. What is the industry?
2. What is the product?
3. What is the market?
4. What is the competition?
5. Within the industry itself, what are the means of competition?

First, what is the industry? It's a variety of industries. There are the trunk carriers. These are the major airlines. These were created and designed to provide basic city to city transport between major city points, major population centers. The next level is what is called the regional carriers. These were created to be feeder airlines to bring air service to the rest of America and to provide ways for the people in these areas to get to central cities and to major population centers to get on trunks and then go back. In order to do this, a subsidy program was set up by the Federal Government to guarantee that these airlines would serve small cities that otherwise couldn't justify it.

There have grown up, in addition to these, a variety of others. There are supplemental carriers which basically do a charter business or freight business. These are very important internationally but less so domestically. There are carriers
which carry only freight; for example, Flying Tiger Airlines. The regional carriers are North Central, Mohawk, Allegheny, and Ozark, etc.; and supplementals are something like World. Lately there are the third level carriers, which are the air taxis, the small airlines.

Allegheny Airlines is the regional carrier which has been very successful in using third level carriers as a means of reducing its obligations to serve small points. Under contract Allegheny yields its route to a commuter company which agrees to call itself Allegheny Commuter Airlines. In turn, Allegheny performs certain services for them. What you have are third level carriers feeding into the regional carriers, which in turn are becoming more and more like trunk carriers. Regionals now often serve major cities; they often provide service between major population centers as well and are very apt to be competing with trunks on certain routes.

Finally, there is the category of intrastate carriers, particularly in California, Alaska, and Hawaii. They are hard to classify; for some of them are quite large and some are quite small.

The obvious product is transportation. You get on an airline and move from point A to point B. What matters also is how convenient it is to make reservations, what the ground arrangements there are when you get to the airport, and was it
a convenient trip? You may fly American both ways, even though an Eastern flight is more convenient because your car is parked at an American garage, which is a 15 minute walk from the Eastern terminal. There are a variety of things on the ground which would affect your choice of which plane you take such as the time your plane takes off and the type of plane you get. If you get a DC9, you'll feel cramped; so you want a 727. Also what inflight service do you get? Do you get a snack or do you get a whole meal?

Again, this complicates the product. All the airlines really have to provide is transportation, and they have to provide transportation either 6 abreast or 4 abreast. That's all they are legally required to do; everything else is completely under their control. At a time of strict economic conditions they can cut down on a lot of the extras. Alternatively, when traffic is booming, when they're trying to get more people on and when they make certain that they don't lose you because they thing that you re going to be travelling alot, they provide varieties of frills which really don't cost very much, although they are not cheap. (The average cost of a lunch in coach is something like $4.50 where the average cost of a snack is $3.80; there's not a great deal of difference. On the other hand, when United Airlines cut out serving Macademia Nuts on their trip from Hawaii, they saved a total of several hundred thousand dollars over giving you a package of regular nuts.) Since they fly so many, even
minor changes in service can mean major total cost considerations. This is the slack I was talking about before. The airlines as an industry are characterized by an enormous degree of variability, particularly with respect to passenger service.

In times of economic turndown, a greater share of the passengers are people who really have to fly. They are not passengers that have alternatives in terms of not flying! They are going to fly any way. You may not have to give them good service. As you get more marginal customers who don't have to fly, you have to keep them happy and at the same time keep everybody else happy. This means that you provide unofficial services.

Next, what is the market? Again, you separate this by purpose, (business vs. personal), and city pair (because it's clear that there are thousands of markets in the U.S. which are basically each city pair: Boston-Washington is one market, Boston-New York is another, Washington-Chicago, Washington-L.A.--these are all different markets.) It's not fair to say that there is only one market for airline travel, because again you have different proportions of business and pleasure travellers on each route and too many different considerations involved. In pleasure travel, again to
Washington, people are much more likely to take the car because it's a shorter flight and they can drive it very easily in one day. For California, it's a different situation; you're likely to have a great proportion of your travellers wanting to go by air. You have to distinguish feeder routes, which connect rural areas, to the population centers or the trunk routes. On international flights, you have questions about how long the flights are, whether it is a non-stop flight (or 7 stops along the way). Again you can have markets in which the airlines can decide to service only business customers. If there are some pleasure customers they take them, but they direct their appeal to business or vice versa.

What is the competition? Well, obviously there are the other carriers, if there is more than one on a particular route. There are trains in some areas, buses, and passenger cars. Particularly for personal travel the auto is the greatest competitor. For business travel I would suggest that one of the biggest competitors is no travel at all. Telephone, tele-type, telex, or various other things substitute imperfectly but work almost as well when air travel is expensive.

How do the carriers compete? Well, here you have as many ways as have been listed so far. There are all those things that vary services or quality. They can vary advertising:
they can vary their prices. This is a regulated industry where prices are all established—technically they are not, but in effect they end up being the same as if established by the Civil Aeronautics Board. However, in certain cases an airline is able to compete in price when its cost structure is different from the cost structure of one of its competitors. Some carriers may be able to support a lower fare. The marginal profits of certain operations is higher in some airlines than it is in others. American, for example, claimed for years that the youth fare (they were the initiator of it) was profitable, where some of the other airlines said this wasn't true and that they found it to be expensive. If cost structures are different, (you fly a different aircraft on a route or the destinations are both intermediate stops on longer routes), then you can offer special discount fares which the other carriers really can match only at much greater costs.

There is a problem in competition because there seems to be some evidence that the proportion of seats you sell on certain routes does not vary directly with proportion of seats you offer. If you decide you want to go from a 10% to a 15% market share you may have to double your capacity from, say, 20% to 40%. There is a nonlinear relationship between the capacity you offer and the number of seats you sell. This particularly favors the established airline, the
dominant airline will tend to become more dominant. The more capacity he is able to offer, the more seats he's going to be able to sell because people get used to it. People learn that Eastern flies every hour on the hour or American flies every half hour on the hour, but the other airlines only every two hours. So, if they want to take the next flight, they just call that airline first.

And, of course, airlines compete with various types of aircraft. There is a lot of competition in advertising offering DC10's with their lounges, or 747's with their lounges, as opposed to some other type of plane. The airlines have a variety of ways to compete but none of them are really directly price related, though they cost the airlines various amounts of money. It is very hard to say anything about which type provides which benefits for such and such a cost. If we do want to characterize the industry, I think we can say a couple of things largely dealing with this idea that you have to have a large capacity to guarantee a large share of the seats. It is what's called a heavy fixed-cost industry. The marginal cost, the additional cost of putting you on a plane when the plane is not full, is obviously very close to zero. Except for the amount of food and beverage service you may get on board and maybe a couple of minor things, such as losses
on baggage, etc.—that's it: and the entire cost is peanuts. In the short run you have a fixed number of planes which are on set routes, these routes are scheduled flights (you must fly them according to the regulations) and so there's very little you can do. Even your labor is fixed (you have strict contracts on your labor). It takes time to train a pilot. You cannot overnight say, well, "I'm busy tomorrow on this flight so I'm going to take a 707 out and put a 747 in." You may not have a 747 pilot or a whole 747 crew. You may have the aircraft but you don't have the labor to switch. You have a very restricted industry which really has to live within the constraints of the schedule. There is very little ability to get around it. As a consequence you have massive price discrimination. The people flying on the same plane are paying a large variety of fares, particularly on a long flight such as from N.Y. to the West Coast. You have family plans, you have youth fare, you have military fares, you have military stand-by, military reserved, youth fare reserved, so the airlines get to pick and choose by offering different types of service and different contingencies under which they may or may not board you. They get to offer these lower fares to people who might otherwise take another way. Eastern's Leisure Class, I guess, is a particularly
good example.

The other thing that is characteristic of the airlines is cross subsidization. There is no passenger who pays exactly average costs. Every passenger is being subsidized by some other passenger or he in turn is subsidizing some other passenger. This is particularly true on the regional carriers where there is a formal subsidy program whereby the CAB each year requests Congress for enough money to subsidize these carriers so that they don't lose money for servicing small points which board very few people. What the CAB does is grant route strengthening awards. The way you stabilize an airline in financial trouble is to give it a profitable route. What this means, of course, is that the people who are flying on that route are making money for the airlines and in turn are being used to subsidize fares on another route. Everybody charges the same fare. In California there is PSA (Pacific Southwest Airlines) which is an intrastate carrier which flies you from L.A. to San Francisco and vice versa for about \(\frac{1}{2}\) of the fare that you would pay if you were flying an interstate carrier subject to CAB rules. The CAB pricing formula is basically a certain fixed amount for each ticket plus so many cents per mile, and the so-many-cents per mile varies with how long the flight is. There
are much cheaper fares at PSA, so there has been consider-
able question about how justified the high fares are from
Washington to Boston. If you had PSA flying Washington to
Boston the fare would be just half as much.

The last thing that we want to talk about is the fact
that we are dealing with the regulators. The trunks and the
regional carriers are completely under the control of the
CAB. The CAB has numerous powers. They must approve all
tariffs. This means they must set all prices. To determine
if a tariff is fair or not they determine what should be
rate base of the company. By this they add up in some way
to determine the total amount of capital invested in the firm.
Secondly, they try to determine the fair rate of return. Now
both of these are nearly impossible questions to get a com-
pletely solid analytical answer to. How do you value planes?
Do you value them at their new cost? Replacement costs? What
you sell them for in the market? How do you evaluate a fair
rate of return? There are some risks involved for the air-
lines certainly because of the fact that they are scheduled
carriers; they must fly.

The most important power is the power to gain control
of routes. The CAB controls which route you are able to fly.
Now this can be crucial. If you're a regional carrier and
you just bought some long distance airplanes and you’re flying a lot of short hauls, you may desperately need some longer routes. North Central Airlines, for example, flies nonstop Milwaukee-New York, which is totally non-regional service. These routes were given in an effort to strengthen the airline so they could lower the subsidy. What this means in effect is that these people who fly North Central from Milwaukee to New York, or Minneapolis to Denver are in effect subsidizing the people who fly on North Central from Grand Forks to Hibbing and something like that. When you're flying on these puddle jumps you're being subsidized by the larger, longer routes. The same airplane which is flying you on the short haul may as soon as it gets to Milwaukee or Minneapolis or Madison turn around and become a long haul plane and fly to New York. How do you once again separate the costs? You can't do it. Anything that you came up with would be purely a matter of convention.

The CAB also controls entry, but the more important issue is that they control mergers. This relates to the economies of scale. If you get larger and larger airlines, are they going to be more efficient in providing service? There is some argument for this: you use your plane more intensively, you can guarantee the use of your pilots, you
have one reservation center, you may be able to handle a lot of people, and a lot more cities very easily. Once you set up the software and the hardware to handle all your division centers, it's good enough to handle maybe double or triple what you have so that there are clearly some economies of scale. Is competition good? Is service to an area really improved by having competition? Well, what is all this saying? There really are an enormous amount of things that you have to consider when you try to determine analytically whether should we do this or that. The issues involved are extremely complex. They involve the industry, the product, the market, what the competition is on the route, and, particularly here, social concerns. In Washington National you have the noise pollution of the planes flying over Georgetown. In fact there are some safety factors involved; there have been a couple of air crashes that have been attributed to trying to lower noise in flight procedures.

On the other hand it is clear that a flight from Boston to Dulles is not the same as a flight from Boston to National for most people. So the product that the airlines provides is in terms of transportation from inner city point to inner city point. It involves a lot of variables which are beyond the airlines' control in a direct sense is limited.
I. Introduction: Models of the Firm

Most analyses of dynamic pricing strategies in the economics literature have adhered to the assumption that business firms seek to maximize profits. Newer models of the behavior of large corporations have recently been developed in which a variety of assumptions about business motivation have been inserted into traditional static frameworks, steady-state growth models of the firm, and non-maximizing "behavioral" analyses. These new models have paid increasing attention to the nature and determinants of the forces governing the size and growth of the companies of which they are composed. In particular, the theoretical models of the growth of the firm are rapidly becoming more rigorous, comprehensive, and widely accepted.

Since firms in the trunk airline industry compete in money and capital markets with numerous other firms in both the regulated and unregulated sectors of the economy, these models of firm behavior can be applied directly to the airline industry. The subject under discussion will revolve around alternative formulations of managerial goals which airline firms may be pursuing in practice. The focus will be on the consideration of different objective functions which the companies may be following in lieu of profit maximization. Since these models reflect the behavior of any single firm in any industry, the analysis is one of partial equilibrium which assumes the activities of
all other competitors as given.\footnote{This restriction is severe with respect to the scope of economic questions, both analytical and practical, that can be answered. Economic analysis also seeks to investigate important subjects which concern systems of many firms, or of all firms, which require consideration not only of how all firms individually behave, but also of how their individual activities interact with and constrain each other in markets, broad sectors and the whole economy.}

This paper has two general purposes. It is intended mainly to provide a frame of reference from which alternative hypotheses can be stated concerning the objectives which managers and executives in the airline industry may be pursuing. It also incorporates as comprehensive a list as possible of alternative objective functions and demonstrates graphically that each separate objective may result in its own unique price (fare) and output (volume) combination when equilibrium occurs.

II. Some Simplified Specifications of Alternative Objective Functions

Using the revered goal (objective) of profit maximization as a base, we propose to analyze the following alternative objective functions:

A. Short-run profit maximization
B. Revenue maximization
C. Sales maximization (break-even)
D. Volume maximization
E. Cost minimization

F. Constrained sales maximization
   1. Minimum value profits
   2. Ascending buffer
   3. Descending buffer

G. "Satisficing"

H. Other specifications (non-graphical)
   1. Utility maximization
   2. Growth maximization
   3. Stockholder equity maximization
   4. Security maximization
   5. Market share equalization

Each case will be examined separately to determine the resulting price-output combination which optimizes each alternative objective function. By nature these models are simplistic yet the underlying importance of the basic demand-supply relationships is reflected in the sharply different results of each model. In essence the shapes of the revenue and cost functions (or demand and supply) determines the optimal price-output combination for each alternative objective.

A. **Short-run Profit Maximization**

Revenues are derived from the demand function and are depicted in Figure 1 (top) as a concave function (to the origin), that is, $RR = P \times Z$ where $P$ is fare and $Z$ represents output (or volume of passengers). Assuming that fares can be changed and that the law of demand applies ($\frac{dZ}{dP} < 0$), $R$ reaches a maximum at point $B$. 
However, to generate profits, a knowledge of costs is necessary. If costs are a function of volume, they can be depicted typically as \( CC \) in Figure 1 (top). Profits are simply the algebraic difference between RR and CC at each alternative level of \( Z \), and are maximized when RR exceeds CC by the greatest amount (point A in Figure 1), the result being a profit curve \( \pi \) (Figure 1, middle). The equating of marginal costs (MC) and marginal revenue (MR) (Figure 1, bottom) for those of you who prefer to think in unit terms will occur exactly at point A.

**B. Revenue Maximization**

With the shape of the present RR curve, revenues are maximized at its peak (point B in Figure 1, top). This result also obtains where \( MR = 0 \) because additional \( Z \) can only occur with a decline in revenues as a result of the law of demand in operation. MR is simply the slope of the RR curve \( (dRR/\ dZ) \).

**C. Sales Maximization (break-even)**

There are different variations of the sales maximization hypothesis. In this case we are referring simply to carrying as many passengers (\( Z \)) out to the break-even point C. For reasons of market penetration, the airline may neither be interested in the short-run in profits nor in revenues, but rather it is interested in trading off less profits or less revenues for more customers.\(^2\)

\(^2\)The typical distinction between cost in the economic sense and in the accounting sense should be made. In economic terms, CC includes as a component a normal rate of return such that \( \pi \) really refers to "excess" profit. In the account sense, CC is the conventional income statement figure which excludes profit.
Figure 1: Total Dollars ($), Profits ($\pi$), and Dollars per Unit ($$/Z$) Plotted Against Output (Z)
D. *Volume Maximization*

An extension of the sales maximization hypothesis is that an airline firm may wish to carry as many passengers as possible, even if it results in a short-term loss. The result is in effect an objective of maximizing all available capacity (point D in Figure 1, top). Note that a large bias would be incurred with the pursuit of this objective function with the present revenue and cost relationships.

E. *Cost Minimization*

Sometimes companies become extremely cost conscious and pursue the goal of cost minimization (point E in Figure 2). This output level occurs at the bottom of the average cost curve (AC) where MC = AC. It is an objective completely independent of demand influences, unlike the goals discussed above. A danger which companies occasionally and regrettably experience is that they may minimize themselves to death if revenue considerations are ignored. If the demand curve (AR in unit terms or RR/Z) lies far below where it does in Figure 2, then cost minimization as a corporate objective still would not help. As it turns out in the present case, total profits are depicted by the hatched area in Figure 2.
Figure 2: Dollars per Unit ($/Z) Plotted Against Output (Z)
F. Constrained Sales Maximization

1. Minimum Value Profits

This hypothesis has been advanced by a number of economists with W. J. Baumol in the vanguard. In the most complete statement of his proposition, Baumol argued that firms with market power tend to maximize sales subject only to the condition that profits not fall below some specified minimum value.\(^1\) In Figure 3, profits are maximized at A. However, if management feels that a certain level of profits is satisfactory or even necessary to maintain (OM in Figure 3, bottom) irrespective of volume (Z), then the company's goal is over-fulfilled at volume OA. It can increase volume to O(Fl) while earning at least OM in profits, enjoying higher "sales" than it would under a short run profit maximization policy. If the company's managers insist on earning profits of ON before seeking to satisfy other objectives such as sales maximization, they will not be in a position to increase revenues beyond the short-run profit maximizing level since the profit objective lies out of reach. The most important implication of this analysis is that if firms in the airline industry in fact strive to increase revenues for its own sake and if they require less profit to meet capital needs (e.g., OM in Figure 3), then they can charge lower fares and offer more volume than they would under the goal of profit maximization. Two variations of this objective are the ascending and descending buffer objectives.

Figure 3: Constrained Sales Maximization
2. Ascending Buffer

In Figure 3, OM represents a "buffer" of profits which the firm desires to earn. These profits may be used for unexpected financing purposes, for dividend declarations, or for retained earnings. As long as OM is earned, the company will sacrifice additional profits for more sales. In Figure 4, KK represents a buffer stock of profits which increases with volume 2. With more and more volume presumably the firm should be in a stronger position to increase dividends or to finance additional expenditures. An allowance for this growth is reflected in the rising slope of KK. In this case the company will select volume (F2) in Figure 4, where sales are maximized subject to the buffer (KK) constraint.

3. Descending Buffer

Alternatively firms may be willing to sacrifice substantial short run profits in order to generate volume which would result in a buffer stock LL that varies negatively with volume. If volume during a given period is decreased sharply, say as a result of a strike, the company may wish to have a larger profit buffer at low ranges of Z. As volume increases though, the tradeoff with profits becomes apparent and the company would opt for output (F3) in Figure 4.

G. "Satisficing"

In the early 1960's, several economists in the Graduate School of Administration at the then Carnegie Institute of Technology developed the "behavioral" theory of the firm. At the heart of this theory lies the concept of "satisficing", usually attributed to the work of Herb Simon.
Essentially satisficing refers to the fact that firms may not be maximizing at all but rather may be pursuing a number of goals simultaneously resulting in accepting a "satisfactory" level of profits. Graphically, this means that the firm can select any volume in Figure 4 as long as some satisfactory level of profits is attained. In the case of pursuing any profit at all, the range would be QC within which the firm would be "satisfied".

H. Other Specifications (non-graphical)

Numerous other objectives could be pursued by firms in practice either individually or jointly. These goals might include the maximization of a firm's utility function, of its rate of growth of output, or of its stockholders' equity. Since ownership and management are separate functions of airlines and other large companies, an important objective to analyze might be the maximization of the management's own security and stability. Also, the companies might be satisfied with maintaining or increasing market shares as an objective independent of any other one.

The goals in this section cannot be demonstrated graphically as we have done with the other alternatives. For those objectives which we have discussed, a summary version of each alternative volume appears in Figure 5.

III. Conclusion

No one has yet succeeded in demonstrating conclusively whether or not airlines or other business firms behave in the ways and for
Figure 4: Ascending and Descending Buffer Objectives; and "Satisficing"
Figure 5: Objectives of the Airline Firm--
Summary (See pp. 2-3)

A - Short-run profit maximization
B - Revenue maximization
C - Sales maximization (break-even)
D - Volume maximization
E - Cost minimization
F1 - Minimum value profits
F2 - Ascending buffer
F3 - Descending buffer
G - "Satisficing"
the reasons postulated in the above models of selecting alternative objective functions. One obstacle to enlightenment is that the behavioral differences between long run profit maximization and various short run alternative goals are so subtle that econometric tests with existing data are not sufficiently powerful to discriminate among the contending hypotheses. Since it is clear that airlines do pursue one or more of these objectives in practice, the present state of knowledge certainly must be extended through more sophisticated econometric research and by more detailed case studies than any heretofore attempted.
PROBLEMS OF EXCESS CAPACITY

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July 12, 1972

Abstract

This lecture discusses the problems of excess capacity in the airline industry and focuses on the following topics: load factors; "fair" rate of return on investment; service-quality rivalry among airlines; pricing (fare) policies; aircraft production; and the impacts of excess capacity on operating costs. The lecture also will include a discussion of the interrelationships among these topics.

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Excess Capacity, Service Quality and the Structure of Airline Fares

by George W. Douglas*

I. INTRODUCTION

A characteristic common to most scheduled transportation systems, is that “demand” only rarely equals “supply.” Because of the discrete nature of the “supply,” or capacity offered, and the stochastic nature of demand, the equilibrium of any scheduled transportation system is characterized over time by “excess” capacity. A measure commonly used to denote this excess capacity in the airline industry is the average load factor, the ratio of the number of passengers carried to the number of seats available. Moreover, since the costs of a scheduled transportation system are largely determined by the capacity offered, the cost per passenger is quite sensitive to the average load factor.

The average load factor in the scheduled airline industry has, in the past, been implicitly regarded as an exogenous parameter, characteristic of the nature of the industry and not subject to control by the airlines or the regulators. Following that assumption, average and long run marginal costs per passenger can be defined, with respect to the costs of capacity and the given average load factor. One might describe in this manner the costs and fare determination procedure as followed by the C.A.B. in the past.

It can be shown, however, that the system’s equilibrium average load factor, rather than being exogenous, is determined endogenously by the market, given the costs and fares facing the carriers. In competitive markets, the existence of scheduling competition tends to bring about an equilibrium ALF at or near the “break-even” ALF defined by the costs of production and the fare level chosen. Similarly, the average load factors in non-competitive markets are higher, ceteris paribus, but their level is also related to the costs and the fare level chosen by the regulators. Most airline markets, moreover, can operate over a significant range of prices, or fare, each price level defining, in equilibrium, the average load factor of the system. Only recently has the C.A.B. recognized that by setting fares it implicitly determines the average load factor of the system, and that the setting of explicit load factor standards for use in computing fares is desirable and proper.1

We will seek to describe in this paper the issues relevant to the selection

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*Assistant Professor of Economics, University of North Carolina at Chapel Hill. The author wishes to thank James C. Miller III, of the U.S. Department of Transportation, with whom many of these concepts are shared, and which were in part developed jointly. The author bears sole responsibility, however, for the views expressed here.

1 See C.A.B. Order 11-4-64, April 12, 1971. In this decision on the “Load Factor Phase” of the General Fare Investigation, the Board’s decision reversed the Examiner’s opinion and established for the first time desirable load factor standards for ratemaking purposes of 55% for Trunks, and 44.4% for the Local Service Carriers.
of load factor standards, and by analyzing the implications of the ALF for the system's level of service quality, suggest various characteristics of an efficient price structure.

II. SERVICE QUALITY AND THE AVERAGE LOAD FACTOR

Although a scheduled transportation system can feasibly operate over a wide range of average utilization, we should expect that the quality of service provided to be closely related to the excess capacity offered. The aspect of quality of crucial importance for us in this regard, relates to levels of delays incurred by passengers using the system. These delays arise from two sources: (1) that a departure is not scheduled at the time a passenger desires to depart, and (2) that the preferred flight might be filled, causing the traveler to take another, less desirable flight. From the first source, we might compare the scheduled departure times with the daily profile of desired departure times, and compute the absolute values of the time differentials. The mean absolute difference between the travelers' desired departure times and the scheduled departure time we denote as "frequency delay." The expected frequency delay should be a function then of the pattern of desired departure times for the route, and the number of flights scheduled.\(^2\) As the daily frequency of flights increases, we would expect frequency delay to be decreased.

The second source of delay encountered is a queuing phenomenon, generated by the fixed scheduled capacity faced by the stochastic demand. We would expect that as additional flights (capacity) are offered, the probability of being delayed and the expected time of the delay would be decreased.

The sum of these two kinds of delay we denote as expected "schedule delay," measuring the expected absolute difference between a traveler's desired departure time and the actual departure. The level of expected schedule delay can be considered a characteristic of service quality, and is a significant determinant of air travel demand, particularly in short to intermediate distance markets, where substitution among modes is feasible. As the capacity is increased by increasing the flight frequency (of a given aircraft type), we would expect the stochastic delay and frequency delay to both decrease, thereby decreasing schedule delay. However, as frequencies are increased, the average load factor would decline (in spite of the additional travel induced by the better service), thereby increasing the average cost per passenger.

We have simulated these delay processes (described in the appendix) and can approximate the level of frequency delay by:

\[ T_f = 92F^{-0.46} \]

The stochastic delay is approximated by:

\[ T_s = 0.445 \left( \frac{N}{\sigma} \right) - 0.645 \left( \frac{S-N}{\sigma} \right) - 1.790 \]

\(^2\) Ideally, we might expect that the flights would be scheduled so as to minimize \( T_f \) for any given number of flights. In practice, constraints on scheduling flights over a route, and potential "clustering" effects of competition may prevent the actual scheduling pattern from being locally efficient.
where $S$ = capacity (seats) per aircraft,
$N$ = mean flight demand,
$\sigma$ = standard deviation of flight's demand

Expected schedule delay, $T$, is the sum of expected frequency delay and expected stochastic delay

$$T = T_f + T_s$$

For a route with the distance and the aircraft type specified, we may compute the relationship between the cost per passenger, and the average load factor, as described in figure 1. The operating costs were estimated using a model developed by the C.A.B., which relates the cost per passenger to the ALF, and the performance and factor price parameters of the various aircraft types. For a specific level of mean daily demand (and its variance), we can then compute the expected schedule delay for any assumed level of capacity (or the ALF). On table 1 we indicate the levels of these delays that might be expected for a hypothetical route. As might be expected, as excess

3 Civil Aeronautics Board, Costing Methodology, Version 6 (August 1970) and Domestic Fare Structure: Costing Tabulations for 1969 (Sept. 1970).
EXPECTED DELAYS PER PASSENGER;

Hypothetical Route with
Distance = 600 miles
Avg. Passengers/Day = 800
Aircraft = Three Engine Turbo-Fan

<table>
<thead>
<tr>
<th>ALF</th>
<th>Stochastic Delay</th>
<th>Frequency Delay</th>
<th>Schedule Delay</th>
<th>Cost/Pax</th>
</tr>
</thead>
<tbody>
<tr>
<td>.40</td>
<td>6.90</td>
<td>23.86</td>
<td>30.76</td>
<td>43.84</td>
</tr>
<tr>
<td>.44</td>
<td>9.07</td>
<td>24.92</td>
<td>33.99</td>
<td>40.99</td>
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<td>.48</td>
<td>11.87</td>
<td>25.93</td>
<td>37.80</td>
<td>38.61</td>
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<tr>
<td>.52</td>
<td>15.54</td>
<td>26.90</td>
<td>42.44</td>
<td>36.59</td>
</tr>
<tr>
<td>.56</td>
<td>20.40</td>
<td>27.82</td>
<td>48.22</td>
<td>34.85</td>
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<tr>
<td>.60</td>
<td>26.97</td>
<td>28.71</td>
<td>55.68</td>
<td>33.34</td>
</tr>
<tr>
<td>.64</td>
<td>36.05</td>
<td>29.57</td>
<td>65.62</td>
<td>32.01</td>
</tr>
<tr>
<td>.68</td>
<td>48.96</td>
<td>30.40</td>
<td>79.36</td>
<td>30.84</td>
</tr>
<tr>
<td>.72</td>
<td>68.03</td>
<td>31.21</td>
<td>99.24</td>
<td>29.79</td>
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<tr>
<td>.76</td>
<td>97.60</td>
<td>31.99</td>
<td>129.59</td>
<td>28.85</td>
</tr>
<tr>
<td>.80</td>
<td>146.63</td>
<td>32.74</td>
<td>179.37</td>
<td>28.00</td>
</tr>
</tbody>
</table>

Delays measured in minutes per passenger.
Cost is weighted average of coach and first class costs, inclusive of “fair” rate of return on capital.

With the information contained in figures 1 and 2, we are now prepared to relate the costs per passenger with the level of expected schedule delay, or service quality. This “tradeoff” relationship is depicted in figure 3. This might be interpreted as the opportunity locus facing the regulators; if a high fare is chosen, the market equilibrium will generate a low ALF, and a high level of service quality; reduction of the fare implies an equilibrium with a higher ALF and a greater delay (or a lower level of service quality).4

III. THE OPTIMAL REGULATED PRICE STRUCTURE

Having the information necessary to describe the technical tradeoff between price (cost) and service quality, the selection of an “optimal” price

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4 The tradeoff curve is drawn over a broad range, and without regard to demand elasticities. Since we assume that total revenues must equal total costs, the range of feasible points of equilibrium would be constrained to be between some critical boundary prices. The feasible range, however, is rather wide in most markets.
and implicit quality level may be investigated. It appears on first glance to be a straightforward maximization problem, in which one should choose that point where the technical tradeoff is consistent with that of the customers’ preferences. This is a particularly difficult problem, however, if, as in this case, quality differentiation is constrained. The regulators must select a quality level for a population of customers whose preferences for quality may be diverse. The level chosen, then, must compromise those aspects of service quality that are not separable among these customers.

The simplest approach to this problem is to attempt to discover the tradeoff preferred by the typical traveler, or the implicit value the traveler places on time he is delayed. By assigning such a price, we can determine an “optimal” level of price and quality, which minimizes total trip cost for

5 Conceivably, the stochastic delays could be priced and thereby differentiated among customers by the sale of “priorities.” Frequency delay, however, could not be reasonably differentiated among customers.

6 This approach, while used persuasively in valuing some delays in transportation, such as congestion delays, should be approached cautiously here. The time lost through congestion is irretrievably lost, whereas schedule delays may have alternative uses. Ideally, we would like to discover the tradeoff of demand

\[
\frac{\partial T}{\partial P} \left| N = \text{const} \right.
\]
that "typical" traveler, inclusive of the value of delay times. In figure 3 we indicate that optimal level where the slope of the technical tradeoff between cost and delays equals the assumed value of time. Alternatively, we may represent the minimization problem with a marginal analysis, such as contained in figure 4. Here we indicate with the curve labeled "C6," the reduction in cost per passenger (fare) of a 2% increase in the average load factor, as a function of the load factor. We also indicate with the curves labeled MDC, the implicit value of the additional delay caused by a 2% increase in the average load factor, with time valued at $5.00 and $10.00 per hour. Cost minimization occurs at that ALF where the fare reduction caused by the increase of the ALF by 2% just equals the marginal delay cost (MDC); in this market between .59 and .66.

As pointed out above, the technical tradeoff between price and service quality varies with changes in the distance, size and dispersion of demand. This has the effect, then, of changing the optimal ALF chosen for markets with different characteristics. We should expect, for example, that the optimal load factor should be greater, ceteris paribus, for a long flight than a short one. The delay for either route is related to the average load factor of the system, or the relative number of empty seats flown, on the average. Thus,
while the delay associated with any given load factor is equal for both routes, ceteris paribus, the cost reduction (in dollars) per passenger, of a slight increase in the average load factor is much greater for the long route than the short one. In figure 5 we demonstrate this effect graphically. The curve C22 represents the cost reductions for a trip of 2200 miles, from an increase in the ALF of 2%. As can be seen, the least trip cost occurs at an ALF of .59 for the 600 mile trip, and at approximately .68 for the 2200 mile trip. On figure 6, we portray the range of "optimal" ALF’s for a market of a given size, as the distance is increased.

We should also expect that the market size should affect the optimal average load factor. The stochastic delays are derived by first computing the probabilities of being delayed one, two, three or more flight intervals; and then multiplying each by the average interval between flights. In comparing a large and small market, with all other characteristics being identical, we find that the probabilities of being delayed are similar for operations at a given average load factor in either market. However, the expected delays are less in the larger market, as the flight frequencies would be greater, and the average interval between flights would be shorter, for any given ALF. Hence, we would expect that the optimal average load factor in the larger market would be greater than that in the smaller market. On figure 7, we describe the analysis graphically. In this case, the marginal cost reduction

**FIGURE 4**

Curve C6 = Cost reduction of 2% increase in average load factor
Curve MDC = Marginal delay cost from 2% increase in average load factor; time valued at $10.00/hr.
Curve 'MDC* = Marginal delay cost; time valued at $5.00/hr.
Least Cost Average Load Factor Analysis as Distance is Varied

\[ C_6 = \text{Cost reduction of 2\% increase in ALF for trip length of 600 miles} \]
\[ C_{22} = \text{Cost reduction of 2\% increase in ALF for trip length of 2200 miles} \]
\[ MDC = \text{Marginal delay cost} \]

**FIGURE 5**

Curve C6 = Cost reduction of 2\% increase in ALF for trip length of 600 miles
C22 = Cost reduction of 2\% increase in ALF for trip length of 2200 miles
MDC = Marginal delay cost

curve, C6, is identical for both markets. The marginal delay costs associated with a market of mean demand of 3200 (labelled MDC32) lie below those associated with a mean demand of 800 (labelled MDC8). Hence, we find that the optimal ALF for the smaller market is approximately .60, while that of the larger market is approximately .64. Figure 8 describes the optimal average load factors continuously against market size, as measured by mean daily demand.

The delay model by which the relationship between the cost and the level of service delays were estimated contains a number of assumptions and approximations from limited data of the characteristics of the stochastic demand distributions. Hence, the relationship should be considered tentative in the quantitative sense. However, the model, when tested indirectly by comparing the forecast distributions of average load factors in specific markets with those observed, was found to be reasonably accurate. In any case the qualitative assumptions of the model (i.e., the signs of the partial derivatives) are reliable, and we are thus prepared to defend the qualitative conclusions; i.e., that load factors on long hauls should be higher than on short hauls, *ceteris paribus*, and higher in dense markets than in thin markets. The measure of the delay, re-
THE STRUCTURE OF AIRLINE FARES

Range of Optimal Average Load Factors as Related to Distance; mean daily demand = 800.

Curve H represents optimal load factors consistent with time valued at $5.00/hr. Curve L represents optimal load factors with time valued at $10.00/hr.

FIGURE 6

relationship could be refined with more extensive data on the demands for individual flights over a wide variety of city pairs.

IV. CHARACTERISTICS OF THE EXISTING STRUCTURE OF AVERAGE LOAD FACTORS

It is interesting to compare the pattern of average load factors that has developed in the industry, with the pattern we have suggested. In one instance, the relationship of fares and the average load factor to length of haul (distance), the industry's pattern has been mildly perverse.

One well known characteristic of airline costs is that the average cost of capacity per mile declines significantly with increases in distance. On figure 9 we describe the average cost per passenger mile at various distances, assuming that load factors are held constant. The source of this nonlinearity is the rather substantial fixed or "terminal" cost per flight, which does not vary with distance. The C.A.B. has, from time to time, investigated the cost and fare "taper," to see if they were in close correspondence. *The Domestic Air Fare Study* of 1967, confused the issue, however, by principally computing the cost "taper" with load factors that varied with distance. Although actual load factor relationships with distance were not exhibited in this study,

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7 The principal analyses and discussions centered on a cost taper derived with load factors varying from .56 at 200 miles to .44 at 1000 miles to .46 at 2,000 miles. See Domestic Air Fares: A Study, Civil Aeronautics Board, Jan. 1968.
Least Cost Average Load Factor Analysis as Market Size is Varied

one can only assume that the varying load factors chosen were typical of the existing pattern. The determination of the study was that the fare (actually the weighted “yield”) taper was not as steep as the cost taper; if this were so it would explain why the load factors were lower for long hauls. Following that study, a number of fare adjustments have been made to increase the fare taper, presumably to be consistent with a cost taper with constant load factors.

The only data currently available to the public concerning the ALF’s in the various markets, is that generated by the current General Fare Investigation. From this, we have data on capacity and traffic on each of 353 non-stop routes, by all certificated carriers during selected months of 1969. We are thus able to analyze the relationship of average load factors to the market's characteristics with cross section regression analysis. This analysis indicates that the average load factor is most strongly influenced by the level of competition, e.g., the number of carriers serving the market. The load factors tend to be higher in large markets than in small markets, but even after adjusting for these effects, there yet remained (in 1969) an inverse relation between the average load factor and distance. The results of these regressions are summarized in table 2.
Range of Optimal Average Load Factors as Market Size is Varied

Distance = 600 miles
Curve labelled H represents optimal ALF's with time valued at $5.00/hr;
Curve labelled L represents optimal ALF's with time valued at $10.00/hr.

FIGURE 8

V. CONCLUSIONS

We have demonstrated that the price level and structures set by the C.A.B. tend to determine the average load factor of the air transport system. Moreover, the level of service quality and the average costs of the system are closely related to the average load factor. By qualitative analysis with simple assumptions concerning the relationship, one can conclude that average load factors should be higher in long haul markets than in short haul markets, and higher in dense markets than in thin markets. The actual specification of desirable load factor standards depends on the quantitative description of the technical tradeoff between price (cost) and service quality, and a measure of the traveler's preference (tradeoff) between price and service quality. With the limited data currently available, delay models were constructed to approximate these tradeoffs, and from these a range of "optimal" average load factors were computed.

APPENDIX

THE ESTIMATION OF SCHEDULE DELAYS

Schedule delay arises from two sources:

(a) That a traveler's desired departure time does not coincide with a scheduled flight ("frequency delay"), and
(b) That the desired flight is filled, and the traveler must take another flight (stochastic delay).

Frequency delay (type "(a)") was estimated by simulation. The daily pattern of demand (Figure 2) of a typical route was transformed into a discrete frequency distribution. A procedure was used to schedule "F" flights during the day, such that each flight faced demand of equal size. The difference between each traveler's desired departure time and the nearest scheduled flight was computed, and their absolute values summed for all travelers. The mean, or average delay for each traveler was computed. The procedure was repeated for F+1, F+2, etc., thus generating the average or "expected" value of frequency delays as a function of the daily flight frequency. These observations were fitted to the function

\[ T_f = 92F^{-0.456} \]

where \( T_f \) is the expected frequency delay, per passenger (measured in minutes) and \( F \) is the daily flight frequency.

To estimate stochastic delay, we characterized the problem as a queuing phenomenon, and described it as a Markov process. To do this, we assumed that each flight faces a random demand with mean \( N_f \) and standard deviation \( \sigma_f \). We describe the state of the system by a variable \( Q \), defined as the number of passengers desiring space on a given flight. Assuming that the distribution of demand is normal, we can then assign probabilities to a one step transition matrix. An example of such a one step transition matrix is...
THE STRUCTURE OF AIRLINE FARES

CROSS-SECTION ANALYSIS BY MARKET OF AVERAGE LOAD FACTORS

"t" - Statistics in Parentheses

All Markets:

1. \( \text{ALF} = 5.86 - 0.2 \times 10^{-4} \times \text{DISTANCE} + 0.8 \times 10^{-6} \times \text{PAX} - 0.07 \text{ NO CARRIERS} \)
   \( (1.4) \quad (9.1) \quad (6.5) \quad R^2 = .213 \)

2. \( \text{ALF} = 2.44 - 0.018 \ \text{LOG DIST} + 0.573 \ \text{LOG PAX} - 0.146 \ \text{LOG C} \)
   \( (1.8) \quad (7.1) \quad (5.5) \quad R^2 = .144 \)

One Carrier Markets:

3. \( \text{ALF} = 4.94 - 0.3 \times 10^{-4} \ \text{DISTANCE} + 1.4 \times 10^{-6} \ \text{PAX} \)
   \( (1.6) \quad (4.1) \quad R^2 = .128 \)

4. \( \text{ALF} = 3.03 - 0.016 \ \text{LOG DIST} + 0.059 \ \text{LOG PAX} \)
   \( (1.25) \quad (6.4) \quad R^2 = .238 \)

Two Carrier Markets:

5. \( \text{ALF} = 3.49 - 0.3 \times 10^{-4} \ \text{DISTANCE} + 1.9 \times 10^{-6} \ \text{PAX} \)
   \( (0.1) \quad (16.10) \quad R^2 = .572 \)

6. \( \text{ALF} = 1.53 - 0.019 \ \text{LOG DIST} + 0.121 \ \text{LOG PAX} \)
   \( (0.8) \quad (4.5) \quad R^2 = .145 \)

Three Carrier Markets:

7. \( \text{ALF} = 4.95 - 0.2 \times 10^{-4} \ \text{DISTANCE} + 0.1 \times 10^{-6} \ \text{PAX} \)
   \( (0.8) \quad (0.8) \quad R^2 = .024 \)

8. \( \text{ALF} = 3.71 - 0.017 \ \text{LOG DIST} + 0.031 \ \text{LOG PAX} \)
   \( (1.42) \quad (2.2) \quad R^2 = .105 \)

Four Carrier Markets:

9. \( \text{ALF} = 4.64 + 0.5 \times 10^{-4} \ \text{DISTANCE} + 0.1 \times 10^{-6} \ \text{PAX} \)
   \( (1.0) \quad (2.8) \quad R^2 = .62 \)

10. \( \text{ALF} = 1.07 + 0.013 \ \text{LOG DIST} + 0.045 \ \text{LOG PAX} \)
    \( (0.5) \quad (2.2) \quad R^2 = .495 \)

TABLE 2

given in Table A1. The row and column headings identify the state of the system, or the number of travelers desiring a seat on the flight. The row headings indicate the possible states of the system at any time \( T_o \), while the column headings indicate the possible states of the system at time \( T_o + 1 \). The entries in the matrix are the conditional probabilities. For example, if the state (number of passengers) at time \( T_o \) were .4 of the mean demand, the probability that at time \( T_o + 1 \) there would be a demand of \( .4N_f \) is .1; that there would be a demand of \( .2N_f \) is .187, etc. If at time \( T_o \), the demand exceeded the capacity, then of course the demand at time \( T_o + 1 \) must reflect this "overflow." Hence, the conditional probabilities would change, as indicated in the matrix. These probabilities are defined with respect to a given capacity, measured in units of "X" where

\[
(2) \quad X = S - N_f
\]

\[
\frac{\sigma_f}{\sigma_f}
\]
where $S =$ aircraft capacity.

The "steady state" of the Markov process defines the probabilities that $Q$ is of any given size. Comparing these probabilities with the aircraft capacity, we can estimate the probability of being delayed by one, two, three or more flights. By multiplying these probabilities by the average headway interval, we can estimate the expected delay associated with any relative capacity, "X." By computing many values of delays, as X is changed, we then fitted the function:

$$T_o = 0.455\left(\frac{N}{\sigma}\right)^{-0.648}\left(\frac{S-N}{\sigma}\right)^{-1.700} \times \text{(headway interval)}.$$

### One Step Transition Matrix

<table>
<thead>
<tr>
<th>State (queue length) at $T_o + 1$</th>
<th>$X = .575$</th>
</tr>
</thead>
<tbody>
<tr>
<td>State at $T_o$</td>
<td>.133N</td>
</tr>
<tr>
<td>.133N</td>
<td>.049</td>
</tr>
<tr>
<td>.40N</td>
<td>.049</td>
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<td>.67N</td>
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</tr>
<tr>
<td>1.2N</td>
<td>.049</td>
</tr>
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<td></td>
</tr>
<tr>
<td>2.0N</td>
<td></td>
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<tr>
<td>2.27N</td>
<td></td>
</tr>
<tr>
<td>2.53N</td>
<td></td>
</tr>
<tr>
<td>3.07N</td>
<td></td>
</tr>
</tbody>
</table>

Note: Matrix condensed for expository purposes; computations were made using $33 \times 33$ matrix.

$N$ represents the mean demand per flight period.

### TABLE A1
THE ROLE OF THE MANUFACTURER IN AIR TRANSPORTATION PLANNING

by James MacKenzie

Douglas Aircraft

July 12, 1972

Abstract

This lecture deals with the role of the aircraft manufacturer in the airline industry. The process will be illustrated by using a fictitious airline as an example—that is, a case study approach with "Mid-Coast Airways" serving as the example. Both in slide form and with supporting papers, a brief history of the airline, a description of its route structure and a forecast based on econometric analysis are presented. Once the forecast rationale is explained, information will outline the requirements for additional aircraft and the application of new aircraft across the system using alternative fleet plan options. The fleet plan will be translated into financial summaries which will indicate the relative merit of alternative aircraft types, or operating plans.
I'm going to talk about the role of the manufacturer in the aviation and commercial field with particular emphasis on the marketing aspects of commercial aviation.

The last time I looked, our advanced research and systems group had several proposals in various states of preparation or submission to NASA relating to a broad spectrum of projects. These included retrofit programs for the JT3D/JT8D engine, two segment approach programs and studies, experimental STOL vehicular development proposals, composite materials for STOL aircraft and a whole host of wide ranging projects. Now, this relationship has been going on for some time but it's primarily been handled by this group which has previously been part of our military organization. We recently reorganized and brought into an overall marketing structure of what was formally our military sales group and is now called government marketing and I think the emphasis or the shift in NASA's approach to truly commercial problems signals a change in our company where we now, and I represent the commercial side strictly, will be dealing more and more in these kinds of problems. We are presently supplying people to a task organization to conduct a funded STOL system study and I'll talk a little more about that later. But, I think the shift of NASA's interest into
commercial programs of large scope signals or represents growing awareness on the part of the Federal Government through sociological and economic problems and I think that this interest is needed and certainly welcomed by the manufacturers and a discussion I had some time ago with a representative of the Port of New York Authority, he mentioned that the area encompassed by their jurisdiction crosses over some 1500 different political and labor entities and so I think that if we are about to achieve an effective STOL system we certainly need policies and institutions of the highest level for the federal government to cut across these jurisdictions and interests to establish an effective, viable, system where we can have land as required where we can develop safe control techniques or systems. I think that it is particularly important, however, that we recognize that if we are to achieve true sociological and technical advances that it has to be done recognizing the economic constraints that are applied to both the aircraft builder and the manufacturer. We're talking now about programs where the development costs exceed the net worth of the companies that are asked to develop the vehicles. The inability of private institutions to financing these entirely such as the programs of the SST and I am sure that
this will apply to any future major system development, demands that we get better ways of financing funding programs of this type. The second thing in these economic constraints applied to the users of the airplanes and if you look at the foundering of the SST program with the prolonged delays and high speed rail development in this country there is a doubtful future of aircraft like the Concord and I think you can relate more to the fact that those systems have yet to prove their economic merit than you can to ecological considerations although the ecologists may take credit for torpedoing the SST program. I wonder what the outcome would have been if that aircraft really had the economic promise that more conventional aircraft have.

I think that it also is important to remember that whatever the Government does in terms of establishing policies and institutions to assist the industry we have to remember that it will be accomplished through private enterprise, that's the builder and the airline and the banking institutions.
Q. Are you stating that the Congress was aware that the SST did not have the economic problems?
A. I think that there are many people that seriously questioned the economic viability of the SST. They certainly knew the Concord was not as economically attractive as the U.S. SST, but the cost of the airplane and the technical unknowns about its terms of maintenance and reliability I know had the airlines concerned. I think that that is a big part of the problems involved. If the airlines had aggressively stated the case and I think that this was part of the problem of the entire SST presentation that really wasn't marketed very well. My hunch is that is was because the economic benefits were very difficult to prove.
Q. Are you suggesting that there might have been some kind of a consensus that it was not economically viable.
A. That may be too strong a statement, but in discussions that I had with various representatives of airlines the common theme was concern, doubt as to whether it was really going to be a money problem. That kind of question as far as operating costs, seat mile cost, etc., were never in question with the 747 or the rest of the subsonic airlines and you see now in the Concord to a much higher degree and it's a much smaller airplane, rising price tag.
Q. Of course, that was not a secret that -
A. That's right, but I think the focus was on ecological aspects and the noise factor.
Q. I think that it was also a question on timing, too. Maybe the airlines would have been ready for something like that.
A. Well, that's right, they were saddled with a tremendous investment for 747's and DC10's and L-1011's all at the same time or just preceding it. And then, you throw on that an economic recession starting in '69 when all airlines were all in trouble anyway. All I'm suggesting is that when your technology enables you to propose certain kinds of vehicles, I think that it's essential that those vehicles offer some sort of economic incentive to the user otherwise you might find that the operating costs are so high that they are not marketable.
Q. We followed the vote very closely from the Aeronautic Space Council Staff's point of view on the SST and several votes throughout its history and my observation was that the final vote was more of an economic vote than an ecology vote. The Congressman who had initially voted in previous years against it on ecological grounds was now convinced that the threat was well enough defined to vote against it, but on the other hand, and it wasn't necessarily concensus, but there
was a big uncertainty and they just didn't have the right answers from the manufacturers or the Government on the economics of the aircraft.

A. Although that didn't get us many headlines.

Q. Oh, no, the papers picked up the ecology issue.

A. That's correct. Since 1920 when the Douglas Aircraft Company was founded, we've watched the phenomenon of commercial aviation grow from an experiment to a national necessity of the first priority and because of this growth there has been a great many entrants into the manufacturing field, very few of them have survived. There are three manufacturers today in the United States competing for commercial markets: Boeing, Lockheed and McDonnell-Douglas. Each of those companies has the productive capacity to satisfy close to the total demand. So we have an industry that is characterized by over capacity. This means that the competition between builders is intense. It's resulted in very spotty earnings records through the years, not only for the three that survived, but for previous entrants. It means that there's tremendous competition between them for product differentiation. Each one strives for higher speeds, more passenger service features, larger capacities, all those things that drive development costs upward, at the same time
price competition working to keep the margin between costs and sale price very narrow. It also drives the break even point of the aircraft much higher than the builders would like to see it and this competition is passed on to the airlines because as a regulated industry where they are regulated in respect to what they can charge for a seat to the public they too seek product differentiation and they seek advantages that they can advertise in order to maximize their share of the market. So we have a combination of high development, high competition between both builders and users and it might be argued that what the industry really needs is either fewer competitors or more regulation within the industry. But, I would argue that given those as problems we can still say that the 707 and DC8 are better airplanes because of that competition and that the 737 and the DC9 are better airplanes because of the competition and that the L10-11 and the DC10 are better because of competition. So, I'm submitting that there is a great deal of merit in the basic structure where you have a highly competitive situation in terms of the quality of the end product. I think that one factor overrides the easy way out which would be to control capacity or to regulate it in such a way as to minimize the problems attendant to both the airlines and the builder. One other thing about this competition was the carrier seek or
or the builder seek product differentiation as to the carriers. This means that the airlines are going into re-equipment cycles before their existing aircraft are fully depreciated or obsolete. What I think we need are Government policies which sustain competition, which are aimed at protecting the economic health of both the aircraft manufacturers and the airline.

I mentioned that I am going to focus today on marketing and this is merely the beginning as to where it all started as far as how you go about developing an aircraft. I think that marketing is appropriate here because it is in the marketing area where all the social, technical, economic barriers are brought to focus. It is there that the success or failure of a given idea is going to be achieved. Marketing is also the principal line of communication between the builder and the airline. At Douglas we have a fairly conventional marketing organization. Sales is the most visible group, it's the principal agency of contact with the airline and they are the spokesman to the outside world, but the sales group represent less than 15% of the total marketing organization. The rest is composed of engineers, economists, financial analysts, schedulers, a whole host of specialists that develop and support a case for the aircraft. To this you can add the entire resources of our engineering organization, our legal and contract group and the products support
groups for after sales support. The marketing process encompasses a very large number of men. If we look at the sub groups within our marketing organization we can first talk about our advanced transportation concept groups. Now, this organization is charged with the responsibility of relating technical possibilities downstream against what they see of the environmental needs to be out into the future and they are going out today to about the year 2000. Their purpose is to keep Douglas Aircraft in the mainstream of air transportation and it's easy to get off track as you can see by the number of companies that have been in the field and have somewhere failed to come up with the right product at the right time. We have a similar group relating the cargo development where they're studying the emerging infra structure of inter-modal transport of containerized cargo and their emphasis is to determine how and when the very large cargo airplane will make economic and technical sense for both this nation and other nations throughout the world. At this point, maybe if we can turn the projector on .... The advanced transportation concepts group prepared this forecast of world traffic and they've done this in a factor technique where if you say we're at about an index of one here by the year 2000 we're going to be up past 20, which means that there is a great tremendous growth potential world-
wide for air travel. These two lines represent out to this point, the low band and the high band in our market research forecast through the year 1980. Beyond they've taken a number of techniques to extrapolate out into the year 2000. They've used delphi techniques and a lot of intuitive judgement. The band out here as you can see is quite wide so there is, the further out you go in the time the vaguer it gets and grayer it gets, but, even if you assume that the low band is the more reasonable, we're still talking about the factor of 8 times the growth by the year 2000.

There will be a definite break in the period around 1985. I don't know why they did that. It could be that they're saying that at that point of time they can't tell any more but they think that there is a maturing of world markets. The group that I'm responsible for is presently going out to 1981 and these fellows simply take it beyond there.

Another interesting part of this growth pattern though, is what they see as how that travel is going to be accomplished and this is the greatest pointer that I've ever seen. It's very appropriate. What they're saying is that really the classic modes are going to persist clear out into the year 2000 with short range aircraft accounting for about 13% of the total, medium range 19% and transcontinental 13%, intercontinental actually coming down, SST is now becoming a very big factor
by that time, long range represents aircraft going some 5000 miles or beyond, equivalent to the 747 or the long range DC10's and STOL now is beginning to emerge as a real factor. I should point out that this is in terms of RPM's. Now you say that 8% of the total may not seem like very much, but in terms of people it could be a great deal. One man traveling from here to London accounts for 6000 RPM's, excuse me, say from Los Angeles to London, and that's the equivalent of say, 20 people going from Los Angeles to San Francisco. So we could be talking about a very large number of people but yet generating a few RPM's out of the total.

I think what we're saying here is that STOL and Feeder Aircraft do not necessarily, they're doing the same service but they're not the same airplane. It's a mix.

Q. Is this the world market or is this the domestic market?
A. That's world.

Q. Do you see any VTOL by 2000?
A. No. That did include helicopters.

Q. How do you differentiate the long range and trans-con?
A. Transcontinental is, let's say, 2500 miles.

Q. Is that somewhere in long, short or medium range?
A. This we're talking about 727 type range capability. Out to trans-con 2500 miles, inter-continental is 3500 and long range is beyond that. The Tel/Aviv/New York type are going
above 5000 miles.

Q. If I perceive correctly, you're present short range are in three segments; STOL, short range and medium range on both of the diagrams. Are you saying that the medium to short range are going to be unchanged?

A. But the mix between STOL and DC9 and 737 and the kind of equipment that we are shifting towards. STOL

Q. Does this include charter service?

A. I believe that this is scheduled. Well, no, I take that back. I think it does include charters.

Q. I think a way to look at that is that the STOL Feeder business might be as much as 80% of the day's total.

A. I'm sure it is. You'll see later that I have some forecast of aircraft numbers by type and I think that we're saying that by 1980 that there are some 480 STOL aircraft.

Our Market Research Group is charged with more near term responsibilities and I mentioned earlier that we are working on a funded NASA study STOL system and we have actually assigned or loaned people to a task-oriented group and they're presently going through exhaustive analysis of a major potential STOL system as to what the capture would be within the market. What the trade-offs are in terms of range against surface desireability on the part of the consumer and what the economics of the aircraft would have to be the make of
the craft. It's a rather interesting study and a rather complex one. We went through the same kind of analysis several years ago when we were trying to decide whether to build the DC10 and it all started with an analysis of the potential economics of an aircraft and big discussions with airlines as to what kind of operating costs levels they were seeking, what comfort standards were they after, what kind of improvements in systems in terms of all-weather capabilities and a whole host of trade studies in which you try to determine what kind of an airplane truly makes sense in the market for the period you are designing the building to. Our goal was to develop an airplane that would have as broad an appeal as possible and you achieve this through what we call operational flexibility. This involves a number of considerations, the effective range of the aircraft, its takeoff and landing performance to enable it to work out of a host of airports, the all-weather flexibility, there are a number of keys that we focused on. The total market estimate was very critical to this decision because we knew we were going to invest over a billion dollars in developing the aircraft and that exceeded our net worth, so you have to get to some pretty reasonable estimates of how many of these airplanes you can sell or you are really facing a disaster. When you think of the experience with the 10-11 and the engine problem you find
out how critical this can become. You may recall that at the time we were offering the airplane we said we'd build it if we had a total of 50 firm orders from at least two major airplane manufacturers. We got American Airlines to commit to 25 firm and 25 options. Following that Lockheed, who was also in the race got a spate of orders from TWA and Eastern, Northeast, Delta, and Air Canada, and at that point our program was really on the ropes. United then committed to the DC10 and with that we had our quota. (They bought 30 firm and 30 options). With that we had sufficient orders to commit to a firm program and we started building the airplane. Because of the lead that Lockheed had jumped into we wanted to overcome this and broaden our customer business. We were fortunate in that we had committed to the General Electric Company for our engine development and that they had early in the game come up with a growth version of the CF6 engine. We were able to convert this additional thrust into higher design weights in order to achieve greater range. We now have four models and as you can see, the basic airplane, series 10, which American, United and National are operating today, is powered by a 40,000 lb. thrust engine. It's maximum takeoff weight is 430,000 lbs. and its range is about 3670 nautical miles. When we go to the long range version, the CF6-50C our thrust is gone up to 51,000 lbs.
We can then go to higher design weights, greater fuel capacities and increase the range up to 5300 nautical miles. We also had Pratt Whitney in the competition with their derivative engine of the JT9-D which produces 50,000 lbs. of thrust and again the same design weights, the airplane is slightly heavier than the GE version so the range is not quite as great but it is actually the next one that will be certified and that will happen this fall. We also went to convertible freighter versions and we've sold those in CF powered versions. They can carry 158,000 lbs. payload for 3150 nautical miles so in the passenger version the range is about equal or in the passenger mode is about equal with the standard passenger airplane, so that's given us additional flexibility and because of this we have now broadened our customer base to 25 airlines. Seven carriers have bought the series 10 airplane: American, Continental, Delta, Lakair is the next one (it's a charter carrier based in London), National has bought the basic airplane, United and Western. Northwest bought the series 20 with Pratt Whitney engines primarily because they believe very strongly in engine commonality. They're a large 747 operator and they felt that the common overhaul line would justify that going to an airplane with slightly lower performance levels. The convertible aircraft has been bought by Martin Air Charter
which is an operator based in Holland, O & A, Sabena, and
TIA and the long range GE power aircraft has been ordered by
El Mexico, Air Afrique, Air New Zealand, Alitalia, Atlantus,
Fin Air, Iberia, KLM, Luftansa, National bought the long
range version for their Miami/London flights and finally
SAS, Swiss Air, UTA and Viasa. Now there are a number of
carriers that have yet to come into either the 747, the
L10-11 or DC10. The competition is very keen for those
remaining operators and now we have the A300B, the French-
British product, coming into the scene actively marketing
in the United States throughout the world within a twin
powered wide cabined aircraft.

Q. Do you know the total rack up of the three airplanes?
A. We sold, including options, 240 airplanes. I think
the 747 is about 210. I'm not sure on the count.

I might mention here that despite Lockheed's problems,
they're tough competitors. I think that their airplanes are
going to work fine. They've been hurt because of the engine
delays because we've broadened our customer base. But the
future looks very bright for them in Great Britain and there
are still a lot of people out there who haven't bought them.

Q. As I recall, Lockheed preceded you people in this type
of aircraft. Can you elaborate a little bit on that and
your view of the 747 and this type of aircraft and why you
felt you should go into this type of aircraft as opposed to
perhaps some other area. You knew that you were going to get
high competition. It seems to me that when two or three companies are all competing for the same market perhaps they would do better if they would kind of divide their market upsurge. That's an over-simplified way of putting it, but I'd like it if you would elaborate a little bit more.

A. I think there are a number of reasons. One, our growth estimate told us that there was healthy growth despite the immediate problems that were facing us. The 747, we believe, was going to have tremendous passenger appeal and here we were building stretched DC8's that we saw just could not compete around the major routes of the world against the wide cabin airplane, so our choice then was whether to enter it or abandon the field and I think at this point that emotion creeps into it. We just hate to give up without a fight. Secondly, we felt the 747 was oversized for the 1970's. It represented about a tripling in capacity from the standard DC8/707's and this jump and there were reasons why the 747 was the size that it was. A lot of developments on that airplane had been accomplished through the C5 competition. We felt that there was logical gap in size between standard body forms in jets and the 747 that would serve as a better vehicle for less dense routes and that's a compliment to 747 service on off time, off day service and I think we proved right. I think that the airplane is going to be quite successful.
We started out with twin engine air bus and American Airlines had written us back for a twin engine air bus, but when we went around to the other airlines we couldn't find any one else that wanted that airplane. They all wanted more range, more takeoff flexibility. They wanted to be able to operate out of Denver and Mexico City. You just can't do it with two engines and go anywhere so the trade study said that it had to be a three engine airplane. If you go to three engines when you've got the takeoff performance and the enroute cruise performance to go to transcontinental and of course when we got the growth engine we could go a long way.

Q. I have been told that the market analysis groups of both Lockheed and Douglas predicted more than break even sales for both companies building essentially the same airplane. Is that true?

A. Yes, that is true. And I think that the total market is there if we assume that everybody gets an equal share. I think they will. While we've done all this product differentiating we haven't done that without a price either. We might break even here.

Q. What are the numbers up to 500/600?

A. I can't answer that question for two reasons. It's a very closely kept number but at the time of the congressional
was to reduce their price and they were very successful and sold five of the airlines practically within a week. We met that price and made a comparable reduction and passed that back to American and the competitive factors keep both cards pretty neat. The bankers get involved where they look at your estimates, do they believe the costs estimates of manufacturing. And then in turn do they believe that you are going to be successful. They do have a lot to say about when an aircraft company can do if it's heavily committed to a long term gap, as to new programs, derivative programs, developmental programs.

Q. What would happen if you had gotten to a point where you would never break even. What would the banks have to do then?
A. I can't answer that, but I think that it's a pretty fundamental thing, unless you make some money somewhere along the way, you're going to cease to exist. In 1966, Douglas was selling aircraft faster when our bankers forced us into a merger simply because the cost of the manufacturer was exceeding the sales price of the aircraft. Now, what McDonald brought to the Douglas company was a lot of money and there was a lot of restraint on his part as to how to get Douglas Aircraft out of trouble. We elected to middle management and we felt that we had a sound engineering group and a sound basic middle management and they left us pretty much alone with some key people coming in with manufacturers
wondering what they could look at and what we were having some problems with, but within a couple of years we have turned around and we've been fairly profitable since and, by industry standards, profitable.

Q. Were you not experiencing a very difficult training period?
A. Oh, yes. We had, I can't remember, I think there was something like 3/4 of the people in production that had been there less than a year.

Q. There was a high turnover as I recall and many people who you were training would work for a couple of weeks and then leave.
A. Turnover was high and experience was low, coupled with some vendor delays of engines and landing gears.

There was a kind of a remarkable recovery but to come back to another question, why did we get in, here is a more current forecast of where we see us going from today up until 1980. It's a healthy growth rate close to 12% per year for total services with a growing in non-scheduled areas as we go up toward 1980. That means that in order to supply that there are going to be a lot of new airplanes built and here are estimates as to what is going to happen to the world fleet composition through the year 1980. There will be a
phase out of the conventional props and turbo props, they'll 
be down to about 700 by the end of the decade. The DC9, 737, 
Caravelle, BAC111 still had some growth left in them primarily 
because operating airlines are still reordering and it looks 
like we're estimating that the fleet will grow to a maximum 
of about 1560 by 1976 and at about that time we see those lines 
closing down and then a gradual decay as we go out into time. 
727 -- there is a lot of life left in the 727 and Boeing has 
done a remarkable job of modernizing that airplane and 
stretching and increasing its range, making the interior more 
attractive and it's showing up in the past few months in rather 
remarkable sales. The older DC8's, 720's, 990's we see phasing 
out and they've already started going out and will be down 
quite low by 1980 and the conventional 8's and 707's also 
starting downhill about now getting down to the low 900's by 
1980. To replace that and to accommodate the growth that we 
have shown on the previous chart, we'll see a remarkable 
growth in numbers of short and medium range wide cabin air-
craft that includes now the A300B, the DC10 twin if there 
is one or any other competitive twin in the U. S. plus L10-11's 
and DC10's. Long range aircraft are composed primarily of 
747, long range DC10's and long range 10-11's and you can see 
that there is a lot of aircraft to be built in the next ten 
years. STOL just emerging will be growing by 1980 to 470 units,
supersonic aircraft primarily. Now the Concord coming in 1976 and we are saying 87 units by 1980.

Q. Would you comment on the USSR?
A. That excludes the USSR. I don't know much about them except that they're beginning to aggressively market in neutral and satellite countries and in some of the countries in Western Europe and they have a pretty good family of conventional aircraft jets. They've got the Illutian family of aircraft, the tri-jets, four engine jets, long range airplanes, YAK-40's. They've got a lot of airplanes and they're trying to sell them. I think they've got some very difficult problems in marketing the Western countries because they have a very bad track record at home and among their satellite nations as far as product support goes. The SST is anybody's guess.

Q. How about Communist China?
A. That's an interesting area, for Boeing, as you know, has had a sales team there and the going export license was granted last week and I think that somebody will sell them some airplanes and we have people in contact with them as well. How much is there and how soon is a difficult question. The country is under-developed in all modes of transport as far as rail and highway systems and it could be argued that maybe air would be the cheapest and the fastest way to get a travel system and a domestic transport building in China
although I don't know their labor costs are bound to be low and maybe building highways would be cheaper, but for foreign international travel they've indicated that they are interested in going into other countries and I think we'll see some action. In the long range the potential is huge, with 800 million people.

Q. What are your estimates as to the passenger capabilities on the STOL feeder jets?

A. That's in the trade study area now, and the last I heard they were talking about 100 seaters. It's very tough to get very good economics with 100 seat STOL aircraft. I think in the long run it might be bigger but then if you do that you cut down on the size of the network so I don't think it's any better now than to just guess from my point of view.

Q. Why did Douglas close the DC8 while Boeing kept open the 707?

A. We just couldn't sell any more DC8's.

Q. I thought that it had the lowest operating costs in the country.

A. It is, the DC8-60. But the problem you run into is one of who are your customers, your established customers? The DC8-61 is not a long range aircraft and I think Boeing production is pretty much limited to their 320B's which is the intercontinental aircraft. Now they're kind of struggling
as well and I don't see so much more in the way of sales for their company.

Q. Will the continued production of the DC8 steal from the DC10?

A. Yes, but if we had had our way we would have delayed the DC10 because we have a very good airplane and a very low cost airplane and we built a lot of them and we're making money on them. Everything argues the delay except the competitive factor with the 747.

Q. You made a reference to the economics of a 100 passenger airplane as pretty poor. Is this an implication that its technology that has to be developed in this area or is this an implication that manufacturing structures are so hard, or have they gotten so big? Has this created a problem, or is it something that just relates to a 100 passenger airplane?

A. I base that on what I understood the study price to be and I think it was somewhere around $12 million. Now you're getting a lot for this, you're getting STOL capability, but with a hundred seats and $12 million the cost per seat mile ran very high so unless you can increase the capacity and once you've got a basic airplane you can stretch it once you've got 50 more seats as this would just improve the seat cost tremendously.

Q. Is the cost of the technology STOL performance as great in the transcontinental area?
A. Sound is one thing, smoke, all weather are all part of the performance. There are a lot of variables and you can compare the costs against all these things and you'll find that you just can't get them for nothing, and eventually it's tested in the market place.

Q. When you say STOL, what band of runway lengths do you mean? Does that include up to 4000 feet (RTOL)?

A. Yes, but we'll say down at 1500, 2000, 2500, 3000 and for each one you've got a different price level and a different engine problem and different augmentor systems. Now let's assume that from our own internal purposes we've got an airplane that needs some real requirements for the future and we're going to go ahead with it but the problem then is to convince the airlines that they really ought to buy it against competitive aircraft being marketed. We see our development sales case as a two faceted problem and the first being performance. We have a large sales engineering group that looks at the aircraft being offered to the airline in terms of the airlines operating environment. We're blessed at Douglas and the same is true of the other manufacturers with very extensive computer facilities that are there primarily because of design and manufacturing requirements but since we do have them we can use them for other things and a lot of our marketing efforts depend on computer support.
When we look at performance of an airplane, we have flight simulation models, which will fly the aircraft over every route that we anticipate the airline using the aircraft and these models compute the allowable takeoff weights, taking into account runway obstacles, temperatures, elevation, wind, they compute fuel burns for the route taking into account any airline ground rules that are imposed such as enroute, navigational tolerances, delays, reserve requirements of destination, fly through capabilities, it's a very flexible program and it also computes costs for the flight according to the ground rules specified by the airline. So, when we are done with the performance analysis we can go to the customer and with some confidence say yes, the airplane will satisfy every mission which you would ask of it or it will do them all except one, two or how many routes there are or perhaps because of runway lane, all up loading limits on the airfield or routes that exceed exchange capabilities, but anyway the airline then knows what the aircraft will do. But, it's not enough that the airplane can do the job that it has to do in an economic fashion.

That just says that a DC10-10 when compared against a DC8 or 707 has a much lower break even load factor and a much greater profit potential primarily because the seat costs are 25% less. Now it is true that it takes more passengers to break even but if you put in routes where the traffic is
indicated to be reaching levels that will generate some good profits for the airline. This is based on a 140 seat airplane against a 270 seat airplane and assuming a yield of 6¢ per passenger mile and it assumes the transcontinental flight.

Q. Do you mean costs, not profit?
A. That's the fare divided by the number of miles and diluted to account for non-revenue passengers, discounts, etc.

Q. What's the primary reason for the DC10's being more sufficient than the standard jet?
A. It's just a lot bigger and a lot more efficient engine and when you break it down in terms of costs per seat, cost per mile and cost per seat mile, it's just a more efficient airplane and that's the productivity game of the jumbo jets or wide cabin jets are bringing (economy of scale).

Q. Isn't the thesis being advanced that the 727 even with 20% higher SFC that you can have more seats because it costs 30% less per seat comes out to the seat mile operating cost total and that's the interest?
A. Well, what we're showing here is profit based on total operating costs where we're taking into account all the depreciation charges and later on in the financial step I'll show you how interest can effect this total. The original type aircraft we mentioned is.

Q. The 727. It seems that its been hitting the DC10 and
a couple of others head on because of its lower cost per seat encourages 30% lower and because of the economy of scale in the lower SFC of the DC10 and all its tradeoffs don't make it look like its always an economic advantage.

A. Well, we say we'll beat the 727's.

Q. What we're trading off here seems that the airplane costs per chairs is lower on the DC10 but what you're trying to do does not require the larger airplane than the effective seats that you're utilizing have a higher cost than the DC10 and so it's essential that you can't put a big airplane on a low demand market and it's the market that needs replacing.

A. The most critical decision that the airline has is to put the right sized airplanes on routes where traffic will support it in two ways; in capacity we have to have a reasonable load factor and you have to be able to provide a competitive level of frequency. It's a nice balance. Well, so we've proved that the airplane is economic and can make money; there are other ways to improve your competitive posture and one is by offering more comfort and this cross section shows the kind of things we're working with when you're comparing a wide cabin airplane with a standard jet. You get out of the tube, you've got the 8 feet high ceilings, the broad aisles, broader seats, the flexibility that comes under the deck with lower galley arrangements, the contain-
erized cargo possibilities, it's just a much more appealing airplane and the passenger benefits from both of these factors. The airplane can operate under a much lower fare structure than it would otherwise because it has more productive aircraft. The airplanes are more comfortable and are more reliable and have more passenger service features and there are two way benefits. But, even given all this, and I'm coming back to your question, it's a great airplane, it's got a lot of passenger field and still can mean a financial disaster if it isn't matched to the market. What happened to the airlines in 1970 is that they had a tremendous amount of 747's, pre-delivered payments on the DC10's and 10-11's and at the same time a recession occurred and load factors fall out and highly competitive system and there just wasn't enough revenue to cover all the costs that kept recurring. The result was that the industry lost something like 100 million dollars. So, we spend a lot of time at Douglas trying to develop better ways to forecast traffic. Increasingly, as far as forecast in the United States goes, we are relying on econometric techniques and basically we're saying that revenue passenger miles are a function of personal consumption expenditures with the velocity of many being simply the GNP being divided by the money supply. The yield that the airlines charge and the passenger trip length which is
the major service standards. It grows and grows because
more and more non-stops services are being provided between
cities so that what use to be a 2 or 3 segment flight may
now be a non-stop and so that your average passenger trip
length is one. Now when we do this, and I'm talking here
about forecasting U.S. traffic in total. You're forecasting
a lot of other variables instead of the depending variable.
We go to the Wharton School in Pennsylvania for estimates
of the various economic indices such as gross national
product and personal consumption expenditures and then we
plug that back in to this variable. The one that has given
us the most trouble is yield because its tough to know where
yields are going, and I'd defer getting into that for just
a few slides because I think that I have a chapter that
explains it a little better. But, when we compare what we
estimate in the econometric models and this one happens to
be a model of the U.S. scheduled service against historic
performance where we plug in the achieved explanatory
variables we get almost a perfect correlation of the past
traffic growth, which says that if you forecast the variables
that we are putting into your format accurately you're going
to get a very accurate traffic course.
Q. What's the number of years before the actual estimate
is made?
A. It doesn't matter when it's made. We could make this chart today. All we have to know is what the PC yields, the passenger trip lengths, etc.

Q. Can the estimate be made before the actual or is it a result of correlation of the actual?

A. The task of whether your model is good is whether it can reproduce history. Now the future will only be as good as our estimate of both variables that go into the formula. I should say that those variables are more stable and more subject to analysis than the dependent variable which is RPM's.

Q. So the estimate really reflects the information taken from historical data.

A. The validity of the model depends on testing it against actually what happened in the test. So, using that we can then say that this is a forecast of U.S. domestic traffic and we're coming up with a total of 11.2% for scheduled service within the U.S. These are the eleven trunks. This is the local service plus intrahawaiin and intra-alaskan trunk. Now, we also have models that will forecast actual airline traffic using the same econometric techniques. Now here you get some differences in variables such as what's the historic share of the market, of the carrier within the total industry. But, I've gone here to fictitious airlines because once we get into real airline forecast we're talking about
proprietary information. Now, moving on knowing the forecast, knowing what the airlines are planning to do about its existence, knowing what it has on hand and on order, we can generate a seat mile demand and what current aircraft on hand and on order will supply and this then represents the gap that must be filled by adding on an aircraft and so you can see what Mid Coast, which is a very large airlines, operating both internationally and domestically. We're forecasting a tremendous growth on the DC10 equipments, wide body twin equip, to satisfy the seat mile gap which I had shown earlier. But even this is not enough for an airline to make a decision as they have to have city fare forecasts so that they can relate aircraft schedules to expectant passenger travel. So, we then look at each city pair within the airlines networks and we take into account a host of demographic and social factors, political considerations, competitive factors on their systems and taking historic data to establish a time series. We then project taking into account these influences to come up with a city pair forecast. Once we've done this then we can show how many weekly passengers are expected between each city pair on their system. Given this we can then go to our airline planning group which has got a scheduled planning
group which has got a scheduled planning and evaluation level which will flow that traffic over the airline system and develop successive aircraft fleet schedules out as far as we care to go and this schematic simply says that on Flight 10 originating in San Antonio and ending Chicago we have 967 passengers in an average week joined by 6 on line connecting passengers from Portland and Seattle, 5 from Mexico City, 23 from Corpus Christi. Those totals then flew to Houston where 695 got off, 1310 originated, 25 connected from Corpus and we got 1647 ending up in Chicago, and we do that for the entire airline system. In short, what we do is develop a liable flight plan and a viable schedule which takes many years of forecasting. Now the model allocates on the basis of looking at each routing and comparing against the total service offered on that route. The variables if it is a daily service, bi-weekly or five a day or whatever it is. The air traffic capacity and the customer attributes of the aircraft, what are the departure and arrival times, etc. Once you develop a rating for that particular flight you can compare it against all the flights being offered in that market and assign it a percentage of the total traffic and that's the way the model flows the traffic. So, given a reasonable estimate of the traffic this is also a reasonable estimate of how that traffic will flow. Once we've developed an operating plan we can then translate that plan into the financial forecast for the
carriers and here we're showing an income statement generated in successive years '72, '73 and '74 for Mid-Coast Airlines where we take into account all the revenues, all the expenses, develop operating income levels and finally net income levels in successive years. This also is computerized and can be generated over night in a very timely fashion. We develop sources and applications of fund statements which show the airlines where the money can be expected to come from and where it will be applied and we can plot then the relationship between costs and revenue over a time frame. This is fairly typical of historic performance by most trunks where they were enjoying very profitable years because of this spread in the middle 1960's and then the tremendous squeeze that was put on them in 1970 and then we're forecasting a return to normal now. I mentioned that the yield is a problem. This reduction in cost per ton mile through the 1960's was achieved primarily because of transition from props to jets. Although we've had larger, more efficient airplanes coming in now in the terms of wide cabin equipment, the productivity gains are not enough to offset inflationary trends so we're seeing 1971 as a kind of water shed year where we're looking at rising costs in the rest of this decade, and we're making a further assumption that the CAB and the airlines through prudent and intelligent fare structure manage-
ment will recognize this rise in costs and adjust fares upward to account for it. If that should occur, then I think we'll see airlines returning to a condition relatively good economic health through this decade.

This shows the picture of the airline and with the event of these new aircraft coming in, how their debt structure is rising to over a billion dollars, but because they're growing tremendously and they're generating profits, their debt equity levels are holding fairly low, just quite a bit lower than they were a few years ago.

Net income. It looks like a pretty impressive gain in net income. Again, the airline is tripling in size, so this kind of level is not terribly out of line and as you'll see on the next chart where we plotted the expected return on investment in the airline where they were down here at practically no return, now rising up by about 10% by the end of the decade. The CAB guide line for a reasonable rate of return from the airlines 12%, so I think what we're saying there is that things are going to get better, but not excessively.

Q. Has the consideration of a four day week entered into any of your discussions?
A. No, sir.

Q. Do you think that might occur?
A. Yes, it sure could.
Q. Are you doing a twin jet?
A. We're talking very seriously about building it, but we don't have it proven, but we are discussing it with many airlines.

Q. If you built your usual quality, twin wide body, do you think you could crack the European market or do you think that they would buy they're own? Will they be forced to buy their own?
A. I might say that some of them would be forced to buy their own and that the preference factor for a European airline for an A300B would be in the order of maybe 15%. Other things being equal you could split the market and I think you would have to bias in favor of a European manufacturer because of the 15%. I think that the reverse would be true in the United States.

Q. Do you think the Civil Aviation Production and Finance Act has solved all, some or none of their financial problems?
A. I'm not familiar with the details of the act.

Q. What is the stopping order of the DC10 twin. Is it the Chairman of the Board; is it a bank not lending the money?
A. It's airline interest.

Q. You can't get 2 or 3 airline orders?
A. I'm not saying we can't, I'm saying we haven't yet, but think if we had the orders we'd build the airplane.
Q. Do you have an idea as to how many firm orders it would take?
A. Yes, and that varies. The Chairman said he would like to have a hundred of them.
Q. How long would it take if you decided to go ahead with this?
A. About two years. We're talking now if we committed this summer. We'd be delivering in late '74, so slightly over 2 years.
Q. Are we going to have 3 companies building them again, do you think?
A. I really doubt it. I think that if we enter it I doubt if Boeing would. Although Boeing might come along with an airplane with a super critical wing or an advanced 727 type or something like that.
Q. You don't believe in a 747 twin?
A. I don't know enough about it. I think that they have to cut the weights tremendously to make an effective airplane with the engine thrust that's available. If you can get the thrust up to say 55,000 lbs., it might be a pretty good airplane.
Q. One more question. Your projections of the passenger miles were that you pretty well assumed that that was all going to be in the long haul of the large jet and that the difference between the characteristics between the large jet and the
smaller type airplane the sensitivities are such that one less larger aircraft means several less smaller aircraft so there's a great deal of leverage there and with a slower less sensitivity (this is one thing that I'm interested in) and the other thing that makes me ask this question is that it looks like a great market in the future are the non-U.S. domestic and non-European domestic but the rest of the world and it seems to me that the market there is for smaller airplanes. Have you looked at these sensitivities and what that means to the profits of the manufacturer? Are the profits low for a smaller airplane?

A. Well, let's tackle the first part first. I assume you're relating to the forecast for MidCoast Airways with the increase of fleet?

Q. No, your general forecast. How many long haul, large jumbo jets are going to be sold and then how many smaller aircraft are going to be sold, etc.

A. We're assuming there that the bulk of that growth and that you're talking about the U.S. forecast is really going to be in the 11 domestic trunk carriers. They represent about 90% of the total productivity of the airlines structure in the U.S. The local service carriers are growing and have grown at a slightly faster rate than the trunks in the last couple of years, but they've got an awful long way to go to really
penetrate or to alter drastically those relationships. Now in that area I would see perhaps quite a shift in the STOL type aircraft, but I guess what we're saying is that conventional aircraft is still going to be doing the lion's share of the work for the next ten years or so.

Q. You didn't say what the future wide bodies are going to be for third generation.

A. I don't really know. I think that there will be super critical wing airplanes, cruising close to Mach 1 and composites, but we're also talking about slow supersonics that swing with a pivotal wing.
CONSUMER MARKETING AND THE AIRLINE INDUSTRY

by William R. Roy
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Abstract

A brief discussion on the fundamentals of consumer marketing as applied to the airline industry. An attempt will be made to boil down the mystique and jargon which frequently surround the subject of marketing. Topics to be covered include: (1) What is "the marketing concept"? (2) How do we find out what consumers want from an airline? (3) Once we know their wants, how do we plan "marketing strategy"? (4) What are the roles of advertising, sales, and middlemen in the process?
Consumer Marketing In The Airline Industry

I am going to try to give you some perspective into key elements of consumer marketing. What it means, how it works, the consumer value it creates.

Third point, frequently one of controversy, today it's popular as part of surge of consumer advocacy to knock marketing's role in the economy, to accuse marketing of creating waste and foisting unwanted goods on to an unsuspecting public.

Sometimes I wish that marketing techniques had the powers that the Nader's Raiders sooth sayers of gloom and doom attribute to it. Unfortunately or fortunately, depending on your perspective, it does not.

Defining marketing is a little like defining sex. It's intuitively understood by the participants but damn hard to put into words. The best definition I came up with trying to synthesize a number of various viewpoints is to say: "The business process by which goods and services move from the producer to the user."

As the economists say, "marketing creates place, time and possession utility." In English, that means the marketing processing enables a customer to find the kind of goods he wants when he wants them and ideally at the price he is willing to pay.
In the airline industry this concept of time utility becomes very important because of the perishable nature of our product. The skill with which we pursue the consumer marketing process in our industry makes the difference between seats going out empty or full. When that plane is sitting on the apron, if we can't fill it, those seats are going out empty and as a result we have lost our opportunity to sell that particular component of our product.

Once we define what marketing is - moving goods from the producer - we realize there are two ways of looking at the process - from the producer's side or the consumer's side.

If we go at it from the producer's side, in other words, how we are going to convince people to buy the product we have available, we don't really have a complete marketing process. We end up trying to get the customer to want the goods or service we are selling.

The real marketing approach takes the consumer's viewpoint and tries to figure what his wants and needs are. Then determine how our product can fill those needs.

This is called the marketing concept - try to understand what the consumer wants. This is a concept which is easy to pay lip service to and hard to put into actual practice.

In my opinion, airline industry has not done a very good job in this respect.
Because of airline scheduling, crew and equipment logistics, it's often easier to fit the customer to our products than fit our products to the customer. It's a little like Henry Ford's well-remembered statement that the customers could have any color car they wanted so long as it was black. We have had a bit too much tendency to do that in the airline industry.

A good example of an enlightened marketing concept approach, whether it was intentional or not, was the introduction of the coach lounge. It gave the consumer a chance to get up out of his seat, a rather confined space, walk to another area of the plane, sit down, relax and move around the plane. So as I say, whether it was intentional or not, this was a good example of the marketing concept in action. There was knowledge on the part of various airlines that the consumer wanted more options on the plane and the idea of developing the coach lounge gave more of these options.

Here are the ways I'd describe what it takes to get the marketing concept juices flowing. I see it as a five-part process. There's nothing sacred about five. I am sure other marketing practitioners could combine or subdivide the components differently and make it a four-step or ten-step processing depending on their bent. These are the five steps.

Beginning with marketing research and analysis, we must find out what the customers' real needs and wants are. Most people don't buy a garbage can for the aesthetic impact but so they have someplace to put the garbage.
Neither do most customers get on an airplane for the sheer ecstasy of flying through the air. As Carl Ally, Chairman of Pan Am's Ad Agency once put it: How may people would pay 250 bucks just to get in a 747 for seven hours to have dinner and watch a movie while circling over beautiful downtown Newark? You get in a plane to go someplace. Getting from point A to point B has value as far as the consumer's concerned. It's that destination impact that is imperative if you use a marketing concept in the airline industry.

Next, we've got to find out how well our product fills those needs and how we stack up against the competition and their ability to fill the same customers' needs.

Finally, a market analysis is needed to determine what our chances of success are. There very likely may be cases in certain product areas, and I keep referring to product areas because I think of the aeronautical business as a product. It is generally referred to as a service but I think you can justify calling it a product. It competes for discretionary income just as other products compete for discretionary income.

If certain customer needs are being filled infinitely better by the competition, it's best to look around for some other needs which our product can fill or to consider making some changes in the product.
One caveat on research - as a former airline research director, I can take certain liberties in knocking research - the best research is often that which confirms intuitive convictions. People close to their industry generally have some idea of what customers think. Beware of startling research results. All you might really have is a piece of poorly executed or badly interpreted research.

I would put limited stock in Freudian-type research where an airline would go out and administer a series of Rohrschach tests to customers and, based on that, determine what really makes people fly. When the 747 first came out there was a tendency in this direction. People said they were afraid of the 747. Some Freudian-type researchers came up with the idea that people thought of the airplane as womb. That people were afraid of the 747 because it was unlike the intimacy of the 707 womb is a lot of bull. They were afraid it couldn't stay up in the air and said so. If you ask people directly and with some depth probes, most people will tell you what they are thinking. Don't let anyone ever let you believe that there isn't a fear of flying which some surprisingly frequent travellers will tell you. We have had large numbers of travellers who make up to 15 international and 40-50 domestic trips per year who will tell you that they still have a fairly fearful approach to flying. Many people feel that if man were meant to fly the Lord would have given them wings and they are a little uneasy about it.
So, in establishing marketing objectives, once we know the customer needs, our own product strengths and weaknesses and competitive potential, we begin the formal marketing planning process.

First we establish marketing objectives - these are the basis on which we build our action plan. Some examples would be: in the case of Pan Am or TWA, to increase the share of the New York to London Market by 15%. This is a competitive strategy. It is trying to get a bigger chunk of the market at the expense of the competition. Another kind of objective is one that stimulates primary demand. For example, to get 10% more wives to travel with husbands on NYC-LAX Transcon. The sort of thing United has been promoting. This is trying to get people who are hardly in the market into the market. So we have two kinds of marketing objectives.

Objectives need to be realistic. One of the problems that airline industry and all industries face is this whole question of making the objective realistic. If we were to say that Pan Am should get a 35% increase in the share of the NY/London market, that would not be realistic. If an objective is unmeetable we should not come up with it.

They also need to be reasonably specific. An objective that is too vague, for example wanting to increase our share by 10%, that's too vague to have much meaning.
It is expedient that marketing objectives are consistent with corporate objectives. That may sound silly but frequently a semantic problem exists and all top management are not committed to the same objectives.

In the airline industry, as with other industries where regulation plays an important role, it is important that regulatory policy is clear or serious conflicts will develop which ultimately impact the company's ability to meet the customer's needs.

What's a strategy? It's a plan for meeting the marketing objective. There are four basic types of strategy. Let's take an example of getting more wives to fly Transcon and follow that through the strategy building process. First we use research to determine what needs are present and what kind of product will best fill those needs. Realistically, the airline seat is not the product. Trying to sell the trip to California on the basis of the great airplane ride is like trying to sell a new car on the basis of its great tires.

Price is, of course, a factor and we need to understand it. Distribution means getting the product into the hands of the user.

Promotion covers all those things we do to tell people about the product.
The basic idea behind developing a product strategy is to figure out how to make your product stand out from the competition. This in trade jargon, is called product differentiation.

There are two components to product differentiation:

The first is the ease or complexity with which we can develop unique product features.

The second is the importance the customer places on that feature in his decision-making process.

The chart shows the consumer value on vertical axis and ease of developing unique product features on the horizontal. Note the color shading -- assume this represents all the product features available to consumers.

It's relatively easy to come up with the low-value unique features like the kinds of costumes the stewardesses wear.

It's also easy to come up with the high-value items like a 747 -- but if one or two competitors also offer 747's, you hardly have a unique feature.

What to strive for is that nugget of a product feature that has a high-value in the consumer's mind and is also clearly unique to our product.
As a general rule the life cycle for new ideas is fairly short. Particularly in the case of many of the things we will come up with which are not patentable so the competition will emulate it very quickly. The idea is to try to come up with unique features that the competition will not be able to emulate.

For example, at Pan Am we stress the experience concept. We know that it has one of the highest values in the consumer's decision-making process. We also know that Pan Am enjoys a unique position in this respect since no competitor can offer a product based on as much international experience as Pan Am. This is one example of the sort of things that are hard for anybody else to take away from you. If the consumer begins to feel everyone is experienced and no one stands out we have lost the edge that we had. This is one of the reasons in the last couple of years for the basis of the world's most experienced airline theme.

If we return to the example of getting wives to travel Transcom, maybe not in-flight at all but at destination can be used as part of a unique ground package featuring items of high value to wives like a free visit to Elizabeth Arden's in LA. Something they won't get from anyone else. It is enough to make the difference in their decision making process. What I am leading up to here is, maybe the decision-making process is not based exclusively on the in-flight or airline experience. It is basic to the total travel experience.
It is tied into this idea of the person's going to a destination. He thinks about destination and is concerned in that respect more than being concerned about what is going to happen in-flight.

Looking into your agenda, you have already had a lot on the subject of pricing so what I would like to do is position it as a marketing concept rather than going into details.

Under marketing concept, price is a function of what the user will pay and whether the producer can recover his costs, including a reasonable return on investment.

At the same time the consumer-oriented seller will be sufficiently sensitive to market elasticity to determine what impact a change in price will have on customer demand and this goes back to the idea of the whole travel experience.

In the travel industry price in the consumer's mind is different from price in an airline's mind.

The consumer is concerned about what the total trip will cost - only to the extent that changes in air fares affect the total cost is the customer going to be influenced. From the time he leaves his door until he gets back - parking, meals, etc., pricing strategy has to take the whole picture into account.

If the consumer perceives that there is a major cut such as the winter 8-day GIT'S we had this past year in the Atlantic which result in much lower total cost to him then price can impact his decision-making process.
QUESTION: Why do you think the airline consumer is smarter than the automobile consumer who historically doesn't perceive the cost of operating an automobile?

ANSWER: He isn't.

QUESTION: Why do you always talk about total costs in the airline markets but not in the automobile?

ANSWER: I am not really talking about total costs in that respect. I am talking in terms of a guy envisioning he is going to get something, he is going to get a travel experience just like he is buying a new car. He is willing to invest $X in that new car. He is also willing to invest $X in that travel experience. The costs of operating that car are not perceived because it is at smaller amounts over a long period of time. If a guy is going to take an international trip and has to lay out, let's say, $1500 that becomes very real to him. If it is $1500 or $2000 he can discern the difference between them. Again I am talking about differences in total expense - not 40 or 50 dollars, but 20% or more change in the product he is buying. One of the things we should light on here is to determine the level of visibility. This is part of the pricing strategy. Where does a company want to be in terms of pricing visibility. Do we want to be one of the pricing leaders, taking the role of giving some impetus to the industry in the way pricing should go. Do we want to be part of the pack or do we want to drag our heels. This is very important in terms of the role a company is willing to play within its industry and really needs a basic strategy to position that effectively.
When we talk about distribution strategy or how we move the product from the producer to the user, we first need an understanding of the various steps that are involved in the process. While airlines perform a service, for all intents and purposes, we can think of the airline ticket as a salable product moving through a distribution channel just as color TV sets, refrigerators, or fashion clothing would move through a distribution network.

In the airline industry the channels of distribution are fairly complex. We can sell an airplane ticket direct in our own sales offices. Have it sold by another airline in one of their ticket offices, have it incorporated as part of a wholesaler's package tour, sell it through a travel agent or via commercial account.

As we can see from the following chart, frequently two or three steps are involved in the distribution of the product. In the case of a commercial account sale it might be either direct to the airline or through a travel agent or it might even be to a travel agent who then goes to another airline, who actually writes the ticket selling our product.

One problem fairly unique to the airline business is the vast number of outlets through which a relatively high priced product is sold. For example, in Pan Am's case, worldwide there are roughly 17,000 travel agencies and 12,000 ticket offices belonging to other carriers, all of which can write a ticket on Pan Am.
These numbers make this distribution system fairly unique to the airline industry. I was trying to think the other night of what other large big ticket items like automobiles, color TVs, etc., the traditional sorts of things have distribution systems where as many different outlets are involved in selling a product and it is very hard to come up with anything. In most cases the big ticket producers have franchised operation where only their product is sold. In the case of GM cars - only GM cars will be sold through a dealership. In the case of major appliances a dealer may carry 2 or 3 other competing brands but there really aren't any situations where, as there are in the airline industry, the retailer carries a multitude of competing brands. For instance, in International air travel, the travel agent will carry over twenty different transatlantic carriers' tickets available. In other words, he can write a consumer's ticket on any of those 23 some odd carriers. He also has the ability to write on any of the domestic carriers. So he is handling a multitude of different products.

I think Pan Am is fairly representative. We may be on the low side. Someone like United who has more domestic offices than we do might very well have more outlets for the sale of their pro-
In the United States alone, there are probably an excess of 15,000 travel agent and airline ticket offices where you can buy an airline ticket.

As a result, it's extremely difficult to control the sale of the product the way producers of other big ticket items like TV's, home appliances, or automobiles are able to operate through, in many cases, franchised dealerships who feature either no competing products or only one or two competing products.

In the airline's case, almost every travel agent can sell not only all the competing domestic carriers' tickets, but also all the competing international carriers' tickets. This makes it extremely rough to develop any form of exclusivity with the middlemen who sell your product to the ultimate user.

Back to the example of the wives to L.A. Assume we develop a tour package with unique features -- How do we get the work to possibly 60,000 sales people in 15,000 retail points, especially when our product is one of maybe 250 others we offer and maybe 2,000 offered all together by us and our competitors?

Our distribution strategy must be able to cope with the kind of situation which results when Mrs. Smith goes into her friendly travel agent and asks about our special wives package.
This takes us to the fourth strategy which is promotion. Because of the limits in the air travel distribution system, promotion becomes a key ingredient in the attempt to make potential customers aware of your product and its features.

Essentially, there are four kinds of promotions:

Advertising, which includes radio, TV, newspapers, magazines and trade publications.

Sales promotion, which includes everything from direct mail to letters to folder racks, to motion pictures of travel destinations, to window displays.

Sales development is a form of missionary sales activity in which we use our headquarters and local sales people to work with key travel agents, travel agency associations, commercial accounts and the like to keep them aware of our product's capabilities.

Finally, word of mouth is an important form of promotion. A satisfied customer is one of the best forms of advertising or promotion an airline could have. From research we found that first-time travelers frequently depend on recommendations from friends, relatives, doctors, or dentists in making a decision on where to go, where to stay, and what airline to use.

Let me spend a few minutes on what promotion can or cannot do. Promotion vehicles, like advertising, sales promotion, etc., can be used for either a push or pull effect. What does this mean? Pull type advertising and promotion means developing awareness, interest or preference for our product in the mind of the consumer so that he in fact goes into a retailer and asks for our product. In effect, we are using promotion to pull our product through the distribution channel.
Push promotion, on the other hand, is the kind of promotion aimed at getting the middleman to promote the virtues of our product to the end user.

Trade advertising, direct mail to middlemen, and the missionary sales development activity are three of key ways in which we build enthusiasm for the product among middlemen. A fourth method which is frequently used in other industries and is known as push money, or special incentives to sell a certain product, is illegal insofar as air transportation is concerned. Many tour wholesalers selling package tours do, however, give retailers a special override commission on the land package for selling large quantities of their tours.

One word on advertising -- advertising has been one of the most maligned of the promotional vehicles available for use. No question that advertising has in the past occasionally been used to mislead the consumer. However, when one reviews the various theories on consumer buying behavior, he finds that a key to the consumer's ability to make a buying decision is the information which he can obtain on the product and its features. Advertising is, in the final analysis, one of the least expensive ways of providing product information to the consumer.
The idea that advertising can, through subliminal means, force the consumer into buying products he doesn't want or need is pure garbage. The most advertising can do is make a customer more aware of the ability of a given product or service to fill the customer's needs. Now, in all fairness, let's admit that these needs may be somewhat latent and advertising a product feature may help to bring them to the surface. But advertising per se cannot create the basic need.

Maybe this wife who is going out to the West Coast really wasn't chafing at the bit until she saw the ad that said now you can go and experience this glorious time with Elizabeth Arden and your husband will now accept you, and you can do it at a low cost. That's basically appealing to her latent desire to get out someplace - to make herself look different so her husband will think of her as newly married. It is not building a need within her, it's simply bringing that need a little more to the surface.

Once we have developed our four strategies -- product, price, distribution, and promotion -- we're ready to bring them together into the overall marketing mix.

By marketing mix, I mean the way we combine the various marketing tools to move the product or service. For example, in some cases, we might use more advertising and less missionary or developmental sales effort.
We might depend more on low price to sell the product or we might concentrate on unique product features.

Frequently, if the product doesn't move very well, we make adjustments in the mix like a little more advertising or other forms of promotion.

Since departure time, in the airline industry, is a product feature, we might decide to make minor changes in this area. However, whenever, major changes in the mix appear to be needed, it is appropriate to pause and review the marketing objectives and strategies to determine whether a more fundamental rethink is necessary.
Measuring the Results:

This is the area most frequently overlooked. It is important as part of the planning process to establish measurement criteria. How are we going to measure success? What level of success means we have a hit? How bad do we let things get before we declare a miss?

After the fact decisions on what constitutes success are also dangerous since they frequently result in lowering our standards for success or failure. Once we are three months down the road and we see some of the problems that exist we are not quite so apt to say we need $X million before declaring this a success. This is unfortunate because the thinking that went into the process originally is the thing that should be used to measure that.

Without pre-established measurement criteria it's also hard to determine whether minor modifications in the marketing mix can have the proper effect.

That sums it up. I congratulate you on wading through this exercise with me. As I recall, one of the fundamentals of learning theory says if an individual can remember 10% of what he hears, he is doing quite well.
The 10% of our visit together here today that I hope you remem-
ber is:

marketing begins with the customer:

consistent success depends on finding a product or service that
fills his needs:

start with research and analysis to determine what the
consumer wants, how the product is positioned in the
market place and how we have to modify our product, if
necessary to meet those consumer wants:

establish realistic marketing objectives, things we are
striving for in that process:

develop strategies on: products, price, distribution and
promotion:

Based on these strategies create a mix of marketing elements,
activate the marketing process, hopefully to achieve success but
also to establish, ahead of the game, the measurement criteria that
we are going to use in measuring the success. It seems to me that
the airline industry has a long way to go compared to other big
ticket item products which implemented the marketing concept in a
big way a number of years ago. That sounds a little pessimistic.
On the optimistic side in the last few years I have seen what I
consider to be quite an increase of marketing interest in the air-
line industry. I predict that we will see in the next decade a
real growth in the marketing concept in the airline industry as it
becomes more consumer oriented. In my next talk later on this morn-
ing with Dan Colussy, I will explore that in more depth.
FUTURE DIRECTION IN AIRLINE MARKETING

by Dan A. Colussy
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July 18, 1972

Abstract

The rapid growth and broadening of the air travel market, coupled with a more sophisticated consumer, will dramatically change airline marketing over the next decade. Mr. Colussy discusses the direction this change is likely to take and its implications for companies within the industry. New conceptualization approaches will be required if the full potential of this expanding market is to be fully realized. Marketing strategies need to be developed that will enable various elements of the travel industry to compete not only against each other but also with other products that are competing for the consumer's discretionary income.
Airline marketing will change dramatically over the next decade. There will be the potential for a rapid growth and broadening of the air travel market, but new conceptual marketing approaches will be required to fully develop this new business potential.

Airline marketing management will face the challenge of re-evaluating and restructuring its activities to be consistent with an environment quite different from the 1950's and 1960's. Even the definition of the airlines' role in the travel industry and the product they provide will be subject to significant change.

Let's take a look at some of these changes in the marketing environment which the airlines will face in the next 10 years. There are five key elements of the marketing environment: 1) Total market growth, 2) Consumer expectations, 3) Competition, 4) Regulation, and 5) Technology.

Within the past 10 years we have seen leisure travel grow from about 1/3 of total airline traffic to approximately 50%. Over the next 10 years pleasure or vacation travel could well reach 2/3 of total airline volume. In fact, at Pan Am leisure travel already represents about 2/3 of our total passenger traffic. This does not reflect an anticipated reduction in business travel, which should continue to grow moderately, but rather a more rapid growth in leisure travel. This is the area of greatest potential for the airlines during the coming years.
The growth of pleasure travel will reflect an accelerated change in several key socio-economic factors. These factors should, in fact, contribute to a greater growth in leisure travel than has been experienced during the past 10 years. These factors include:

1. **GREATER DISCRETIONARY INCOME THROUGHOUT ALL STRATA OF THE POPULATION.** While perhaps difficult to be optimistic about our general economy based on our experience during the past two years, most economists are in general agreement that the next decade will present unique opportunities for a broader distribution of our country's wealth and greater per capita discretionary income at all levels.

2. **WE WILL FIND OVER THE NEXT 10 YEARS THAT PEOPLE WILL HAVE CONSIDERABLY MORE FREE TIME.** This will result primarily from the trend toward longer vacations. In a recent behavior science corporation study conducted for Pan Am, 37% of the respondents who earned over $15,000 a year, had 4 or more weeks of vacation. Of the total sample, almost 60% stated that they split their vacations. The combination of longer vacations and a splitting of the vacations creates new potential for multiple air travel each year.

I might note that we recognize there is some traffic potential created by the movement to shorter work weeks, as a result of 4 day weeks and 3 day weekends with the new holiday schedule. However, the market growth resulting from this move-
ment may be smaller and slower than many in the industry now anticipate at least in the international travel markets.

3. **THERE IS AN OBVIOUS CHANGE IN LIFE STYLE, REFLECTING A TREND TOWARD GREATER EMPHASIS ON PERSONAL ENRICHMENT.** In the past, travel has had some difficult in competing with tangible durable goods because it was not an item with a "useful life" that could be utilized over a period of time. However, it now appears that travel is being perceived more as a personal investment and this will lead to further growth in travel. The extended 3 to 4 week trip is becoming more important in the international market. A recent Stanford Research Institute study reveals that self-expression and individualism are becoming more important value trends while status achievement and conformity are receiving less emphasis. In the 30's and 40's a trip to Europe was made for status. Today's younger generation make the trip for personal enrichment. This reduced emphasis on "materialism" is also shown in the Behavior Science Study. When asked how they would spend a windfall gift of $1,000, foreign travel was rated number 2 just behind home improvements but ahead of domestic travel or a new automobile. New automobile placing behind travel is a significant change in the typical American's attitude.

To summarize, leisure travel has become an integral element of the life style of a greater number of people than ever before. Over the next 10 years it will become a key element of the life style of millions of new people not previously in the market if,
of course, the travel industry does a proper marketing job.

The business and marketing significance of this can be best illustrated by reviewing what we believe to be the 3 key consumer market segments:

1. **The Experienced Traveler** - The "heavy user" of leisure travel, through multiple annual trips, will grow substantially in absolute numbers and relative importance. Primarily composed of people who have grown up in the '60's and '70's accepting air travel as a commonplace event, this segment of consumers has no reservations about flying and indeed look upon travel as a rewarding and desirable experience.

2. **The First Time Traveler** - Airlines, in our preoccupation with battles for share of market, have perhaps lost our perspective on the fact that only a small proportion of our population flies in a given year. There is ample evidence, however, that each year millions of people discover for the first time that air travel is easier and more affordable than they thought possible. Less than 10% of the U.S. population has ever left the North American continent. And once they try it, they like it. They're hooked. Participation in just one charter or a group of local friends is all it takes to introduce these people to air travel. This market segment, (the great middle America) because of its absolute size, represents truly substantial business potential.

The motivations which bring these people into the travel market are diverse. They include special interest activities such as sport related, religious, and study groups. Additionally,
strong cultural ties and increased pride of identity among the various ethnic groups in our country represent a key motivation for international travel. There is a real tendency for second generation Americans to go back to their homeland for a visit.

3. **The Youth Market** - This is a market segment which has perhaps been overworked and over-emphasized in other industries. But in the travel industry, the youth market, because it is traveling more frequently and at earlier ages, will continue to represent a key source of traffic.

The second key element shaping the marketing environment over the next decade will be the nature of consumer expectations. In general, the air traveler will be smarter and more knowledgeable. This will be partially a reflection of the increased number of consumers with accumulated travel experience which is far beyond that which characterizes today's consumer. People coming back and talking about their trips improves the whole security thing. This accumulated travel experience will cause and permit the consumer to be more discriminating in terms of his travel decisions relating to choice of destination and selection of airline. The current wave of consumerism, sharpened by the consumer's own travel experience, will lead to a new emphasis on travel value. This value consciousness will be the key factor influencing the consumer's travel decisions.

The consumer will be offered more diverse travel options, and
he will be more skillful and discriminatory in his selection of travel products. As a result, he will not be motivated by the types of promotional techniques currently employed by many airlines.

The third key element of the marketing environment will be the competitive situation which individual airlines will face. This competition will exist at 4 levels. First, there will be competition between the various scheduled airlines. Secondly, there will be competition between the scheduled airlines and the supplemental airlines. Thirdly, there will be competition between the airlines and other modes of transportation. Fourth and probably most important, there will be competition between travel and other applications of the consumer's discretionary income.

Competition between the scheduled carriers will no doubt continue undiminished as each tries to capture its fair share of the market. Depending on each airline's route structure, the competition will be for both the business and leisure travel markets. The focus of competitive efforts directed to the business market will be on special services and schedules. Competition for the leisure market will focus on destinations and service features.

The competition that now exists between scheduled airlines and the supplemental will be considerably blurred as more scheduled
carriers offer a product comparable to the supplementals. Through their own charter activities, the scheduled carriers will eliminate the price advantage previously maintained by the supplementals. Market share in the charter business will then become a function of effectiveness in product structuring and promotion. At PAA, we feel there has been no major mass marketing effort directed at general leisure market to develop charter traffic. This is changing today.

Competition between the airlines and other modes of transportation will be primarily limited to the automobile. Steam ships have adopted a marketing strategy of positioning themselves less as a mode of transportation, and more as a destination. As a result, combination fly/cruise programs should be expected to expand, making the two industries complementary rather than competitive.

The automobile will be a more important factor in the domestic market place, where it competes both as a substitute and as an alternative to air travel. However, it also represents competition to international travel, since a consumer must choose between a traditional family vacation by auto and a vacation by air to a more exotic or unfamiliar location. The consumer may prefer to have a summer home in N. H. than spend $4,000 to $6,000 on an international trip.

Competition between travel and other applications of the
of the consumer's discretionary income will become even more intense. New products for the home, such as entertainment and household appliances now on the drawing board, will be expensive and capture a substantial portion of the consumer's discretionary dollars. Perhaps even more importantly, the trend toward purchase of second homes, campers, boats, and other high cost leisure products can be expected to cause significant competition for the consumer's discretionary income. This competition will exist both in terms of the initial financial investment and in the subsequent income and leisure time spent in utilizing the purchase.

The fourth element of the marketing environment involves the area of industry regulation. Trends toward both U.S. and foreign governments action to stimulate air traffic, particularly through bulk travel concepts, are accelerating. In particular, we can expect relaxation of the limitations on the number of off line charters permitted entry overseas, particularly at Pacific destinations. Second, we can anticipate relaxation of qualification requirements for affinity and ITC charters. Additionally, we can expect continued downward pressure on air fares, both for scheduled and supplemental services. Pan Am advocates part charters.

The fifth element of the future marketing environment relates to technological changes within the industry. Supersonic aircraft, beyond the Concord, with more favorable economics and true inter-continental range capabilities may be expected in the early 1980's. However, in the upcoming decade they will impact principally in
the high priority business travel market, where time is the critical factor. Their impact on leisure markets will be limited to high income consumers willing to pay a premium for travel to more distant locations in shorter time periods.

As far as large subsonic transport aircraft are concerned, in the next decade we will see only evolutionary growth in existing models of aircraft with no major technological breakthroughs. The DC 10 and L-1011 will probably be stretched in both size and range capability. The maximum capacity for an intercontinental aircraft will probably be limited to approximately 600 seats for an all economy 747. Improved comfort features for narrow-body equipment will assure maintenance of their value for use in less dense markets or those with high frequency requirements.

Other advances may be expected to improve reliability, utilization and all-weather capabilities. All these factors which should contribute to better cost efficiency of existing aircraft and will hopefully permit airlines to begin to realize an adequate return on the massive investments we have made in these aircraft.

At present, our passenger handling systems on the ground are very labor intensive. Without advancement of these systems, the expected traffic growth would result in poorer standards of service and/or spiraling costs. Automated check-in and seat selection should be a reality within the next 10 years. An alternative to
the present high cost reservations system, for at least some routes, should be a possibility.

In general, technological change within the airline industry will not be dramatic. Advancements should enable us to keep pace with traffic growth but not contribute to it, as did the introduction of the jets. Additionally, we might expect cost efficiencies to keep requirements for fare increases at rates lower than for most other goods and services.

Outside the airline industry there will be requirements for other elements of the travel industry to introduce technological advancements. Hotel handling of passengers at check-in and check-out, tour operations, and surface transport to and from airports must all be upgraded to accommodate efficiently the growth in traffic. At this time there is limited coordination among the airlines and these other elements of the travel industry in terms of advance planning. I expect the airlines will take a more active role in assuring that all elements of the travel industry are better integrated and prepared for handling passenger growth. This is a real change in direction for airline intent and interest.

Having identified these 5 elements of the marketing environment -- specifically, total market growth, consumer expectations, competition, regulation, and technological changes--what are the implications for the airline's marketing management.
I believe these implications can be summarized in 3 key areas.

First, the airline industry faces a period offering greater business growth potential than we have ever known before. This will result from continued growth in business travel and a boom in leisure travel stimulated by greater discretionary income, more free time and multiple vacations, plus a change in lifestyle emphasizing personal enrichment. The primary consumer segments accounting for the leisure travel growth will be the experienced, frequent flyer, the first time travelers, and the youth market. The major obstacle to exploiting this growth potential will be the alternative uses for the consumer's discretionary income.

Secondly, the transportation element of travel will become less important in the consumer's travel decision. Instead, more consumers will be interested in buying a total travel experience. Essentially, he will expect to purchase a package of services that will facilitate his movements virtually from his door to his destination and back home. The leisure traveler will expect much more help in planning his trips and assistance during his trip. The business traveler will expect a similar total travel service, with of course, a different package of features more suited to the nature of his travel.

The airlines are the logical element of the travel industry to assume the responsibility of providing the consumer with a satisfactory total travel service. More than any other element of the industry, the airlines are perceived as already having this
responsibility as far as the consumer is concerned. It is the airlines that give the greatest promotional support to the stimulation of travel and it is the airlines who are best able, in terms of resources and potential gain, to assume this responsibility.

Concurrent with this consumer emphasis on a total travel experience, the airlines must become more involved with quality control for the total trip and pricing of the total trip. Pricing, in particular, will be a key element of competition both in pricing of the air transportation as well as the land portion of the trip.

Finally, the growth in the travel market will support and require even greater market segmentation through product diversity. The travel industry will be similar to the automobile industry, where total market growth has permitted virtually unlimited model and option offerings. Because travel and the objectives for travel are so strongly related to differing personal interests, experience levels, and personality characteristics, the trend to market segmentation in our industry through product diversity can be expected to accelerate rapidly. This is giving the customer more options, even in a mass travel market situation. This product diversity will be required to develop frequency of travel. It will be made possible by a total market so large that there will be adequate volume to support very specialized travel products. The growth in international air travel is very high. The product
line will range from charters sold only as basic, economy trans-
portation to special ground and inflight service packages for
first class travelers and from large, standardized group tours
to individualized special interest travel itineraries.

Before defining what I believe to be the future direction of
aireline marketing strategies, I would like to review quickly
the key elements of the changing marketing environment and their
implications for airline marketing management.

Within the marketing environment the airlines face changes
in total market growth, consumer expectations, the nature and
degree of competition, regulation, and technological advancement.
These changes will result in significant new business potential;
a consumer emphasis on the total travel experience, with a resulting
priority on quality control and pricing of the total trip; and
increased market segmentation through product diversity. To meet
these challenges, I believe the industry will move toward new
marketing strategies in 6 key areas.

First, the airline industry can be expected to expand its
diversification activities both vertically and horizontally. Many
airlines, including Pan Am, have hotel subsidiaries. Others,
including Pan Am, market their own brand name tours, for which
they control pricing and quality. Some airlines, including TWA
and Pan Am, have recently announced new emphasis on charter travel.
And Pan Am has just announced its entry into an auto rental program
in Europe. Pan Am's network of 650 locations in Europe is as large as Avis or Hertz in Europe. Recognizing the potential and the obligation for assuming the responsibility for the consumer's total travel experience, the airlines will move much faster into all key elements of the travel industry.

The second element of the new marketing strategies to be employed by the airline industry involves consumer priorities. During the past decade we have seen the airlines shift their priorities between frequent business travelers and new or inexperienced pleasure travelers. Within the next 10 years, a further change will lead to new consumer target priorities. The three primary targets will be the frequent business traveler who is primarily traveling first class; the "frequent" leisure traveler, who will make two or more trips per year; and the first time traveler. Each of these groups offer significant leverage for increased business and all product and promotional strategies will be heavily directed toward these consumers.

Thirdly, the airlines' definition of their product will change to be consistent with their new role as the supplier of a total travel experience. The present emphasis on inflight amenities, such as coach lounges, decor, meals, and movies will be pushed into the background and the airlines will be more concerned with structuring and providing a pleasant trip.
There will be significant increases in the variety and number of tour packages available to the consumer. This is not to imply that the market will be characterized by increased escorted group travel. Quite the contrary is true. While people may travel in groups for the air transportation, their land packages will differ considerably from one traveler to the next.

The airlines will have incentive to become even more involved in the development of the tourist infrastructure at the destinations along their route system. This will include such activities as sightseeing, hotels, car rentals, transfer services, and support industries.

This involvement by the airlines will result from the emphasis on quality control and the need for competitive pricing. The demand for new destinations and new travel experiences by the experienced traveler will also stimulate participation by the airlines in developing new vacation markets.

There is going to be a consolidation into a smaller number of total travel conglomerates. The airlines are in a strong position to head these up. Alternatively, someone like American Express could gain aircraft capability.

Finally, the product distinctions between scheduled airline's service and that of the supplements should be significantly diminished if not completely eliminated. A good percentage of the pleasure travel will be based on movements of people in large groups on either plane load or part charters, using both affinity
and non-affinity concepts.

The fourth key element of marketing strategy relates to pricing. In general, there will be an effort to simplify air fares in order to facilitate sales activities, consumer understanding and acceptance, and a profitable balance between fares for both business and pleasure markets. Most people in the industry realize that the fare situation is very complex and difficult from a sales standpoint. Developmental fares will be utilized to increase frequency of pleasure travel and to bring new consumers into the market. These pricing incentives, to the extent practical must, however, also be directed at offsetting seasonal and day of week traffic imbalances. This will tend to maintain some degree of complexity in fare structure, but this will be necessary if airlines, hotels, and other elements of the travel mix are to maintain traffic flow at some stable levels. The basic economics of our industry dictate that our resources must be effectively utilized on a year round basis. If this can be accomplished the consumer will ultimately benefit in that we can be offered the lowest price possible and the widest number of travel options to meet his own unique set of values and needs. Pricing strategy then will play a vital role in developing new business as well as ensuring fair and equitable prices to those consumers already in the travel market. All of this must be accomplished and still permit the airlines to maintain a
reasonable rate of return and stable financial condition.

There will continue to be fare differentials, but they will be more like 10-20% rather than the 40-50% differentials we see today. The dumping of seats will not continue, but differences in overall service will be charged different fares.

The fifth key element of future marketing strategies involves the channels of distribution. At present, the airlines have limited control over their channels of distribution. This must change if we are to ensure the quality of the travel products being offered. Consumers are expected to demand better and more informed travel counseling. This requirement for more extensive travel counseling and the airlines desire and incentive to gain greater influence over the sales outlets which sell our products should lead to a more selective appointment procedure of retail travel agents. Retail travel agents will continue to play a vital role in the selling of air transportation essentially for airlines like Pan Am who do not have a large number of their own retail outlets throughout the U.S. In the area of packaged tours, distribution changes are also likely as airlines strive for better quality control and better brand identification in an effort to develop stronger consumer interest and confidence in new tour products. This should result in a consolidation in the number of current packaged tour wholesalers and a closer working relationship between airlines and wholesalers in an effort to provide a more attractive and higher value consumer product.
The sixth and final element of marketing strategy involves the advertising and promotion activities of the airlines. First, there will be an increased priority on promotional efforts directed toward the stimulation of primary demand. This will reflect the objective of increasing the frequency of pleasure travel and the positioning of travel as an alternative to other applications of the consumer's discretionary income. Competitive advertising between airlines will focus more on the greater appeal of one carrier's destinations versus those of its competition. The primary emphasis, however, of airline advertising and promotion will be on the appeal, value, and quality of the total travel experiences which it can offer. This emphasis on the airline's ability to provide a total travel experience will be an important part of its promotional efforts.

Continued focus on inflight amenities concerned principally with the air portion of the total travel experience will have to be de-emphasized if our promotional resources are to be most effectively utilized in developing and capitalizing on the future traffic potential. Heavy promotion on special lounges will not properly compete for the consumer's discretionary dollar given the wide variety of non-travel options he has for these expenditures. It's our belief that airline marketing has matured to a point where more sophisticated techniques will be brought to bear on our total marketing problem.
I have tried to outline the challenges and opportunities that face the airline industry, and in particular its marketing management. I have described what I believe to be the direction that the airlines will pursue in six areas of marketing strategy. To recap these areas, they are: Increased vertical and horizontal diversification in the travel industry, the placement of priority on the "heavy user" of pleasure travel, an emphasis on structuring and providing a total travel experience, the development of new pricing concepts for air transportation and travel packages, a restructuring of the channels of distribution, and a promotional effort that is consistent with the airline's definition of its product and target consumer. During the past 15 years, the airline industry has experienced both feast and famine several times. The lessons learned during this period and the total business potential resulting from the social and economic changes that can be expected provide the basis for being more optimistic about our industry than we have ever been before.
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It is shown that it is a natural property of air transportation networks for competitive airlines to concentrate their operations at individual airports serving a given market. This implies that a strategy of developing satellite airports is doomed to failure unless the competitive behavior of the airlines is restricted. The results are demonstrated by tracing out the implications of observed patterns of traveller behavior as regards choice of carrier on the optimal game strategy for any particular airline. Analytic results for a two airline--two airport situation are extrapolated to the more general case, and specific supportive evidence from current operations are cited.
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Appendix I Proof of Structural Properties of Renard's Model
1. **Objectives**

The purpose of this study is to define the patterns of behavior of airlines and air travellers in an air transportation network and to analyze the implications of such behavior with specific reference to their use of satellite airports.

2. **Initial Observations**

Initially it was necessary to get an overview of the relationships between small and large airports that serve a single metropolitan area. We wanted to know what the general tendencies were with respect to passenger volumes and scheduled flight frequencies. The following six airport "sets" were chosen for examination:

- Cleveland - Akron
- Detroit - Flint - Lansing - Toledo
- Houston - Beaumont
- Philadelphia - Harrisburg - Allentown
- Pittsburgh - Youngstown
- San Francisco - Oakland - San Jose

We gathered our data on frequency of service from the CAB's "Airport Activity Statistics" for 1970 and from the "Official Airline Guide" (the former source deals with total frequencies at each port and the latter with the frequencies on specific links of the air transport network).(1,2) Data on demand were extracted from the CAB's "Origin-Destination Survey". We then used 1970
census data by county and by township to calculate the population within a radius of about fifty miles of each airport. The geographical proximity of each town to each airport determined to which airport its population was assigned.

The review of these data indicated, first of all, that the role of satellite airports at present is quite small. Secondly, it suggested that the market share of traffic of the satellite airports was low due to a lack of frequency of service. First, the demand per unit population (i.e. population nearest each airport, as described above) is much lower for the satellite airports than it is for the larger airports. (Figure 1) This implies at the very least that the large difference in airport use is not due only to the difference in population near each airport, but also to other factors as well. If population alone were a factor, the ratios of population to demand would be approximately the same at each airport. But, as Figure 1 shows, the difference in ratios between small and large airports is quite large. For example, the ratio of volume to population at Cleveland is slightly less than 1.0, while the value for Akron is in the vicinity of 0.12; similarly, Detroit has a value of about 0.8, whereas Lansing is at about 0.14 and Flint, about 0.07. These differences imply that the proximity of populations to airports contributes little in explaining the distribution of demand between neighboring airports. In any case it is clear that
connections and the availability of alternative flights as a protection against missed flights.(5,6)

In particular, Taneja concludes that:

"...the dominant explanatory variable of market share is frequency share. To the first approximation the relationship between the percentage market share and percentage frequency share is almost a straight line. However, by introducing a third variable, number of competitors in the market, we obtain a family of S-shaped curves."

Frequency share refers here to the percentage of non-stop and one-stop flights that are performed by a given airline in a given market (e.g. Boston to New York); similarly the market share refers to the percentage of passengers carried by a given airline in a given market.

Renard's further work on this subject also found an S-shaped relationship between market share, MS, and frequency share, FS. He puts forth the following interactive model to relate MS and FS for any airline, i:

\[ MS_i = \frac{FS_i}{\sum_{j} FS_j} \]  

(3.1)

where \( \alpha \) may depend on the number of competitors but appears to lie in the range 1<\( \alpha \)<2. (Figure 4)

Renard's model has the following characteristics for which proofs are given in Appendix 2.

(1) For any given frequency share an airline may have, its market share increases as the number of its competitors
connections and the availability of alternative flights as a protection against missed flights. (5, 6)

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\[
MS_i = \frac{FS_i^{\alpha}}{FS_1^{\alpha}}
\]  

(3.1)

where \( \alpha \) may depend on the number of competitors but appears to lie in the range 1 < \( \alpha \) < 2. (Figure 4)

Renard's model has the following characteristics for which proofs are given in Appendix 2.

(1) For any given frequency share an airline may have, its market share increases as the number of its competitors
increases and thus, as its relative size increases.

(2) If all \((M - 1)\) competitors of any airline \(i\) have equal frequencies, and if its frequency share is less than its equal share, \(FS_i < 1/M\), its market share will be less than its frequency share, \(MS_i < FS_i\). Conversely, if \(FS_i > 1/M\), \(MS_i > FS_i\).

The S-shaped function relating market share to frequency share would reflect what the airline industry tends to regard as a well-known tendency for the public to "go with the winner", that is, to travel disproportionately with the carrier that offers the most service along a particular route.

Evidence for the existence of this "S-shaped" response of the public is given by many instances. American Airlines, for example, has made a practice of scheduling at least one more flight than its competitors along given routes. As a result, American seems to have enjoyed a market share considerably larger than its frequency share, in particular along its coast-to-coast routes in competition with United and Trans World Airlines(6).

4. Implications of Traveller Response for Airline Strategy in a Given Market

The implications of the public's S-shaped response patterns to frequency of air service on the behavior of two competitive airlines is quickly and intuitively deduced. Assuming that costs of operating in a given market are directly proportional to
the number of flights, which is reasonable in general, there are ranges of operation for which revenues increase much faster than costs (i.e., above a 50% frequency share). Conversely, going below a 50% frequency share, revenues decrease much faster than costs. (Figure 5) Either airline will, naturally, try to increase its frequency share above 50%, as that maximizes profit. But the other airline, which would be forced into a profit-minimization point if it allows this to happen, will insist on maintaining its frequency share. Alternatively, it might choose to drop out of the market, but in any case would not, unless special circumstances prevail, choose voluntarily to accept less than its equal share (in this case, half) of the frequency and market share. In short, the non-linear response patterns of the travellers, when coupled with a linear cost function, places the competitive airlines in a dynamic game which forces them to one of three equilibrium points, as shown in Figure 5.

Exceptions to this rule are bound to exist. Some airlines, first of all, will not perceive linear costs as suggested by Figure 5, for a variety of scheduling and other reasons, their costs for providing a particular flight along a link may be very low. They may choose to offer the service because, even though it obtains a disproportionately small share of the traffic, its peculiarly low costs still make it profitable. Conversely,
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some flights which may be offered operate at inconvenient times and do not, therefore, really compete. An airline may, then, justifiably accept a frequency share less than its equal share because it recognizes that its market share will not be significantly affected.

The significance of the kind of analysis suggested in the first paragraph does not lie in its possible precision, but in that it defines the dynamics of the competitive process in which the airlines are engaged, and prescribes the equilibrium points toward which they will tend. This kind of analysis will be extended to the general case of competition among several airlines and several airports, and is shown to provide a strong explanation for the inability of satellite airports to attract much traffic.

Considerable evidence exists to indicate that airlines actually compete as our analysis suggests. Taneja's data on two-airline competition shows that some 20% of all competitors in the sample have identical frequency shares, and about 50% have essentially identical frequency shares, namely between 44% and 56%. (Figure 6) (5)

The same kind of results are obtained when there are several competitors in a market. Analysis of the 1969 daily frequencies of the three major airlines in TWA's 25 top city-pair markets shows that, with the exception of three or four markets, each competitor has approximately the same number of flights (Table 1). (7)
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A concrete example of the bad effects of not matching a competitor's schedule is provided by the experience of TWA on the Philadelphia-Los Angeles route in the summer of 1969. Prior to then, TWA and its competitors, American and United, each had two daily flights. That summer, American and United each laid on an extra flight. But TWA, arguing internally that, since the load factor on the route was only 50%, there were enough seats and no increase in capacity was warranted, did not add a flight. The result was that, as TWA's frequency share dropped from 33% to 25% or by a quarter, its market share was estimated to drop by nearly a third. (7)

The airlines themselves are well aware of this effect. To quote from the TWA report (Ref. 7):

"...No airline can be a fully effective competitor on a route if its schedules fail to provide time-of-day coverage at least approximately as convenient as the other carriers on that route." (p. 4)

"In a two-carrier competitive market, the incremental unit of capacity tends to be one schedule by each carrier, or two schedules for the industry.
And the incremental unit of capacity in a three carrier competitive market tends to be three industry schedules." (p. 12)

"When one gets to larger markets, it becomes less vital to match another carrier's frequency precisely." (p. 5)

This last quote is of special interest. First it helps explain why "precisely equal" competitors many times do not exist. But more interestingly, it reflects the fact that relative frequency shares,
not relative absolute frequencies, are seen to be the important determinants of market share.

To illustrate how Renard's model explains the observed phenomenon that precise matching of competitive carriers' flights is most important in smaller markets, it is sufficient to trace through the effect of any competitor cutting out a flight in a market served, say, by four flights a day and by 10 flights. The loss in potential traffic is much greater in the smaller market.

Renard's S-shaped model appears to provide a reasonable basis for explaining the observed tendency of airlines to match schedules, and it also seems to explain adequately why, in large markets, it is "less vital to match another carrier's frequency precisely." In short, the S-shaped model of traveller response to frequency appears, by tracing out its implications through the competitive game, to provide a good explanation of why airlines schedule flights at airports as they do. A similar argument will now be used to explain how carriers schedule flights between principal and satellite airports.
5. The General Problem

5.1 Initial Assumptions and Definitions

The discussion of initial observations suggested that the relative frequency of flights in a given market was far more important than the distribution of population in explaining the distribution of demand between neighboring airports. Since the "frequency delays" caused by usual schedules are generally much larger than those due to airport access or airfield congestion, we may surmise that the latter factors are also less important in describing airport use.

If our observations to this point have any merit then we can see a parallel between the competitive situation of airlines and the competitive situation for airports. We may think of the airports as competing for a share of the existing market (to a given destination) on the basis of their relative frequency of service to the given destination. There is, of course, a conceptual difference between market share for airlines and market share for airports. With respect to airlines, the "market" refers to anyone who uses the airport as an origin for a specific destination; that is, the market is concentrated at one place. But with respect to airports, the "market" is dispersed and what may be defined as a "market" for one airport may not qualify as a "market" for another. But to the extent that the distribution of population is of minor significance, we feel justified in thinking
of the air passenger in a given area as constituting one market for any given destination (even though the other variables may help to explain market shares for airports, the frequency shares seem to be the primary descriptive variables and ought to give us the basic structure of the airport market share model).

To verify the plausibility of the parallel between passenger behavior for airlines and airports, the market share of airports was plotted versus their frequency shares. (Figure 7) Data for eight airport "sets" flying non and one-stop flights were used for this graph. Inspection of these points shows that there is a strong similarity to the s-shaped relationship postulated by Taneja and Renard for airlines.

The series of choices that must be made by each air passenger is illustrated by figure 8.

The passenger must first choose between airports, say I and II, and then choose from among the airlines, say a and b, within the chosen airport. Whereas before we explored what inference the non-linear passenger response to frequency had on airline behavior at a single airport, we are now interested in finding what each airline will do to maximize its share of the total market over two airports, and in determining what kind of stable equilibrium use of the airports may result. (In reference to our diagram, airline 'a' would try to maximize the sum of flows through paths 0-1-2-4 and 0-1-3-6).
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Let us now define the symbols to be used in our analysis:

\[ MS_j = \text{market share of airport } j \]
\[ MS_i = \text{total market share for airline } i \]
\[ MS_{ij} = \text{that portion of } MS_i \text{ which airline } i \text{ accumulates in airport } j \]
\[ FS_j = \text{frequency share of airport } j \]
\[ FS_{ij} = \text{frequency share of airline } i \text{ within airport } j \]

Our problem is to find how each airline \( i \) can maximize \( MS_i \),

where, using the S-Shaped functions for passenger response:

\[
MS_j = \frac{FS_j}{\sum_j FS_j}
\]

\[
MS_{ij} = MS_j \left[ \frac{FS_{ij}}{\sum_i FS_{ij}} \right]
= MS_j \left[ \frac{FS_j}{\sum_j FS_j} \right] \left[ \frac{FS_{ij}}{\sum_i FS_{ij}} \right]
\]

\[
MS_i = \sum_j MS_{ij} = \left[ \frac{1}{\sum_j FS_j} \right] \sum_j \left[ \frac{FS_j FS_{ij}}{\sum_i FS_j} \right]
\]

As each airline \( i \) tries to maximize its own market share, it will be
opposed by other airlines which also want to maximize their market
share. The problem then is to find an equilibrium state (if it exists)
in which each competitor is satisfied that he cannot improve his position
under existing conditions.
5.2 Two Airport - Two Airline Examples

To obtain insight into the nature of the problem we first explored a simple two airport - two airline situation. This example was examined by evaluating all relevant cases and seeing what happened. Subsequently, as indicated in sections 5.3 and 5.4, the general cases were examined.

As can be appreciated, the airlines are engaged in a competitive game. They assign their flights to either of two locations, and their assignments can be countered by their competitors. Their mutual object is to attain a position of maximum advantage, which reasonably appears to be defined, for fixed fares, as the largest market share. For a two competitor situation, the preferred strategy, the "solution", can be inferred from a payoff matrix.

We can use the formula for $MS_1$ to calculate a two dimensional payoff matrix for the two airport - two airline competitive situation. Assume that airline #1 has $n_1$ flights which it wants to allocate between the two airports and that airline #2 has $n_2$ flights that it wants to allocate. We define:

$k =$ number of flights airline 1 allocates to airport 1

$l =$ number of flights that airline 2 allocates to airport 1

$MS_{k,l}^1 =$ the total market share for airline 1 when airline 1 allocates $k$ flights and airline 2 allocates $l$ flights to airport 1.
We can therefore get the following type of payoff matrix:

\[
\begin{array}{cccccc}
0 & 1 & 2 & \cdots & l & m_2 \\
0 & & & & & \\
1 & & & & & \\
2 & & & & & \\
\vdots & & & & & \\
K & & & & & \\
\vdots & & & & & \\
m_1 & & & & & \\
\end{array}
\]

\[MS_{1}^{k,l} = \left\{ \begin{array}{c}
\frac{1}{(K+L)_{(m_1^0+m_2^0-K-L)^+}} + \left(\frac{K}{m_1^0+m_2^0-K-L}\right)^{\infty} \\
\frac{\left(\frac{K}{m_1^0+m_2^0-K-L}\right)^{\infty} + \left(\frac{m_1-K}{m_1^0+m_2-K-L}\right)^{\infty}}{\left(\frac{m_1-K}{m_1^0+m_2-K-L}\right)^{\infty} + \left(\frac{m_2-K}{m_1^0+m_2-K-L}\right)^{\infty}} \\
\end{array} \right. \]

While the values \(MS_{1}^{k,l}\) represent the market shares for airline 1, the values \((1-MS_{1}^{k,l})\) would represent the market shares for airline 2. Analysis of this type of matrix for specific values of \(n_1\) and \(n_2\) amounts to a zero sum, two-player game. The payoff matrix for a two-airport two airline situation was calculated for \(n_1 = n_2 = 10\) (Table 2). As can be seen, the first and last rows dominate all other rows for airline 1, while the first and last columns are dominated by all other columns for airline 1 (they therefore dominate all other columns when we speak in terms of payoffs for airline 2).
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Analysis of this matrix using zero-sum, two player game theory indicates that five possible equilibrium states exist. The points are:

1. Each airline has all its flights at airport 2 (k=0 and l=0)
2. Each has all its flights at airport 1 (k=n₁ and l=n₂)
3. Airlines 1 and 2 each split their flights evenly between the two airports such that \( k = \frac{n₁}{2}, \quad l = \frac{n₂}{2} \)
4. Airline 1 has all flights at airport 1 and airline 2 has all flights at airport 2 (k=n₁, l=0)
5. Airline 1 has all flights at airport 2 and airline 2 has all flights at airport 1 (k=0, l=n₂)

Naturally, these equilibrium situations presume that the markets around each airport are comparable. As, in reality, this will not be the case, some airport will have some intrinsic advantage, probably locational, so that some of the equilibria points will not be chosen. Specifically, airlines will not choose to locate at the less favorable airport if alternatives are available. As one is, namely that they both locate all their flights at a single airport, they will tend to do so - to the extent the analysis is correct. This is what is demonstrated below.
It can be shown that any two-dimensional payoff matrix of the type described here will have all of its four "corner values" and the central point, $MS_1^{(n_1/2, n_2/2)}$, equal. Since we are dealing with a fixed total demand, it is obvious that $MS_1^{0,0} = MS_1^{n_1, n_2}$ and that $MS_1^0, n_2 = MS_1^{n_1, 0} = MS_1^{(n_1/2, n_2/2)}$ (airport location is assumed to be insignificant and the passenger is reacting to the flights). We must now show that $MS_1^{0,n_2} = MS_1^{0,0}$.

From our equation for $MS_1^{k,l}$:

$$MS_1^{0,m_2} = \left[ \frac{1}{\left( \frac{m_2}{m_1 + m_2} \right)^\infty + \left( \frac{m_1}{m_1 + m_2} \right)^\infty} \right] \left[ 0 + \frac{\left( \frac{m_1}{m_1 + m_2} \right)^\infty}{\left( \frac{m_1}{m_1 + m_2} \right)^\infty + 0} \right]$$

$$= \frac{1}{\left( \frac{m_2}{m_1} \right)^\infty + 1}$$

$$MS_1^{0,0} = \left[ \frac{1}{0 + 1} \right] \left[ 0 + \frac{\left( \frac{m_1}{m_1 + m_2} \right)^\infty}{\left( \frac{m_1}{m_1 + m_2} \right)^\infty + \left( \frac{m_2}{m_1 + m_2} \right)^\infty} \right]$$

$$= \frac{1}{\left( \frac{m_2}{m_1} \right)^\infty + 1}$$
If we can show the dominance of end rows and end columns for all two airline two airport payoff matrices, we will be assured that equilibrium states always exist for such cases, and that they exist at $K = 0$ or $n_1$ and $l = 0$ or $n_2$, as well as for their equivalent $K = n_1/2$, and $l = n_2/2$.

5.3 General Solution of the Two Airport Two Airline Problem

To show dominance for the end rows and columns as described in section 5.2, we need to show that the expression for $MS_{k,1}^{k,l}$ is a maximum either at $K=0$ or $K=n_1$ for any value of $l$, $0 \leq l \leq n_1$ (because it is arbitrary which airline we call 1 and which we call 2). Letting $N = n_1 + n_2$ and multiplying the numerator and denominator by $N^\alpha$ we get:

$$MS_{k,1}^{k,l} = \left[\frac{1}{(K+l)^\alpha + (N-K-l)^\alpha}\right] \left[\frac{K^\alpha}{(K+l)^\alpha + \frac{l}{K+l}} + \frac{(m_i-K)^\alpha}{(N-K-l)^\alpha + \frac{n_2-l}{N-K-l}}\right] = A + B$$

where:

$$A = \frac{K^\alpha}{(K+l)^\alpha + (N-K-l)^\alpha \left[\frac{K^\alpha}{(K+l)^\alpha + \frac{l}{K+l}}\right]}$$

$$B = \frac{(m_i-K)^\alpha}{(m_i+K)^\alpha + (n_2-l)^\alpha + (K+l)^\alpha \left[\frac{m_i-K}{(N-K-l)^\alpha + \frac{n_2-l}{N-K-l}}\right]}$$

Dividing $A$ through by $K^\alpha$ and rearranging we get:

$$A = \frac{1}{\left[1 + \left(\frac{\ell}{K}\right)^\alpha\right] \left[1 + \left(\frac{N}{K+l} - 1\right)^\alpha\right]}$$
Therefore, $A = 0$ at $K = 0$ and $A$ increases monotonically as $K$ increases.

If we divide $B$ through by $(n_1 - K)^{\infty}$ and rearrange, we get:

$$B = \frac{1}{\left[ 1 + \left( \frac{m_1 - \ell}{n_1 - K} \right)^{\infty} \right] \left[ 1 + \left( \frac{1}{n_{12} - 1} \right)^{\infty} \right]}$$

So that $B = 0$ at $K = n_1$ and $B$ decreases monotonically as $K$ increases.

We now know that $MS_{k,1}^{1}$ is correctly represented by either of two graphs as $K$ is advanced from 0 to $n_1$. (Figure 9) We have also shown for one particular case (Table 2) that $MS_{k,1}^{1}$ is maximum at $K = 0$ and $K = n_1$, thus it is impossible for graph II to be true.
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We have therefore shown that the "all or nothing" allocations of flights, the corner points, are always optimal for the two airport two airline situation. By extension so is their equivalent, the center point.

5.4 Extrapolations

From what we know of the two airline case and from what we have shown about the structure of Renard's market share model, we can project some results for the three or four airline situation. We have shown for the two airline-two airport case that an equilibrium state could exist for any "all or nothing" combination of allocations by the two airlines (i.e. for any combination of K = 0 or n₁ and 1 = 0 or n₂). Then theoretically an equilibrium situation could exist if both airlines were to choose the same airport or if each were to choose a different airport.

Let us now suppose that we start with an equilibrium state in which one airline has all its flights out of one airport and the other airline has all its flights out of the other airport (in a two airline-two airport situation), and then a third airline enters the scene; assume that each of the three airlines has n flights available to it. If airline #3 were to split its flights equally among the two airports, its MS would be, since each airport would have half of the total:
If it were to decide to put all its flights at one airport, its MS would be:

\[ MS_3 = \left[ \frac{\left( \frac{m}{2} \right)^\alpha}{\left( \frac{m}{2} \right)^\alpha + m^\alpha} \right] \left[ \frac{1}{2} \right] + \left[ \frac{\left( \frac{m}{2} \right)^\alpha}{\left( \frac{m}{2} \right)^\alpha + m^\alpha} \right] \left[ \frac{1}{2} \right] \]

\[ = \left[ \frac{\left( \frac{m}{2} \right)^\alpha}{\left( \frac{m}{2} \right)^\alpha + m^\alpha} \right] = \frac{1}{1 + 2^\alpha} \leq \frac{1}{3} \quad \text{for } \alpha > 1 \]

It would therefore be wise for the third airline to put all its flights at one airport rather than to split its flights equally. While we do not know whether or not some strategy which lies between an even split and a 0% - 100% split is better than a 0% - 100% split, it appears highly unlikely. Each time the airline removes
one flight from the airport going to 0% and adds it to the airport going to 100% it is decreasing its share in the airport whose market share is less than its frequency share while at the same time increasing its share in the airport whose market share is greater than its frequency share. If we assume then that airline 3 puts all its flights at the airport with airline 2, are we at an equilibrium situation? The answer is obviously "no!" If airline 1 were to stay where it is it would have all of the market share of airport 1, where the market share is less than one-third. This is obviously because only two airports are in competition and, according to the structure of our model, airport 1 would have MS < FS, where $FS = \frac{1}{3} \left\langle \frac{1}{m} \right\rangle$ for $m = 2$.

But if it moved all its flights to airport 2, it would have a proportional share, or $\frac{1}{3}$, of the entire market, a better situation. So the intrinsics of a third carrier will impell the others to concentrate their flights at a single airport.

If we had originally assumed that the first two airlines were both entirely at a single airport, the third airline to arrive would have found itself in the same position that airline 1 found itself after airline 3 had arrived. Thus for the three airline competitive situation there exists only one equilibrium situation, or two equilibrium points where the carriers are all located either at one airport or the other (where all flights are at a single airport), whereas the two airline case may have (under ideal conditions where
the distribution of population is not a factor) five equilibrium points.

Now let us extend this reasoning to a four airline competitive situation. The fourth airline enters a market in which three airlines are concentrated at one airport; it can either place all its flights at the same airport as the others or it can put some number of flights at the airport which presently has no service. It seems intuitively obvious that no matter how many flights the fourth airline wishes to place in this market, it would be best to put them all at the busiest airport. If it put all its flights at the other airport, it would be in a two competitor situation where its frequency share would be equal to:

$$\frac{m_4}{m_1 + m_2 + m_3 + m_4}$$

If, on the other hand, it put all its flights at the other airport, it would be in a four competitor situation with the same frequency share, which (according to the structural property proved earlier) would result in a higher market share than the two competitor situation.

6. Conclusions

6.1 Statement of conclusions

We have suggested, through a series of logical arguments, that it is better in a two airport situation for a number of airlines serving a given market to congregate at a single airport rather than to split into two groups of airlines, each group using a different airport to serve the same market. We have also shown through intuitive
reasoning that the congregation of all airlines at a single airport is the absolute optimum situation; that is, that the splitting of flights between airports (in serving a particular market) by any one airline is a sub-optimal strategy and therefore an unstable situation. We have not yet been able to present any rigorous mathematical proof of the latter assertion. It would, therefore, appear that the concentration of traffic for any market at a single airport in a given metropolitan area is the natural result of the competitive game played by the airlines. Satellite airports can therefore never be competitive with existing airports unless measures are taken to limit the degree of competition at the existing airports.

6.2 Supportive Evidence

Evidence in support of these conclusions can be found in all multi-airport regions of our country. The following examples are extracted from Batchelders' thesis (8).

1) In competition with O'Hare Airport in the Chicago area, Midway Airport has seen very little use despite pressure by the airport authority and despite congestion delays at O'Hare.

2) In spite of the numerous airports located within the Los Angeles region and the San Francisco region, there is only one important link between the two regions, that between the major airports, San Francisco and Los Angeles International.
3) In the Washington region, almost all short haul traffic goes through National, while most long haul traffic goes through Dulles. The traffic at Dulles is more or less forced there by long haul restrictions at National, whereas the concentration of short haul traffic at National is voluntary and no doubt the result of competition among the airlines.

4) In New York we find that most long haul markets are served at Kennedy, while most short haul markets are served at La Guardia and Newark. But even for the short haul markets, either Newark or La Guardia dominates any given market.

That the previous examples are the result of the competitive games played by the airlines is supported further by the following statement made by TWA (7):

"Normally, the provision of service at a satellite is not obtained by mere transfer of a carrier's flights previously serving the area's primary airport. The reason gets back to the competitive considerations set forth at the outset... even though a carrier starts supplemental service at a satellite airport, it is not prepared to seriously impair the competitive attractiveness of its pattern at the primary airport."
The airlines know that to remove flights from a given market in the primary airport and to move these flights to the secondary airport would hurt them in terms of total market share. Their only alternative is to leave the frequency of service as it is at the primary airport and to bring in new flights at the satellite airport; but since for most markets the existing number of flights are more than enough to meet demand, it seldom pays for an airline to add even more capacity to that which is already available.
REFERENCES


APPENDIX I

Proof of Structural Properties of Renard's Model

Proof (1)

Property:

For any given frequency share, as the number of competitors gets larger, the corresponding market share also gets larger.

Proof:

Let $F_1$ = frequency share of airline 1 in a given market
$U_j, P_j$ are frequency shares of competitors of airline 1

We must show that:

$$MS_1 = \frac{F_1}{F_1 + \sum_{j=2}^{\infty} P_j} \leq MS' = \frac{F_1}{F_1 + \sum_{j=2}^{\infty} P_j}$$

where:

$$\sum_{j=2}^{\infty} \mu_j = \sum_{j=2}^{\infty} P_j$$

for $n=2$ and $u_2 = P_2 + P_3$, we must show: $(P_2 + P_3) \geq P_2 + P_3$

which is equivalent to showing that:

$$1 + \left(\frac{P_3}{P_2}\right)^{\infty} \leq (1 + \frac{P_3}{P_2})^{\infty}$$

letting $P_3/P_2 = \mu, \mu > 0, \infty > 1$

then we know that:

$$(1+\mu)^{\infty-1} \geq \mu^{\infty-1}$$

$$\therefore (1+\mu)^{\infty-1}[1+\mu] = \mu^{\infty-1}[\mu] \geq [1+\mu] - \mu$$

$$\therefore (1+\mu)^{\infty-1} \geq 1$$

$$\therefore 1 + \mu^{\infty} \leq (1+\mu)^{\infty}$$

The proof is now complete.
Proof (2)

Let: 

\[ m \] = number of competitors in a given market at a given airport

\[ n_k \] = number of flights by airline 'k' at the given airport and for the given market

\[ N \] = total number of flights for the given airport

\[ n_i / N = FS_i = \text{frequency share of airline i} \]

\[ 1/r = MS_i = \text{market share of airline i} \]

Property:

If all \( m-1 \) competitors of airline 'i' have equal frequencies, then:

\[ MS_i \leq FS_i \text{ when } FS_i \leq 1/m \]

and

\[ MS_i > FS_i \text{ when } FS_i > 1/m \]

Proof:

Substituting into Renard's formula we get:

\[
\frac{(\frac{m_i}{N})^\alpha}{(\frac{m_i}{N})^\alpha \times (m-1)\left(\frac{(N-n_i)}{m-1}\right)^\alpha} = \frac{1}{r}
\]

\[
\frac{1}{1 + (m-1)\left[\frac{N-n_i}{m_i(m-1)}\right]^\alpha} = \frac{1}{r}
\]

\[
(m-1)^{-\alpha} \left[\frac{N}{m_i} - 1\right]^\alpha = r-1
\]

\[
\left(\frac{m-1}{r-1}\right)^{-\alpha} \left[\frac{N}{m_i} - 1\right]^\alpha = (r-1)^\alpha
\]

for \( 2 < \alpha < 1 \) and \( r \geq m \) (or \( \frac{1}{r} < \frac{1}{m} \))

\[
\left(\frac{m-1}{r-1}\right)^{-\alpha} > 1
\]

\[ \therefore \frac{N}{m_i} < r \]
which implies that \( MS_i = \frac{1}{r} < \frac{m_i}{n} \)

1) Thus for \( MS_1 < \frac{1}{m} \), \( MS_1 < FS_1 \)

we must show that when \( MS_1 < \frac{1}{m} \), \( FS_1 < \frac{1}{m} \)

Let \( FS_1 = \frac{m_i}{N} \) and \( FS_0 = \left[ \frac{(N-m_i)}{(m-1)/N} \right] \)

then \( \frac{FS_1^\alpha}{FS_1 + (m-1)FS_0^\alpha} = \frac{1}{r} \)

\[ (m-1) \left( \frac{FS_1^\alpha}{FS_0^\alpha} \right) = r-1 \]

Since \( 2 < \alpha < 1 \) and \( r > m \), we see that \( \left( \frac{FS_0^\alpha}{FS_1^\alpha} \right)^\alpha > 1 \)

\[ FS_0 > FS_1 \], which says that each competitor's share must be larger than 'i's share.

\[ FS_1 < \frac{1}{m} \] for \( MS_1 = \frac{1}{r} < \frac{1}{m} \)

ii) Thus for \( FS_1 < \frac{1}{m} \), \( MS_1 < FS_1 \)

It can similarly be shown that for \( FS_1 > \frac{1}{m} \), \( MS_1 > FS_1 \).
Abstract

An overview of the role of the airport in the transportation complex and in the community; the establishment of the airport including its requirements in regional planning and the operation of the airport as a social and economic force.
I would like to ask you to think with me in a non-dimensional way about the airport as a part of the air transportation system under three broad headings:

First - the various roles the airport plays in the system.
Secondly - what goes into the establishment of the airport, especially in the planning area.
Finally - what considerations must be given primary weight in the operation of the airport.

As we reflect on these aspects of the airport as a part of the air transportation system I will also attempt to highlight certain problem areas that need attention.

THE ROLES AN AIRPORT PLAYS

1. **Airside Part of Airport**

   Here aircraft land, take off, are serviced and are separated from or united with the loads they have carried or will carry.

   This is the part of the airport historically associated with the term "airport manager". This is the technical and operational part of the airport and involves interfaces with suppliers and operators of new equipment; with the ATC function and with the provision of emergency rescue services. Problem: Airplanes can be produced faster than this type of facility. There is a need for more planning and construction lead time.

2. **Land Side Part of Airport**

   Here passengers and cargo arrive and depart by various
ground means or local air transport. They enplane or deplane using such services or processing as may be appropriate or desired during the transition.

This is the part of the airport that has mushroomed in recent years into acres of car parks, complexes of terminal buildings and myriads of services demanded by or offered to patrons in today's living. Let us call it the commercial/social part of the airport. For the future we must look toward a simplification of these functions and a reduction of the ground handling costs associated with them. There will be more off airport processing, more mass transfer direct to plane side; more use of rail from city centers; and more use of busses and exclusive bus lanes from regional collection centers.

3. **The Airport as a Community Asset**

An airport stimulates the economy. It is a resource as an employment center and a generator of secondary employment and income, an educational center, a recreational area, and a source of improvement to the environment and ecology of the community and an influence in this direction with all parts of the aviation industry.

After listening to the environmental concern so eloquently expressed last year at the MIT/NASA V/STOL Workshop and again last November at NASA's Langley Conference on "Vehicle Technology for the 70's and Beyond" it would be redundant for me to urge again that the various quieting programs now underway
be expedited. We are beginning to pay a frightful price in stymied development for our neglect in the past. There is and will be no fourth airport in New York. There may be ultimate limitations on airline runways at Kennedy, La Guardia and Newark Airports. The Everglades jetport is stopped. In L.A. there are noise suits. Palmdale is stymied; Boston at an impasse. (In Boston, the Mayor classifies airports in the same league with dope pushing, prostitution and crime). We must begin to use transportation resources to at least help to improve the environment. I had hoped the PONYA could have demonstrated this by cleaning up Jamaica Bay as it produced the needed new runways at JFK, but the NASA study said the two could not be done compatibly. (At this juncture let me pay tribute to NASA and specifically to Ed Cortright for organizing the above referred to conference at Langley last November. Ed's keynote address at that conference with its succinct slide reproductions should be required reading for everyone in airport and aviation planning.)

4. Airport Dealings with Governments (local, country, state, federal and agencies thereof.) The problem is to devise means of making it possible for the elected official to say "yes" instead of necessarily currying favor with the electorate by opposing any and all new technological developments.
5. **The Airport Role in Dealing with Area, Regionwide or National Planning Agencies.**

Obviously the airport must be planned in collaboration with area regional and national planning agencies and they have to be brought in before the fact and not read about the proposed development in the papers. A disgruntled state highway director doesn't produce very good access to airports. But even more important is that the size and capability of the airport must bear some relationship to the region's needs. Conversely if airport development (and capacity) is stymied for environmental or other reasons, regional planners must know it to chop off other development that would otherwise get out of phase.

While on this subject of regional capacity let me digress for a moment to comment on one of Dave Cout's points - the size of the market for STOL services. I believe his conclusions were directed to the so-called natural demand market which in many cases did not appear sufficient to justify development of the new vehicle. I submit that there is another market - I will call it a market of necessity - which should be added to the natural demand market and which may therefore affect the conclusion. This market of necessity is produced by the upcoming shortage of CTOL runway capacity in many hubs.
due to the arrest of development for environmental and political reasons. In the NY area, for example, the denial of a 4th airport site and the denial of additional runways for JFK in Jamaica Bay make it inevitable that at some time in the future the existing CTOL runways on JFK, LaGuardia and Newark will have to be restricted solely to that traffic which cannot move either by other modes or by aircraft which can use STOL runways on JFK and Newark or at other STOLports to be developed. You heard Bob Ransome refer to this probability yesterday when he said the limited gate capacity at LaGuardia should be used for medium/long haul jet services and not for PSA style services.

6. The Airport's Role Vis-a-Vis the Role of the Airline (national or other).

This question applies more generally outside the USA in jurisdictions where the national airline and the national airport are operated by the same entity and involves the degree of subsidization - if any - that should be accorded to each. By the back door this also raises the question of the equitability of the level of airport charges which we will pick up further along.

II. ESTABLISHING AN AIRPORT

2.1 General Criteria and Policy Objectives of the Planning Process.

In this area the governing factors will be the time period over which the airport system is expected to function, the
scope, meaning the size of the area to be served by the airport, the type of an airport that is contemplated, the standards to be followed, (whether national or international), and finally the type of ownership, operation and regulation of the airport under consideration.

2.2 Study Organization

Organization for the study must include identification of issues or specific issues to be studied; the limitation that may be imposed on the study by work schedules and available budgeted funds; and a detailed layout of the structure of the study and the procedures to be followed.

2.3 The Planning Process

There are certain steps which must be followed in the planning process consisting of: (a) an inventory of existing facilities; (b) forecasts of the traffic to be handled; (c) demand and capacity analyses of the several components of the airport system: namely, aircraft, airfield, terminal airspace and ground access technology; (d) facility requirements and (e) environmental studies. It is in the area of (c) above that the excellent work of Ed Cortright and NASA are making such an appreciated contribution.

2.4 Site Selection

This process includes the ranking of alternatives and the
selection of systems. It is most important that in the site selection process there be progressive utilization of the pre-
liminary office study; primary and final field surveys and a great deal of attention paid to the establishment of relations with the community and other planning agencies at the right times in the process. The latter point is emphasized by what we did not do in New York when conducting the pre-
liminary studies for the fourth airport. A premature leak in the press put the pack in full cry before we could even try to enlist the support we needed - the rest is history.

2.5 Evolution of the Master Plan.

This involves several different layouts; the airport; land use around the airport; the terminal area; and means of airport access. There must also be a financial analysis including schedules and costs, studies of economic feasibility and methods of financing.

2.6 Evaluation of the Master Plan

Here all of the skills and methodology of cost benefit and cost effective analysis must be brought into play to insure the selection of the most feasible master plan.

2.7 Plan Implementation.

When it comes to implementing the plan selected the consider-
ations are many. The political and environmental climate
must be given full weight in establishing the timing, financing, and land acquisition schedule. Likewise, the recommended legislation or regulation for the airport and appropriate land use controls must be most carefully dealt with. Here again insoluble problems will arise unless careful coordination is exercised at the proper time with those who can say "No."

2.8 Organization, Staffing, and Direction

This is probably one of the most vital steps in the establishing of the airport. We must think of the organization chart as the skeleton of the human frame: the job descriptions which tell what people do are the flesh and blood. The working relationships which define how people react with one another are the nerve system of the enterprise.

The organizational structure and the people who man it must be flexible enough in their working relationships to permit the use of task forces drawing on many different disciplines to solve a particular problem when appropriate. There must be a definite plan made also for the training and on-the-job development for staff.

I cannot emphasize enough the importance of the staffing process, particularly the facet requiring a full mutual knowledge and understanding of working relationships between
the boss and those he supervises in both directions, and
between those they serve, or advise or audit in both direc-
tions. This subject is several lectures in itself.

III. OPERATION OF THE AIRPORT

We heard Jim Miller say that one of the highest forms of
managements is that it will be economically efficient. Per-
haps this can be paraphrased to say that successful manage-
ment is the walking of a tightrope between many conflicting
standards. For example, a balance must be struck between
economics on one hand, and environmental considerations on
the other, and between the need to expedite the flow of traffic
and the need for careful screening to prevent highjacking.
Let's plunge right in to the operation of the airport by
talking first about:

3.1 Capital Revenue and Expense Budgets for Control of

Operating Results

This involves the formulation and use of continuous long-
range moving capital forecasts; provision for the transition
of these forecasts each year to the annual budget; codifica-
tion of revenues and cost budgets by revenue centers, cost
centers and management control centers; and reporting opera-
ting results thereon in the same code. This of course is
the key to successful management. The airport must be fully
cost accounted and must pay for or know what the costs are
for everything it does whether it is operating on a self-
supporting or a subsidized, cost-known, basis.

3.2 **Property Control:**
This is a broad subject covering the acquisition of property,
its inventory and disposal and procedures for revenue collec-
tion and deposit and fund control.

3.3 **Project Coordination, Evaluation, and Control**

This is one of the most important series of functions in
every airport management. The key is the repetition of the
economic analysis at each milestone to be certain variations
from the financial plan are caught while there is still time
to take corrective action. As I lay out the steps to be taken
in Project Coordination, Evaluation and Control, I will show
by an asterisk (*), each time the all important economic
analysis must be made. The steps are: The forecasts; the
functional plan; the planning, or stage one cost estimate*;
coordination with users, leasees, operators, and other inter-
ested governments or agencies; the stage two estimate*;
project approval; contract plans and specifications; pre-
paration of the contract by the law department; advertising
for bids; stage three estimate*; award of contracts; supervision
of construction; (change orders and claims should be sup-
ported by stage three estimates* or by costs added by structural
the boss and those he supervises in both directions, and between those they serve, or advise or audit in both directions. This subject is several lectures in itself.

III. OPERATION OF THE AIRPORT

We heard Jim Miller say that one of the highest forms of managements is that it will be economically efficient. Perhaps this can be paraphrased to say that successful management is the walking of a tightrope between many conflicting standards. For example, a balance must be struck between economics on one hand, and environmental considerations on the other, and between the need to expedite the flow of traffic and the need for careful screening to prevent highjacking. Let's plunge right in to the operation of the airport by talking first about:

3.1 Capital Revenue and Expense Budgets for Control of Operating Results

This involves the formulation and use of continuous long-range moving capital forecasts; provision for the transition of these forecasts each year to the annual budget; codification of revenues and cost budgets by revenue centers, cost centers and management control centers; and reporting operating results thereon in the same code. This of course is the key to successful management. The airport must be fully cost accounted and must pay for or know what the costs are
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paration of the contract by the law department; advertising
for bids; stage three estimate*; award of contracts; supervision
of construction; (change orders and claims should be sup-
ported by stage three estimates* or by costs added by structural
integrity considerations supported by stage three estimates or actual quotations*); approval of payments to contractors or the withholding of payments until work is satisfactorily performed; certification of completion or occupancy; and finally post-completion analysis of the project immediately upon completion and periodically thereafter. The constant economic evaluations are required to control the project for the maintenance of adequate coverage of the investment and includes the necessity to either scale the project down, or revise revenue projections upward when coverages appear in jeopardy.

3.4 **Safety Services and Requirements:**

Here a uniformed code of airport rules and regulations must be developed, circulated, explained and enforced. Security forces must be trained in various disciplines and operate with all the elements of the airport organization as well as with the tenants of the airport under a well defined, publicized and understood emergency plan. The security forces must maintain a close liaison with the law department of the enterprise to cover enforcement measures and must deal with such matters as fire prevention, theft prevention, traffic control, sabotage, highjacking prevention and the use and the development of appropriate emergency equipment.
3.5 **Compliance with Federal or International Standards**

This facet of airport operation requires the determination as to whether national or international standards will be followed in the operation of the airport and involve questions as that of airport certification by the national government currently under discussion in the United States.

3.6 **Relations with Users, Suppliers, and Services:**

The airport operator quite obviously must maintain day-to-day working relationships with such variegated tenants as airlines, the postal administration freight forwarders, truckers, customs brokers, customs, immigrations, and health authorities, concessionaires, fuel companies, utilities, ground transport operators, industrial tenants, aerospace industry tenants, agricultural developers interested in using the airport land, not to mention passengers and patrons using the airport. In these relations with all of the foregoing tenants in the airport the needs and opportunities for revenue development from each type airport user must be kept uppermost in mind. The latter point - revenue development opportunities from each type airport user gives rise to one of the largest sources of misunderstanding that exist today between airports and their users: namely what are the equities of airport charging? The answer lies not with the airport...
operating entity but in most cases with the airport owner—generally a municipality, county, state, or, outside the United States, a nation. The decision as to whether an airport shall be self-supporting, or subsidized, is one that is usually made directly or indirectly by the electorate of the owning entity. In the New York area the decision was made by the cities of New York and Newark in 1947 that they wanted their airports not only to be self-supporting but also to contribute a return on the investments that had been made in the airports. They wanted to use their capital for schools, hospitals, and other purposes and not for airports. An equally valid decision is frequently made by a country where the National airport might be regarded as a source of tourism or used to attract industry to a developing nation. As such, the national government of that country, could be perfectly rational in determining that its airport deserves subsidized support.

3.7 **Airport Maintenance:**

The first step is to develop a long range periodic maintenance plan, from which may be derived annual major work programs and routine planned maintenance programs, leaving an adequate amount of budgeted time to handle the inevitable unscheduled or non-routine maintenance, usually
called repairs. Too often the maintenance program of an airport degenerates into a galloping rush to keep ahead of the last category just mentioned, an unscheduled or non-routine maintenance or repairs. It is also a temptation in lean years to defer scheduled major work programs or routine planned maintenance - a temptation that must be rigorously resisted. In passing, let me say that computer techniques are now coming into successful use to inventory, schedule, record and report maintenance functions and thereby greatly facilitate management budgeting and man-power control.

3.8 Supervision of Construction:

This means the completion of the proposed construction within the budgeted time and cost. This process requires dealing extensively with contractors and suppliers in the conduct of the work. Behind the scenes there is a constant interchange with planners and designers in handling change orders, liaison with air traffic control services and airport operations to hold to a minimum interference by construction activities with the operation of the airport, with engineers in matters of quality control and structural integrity, with financial interests to be certain that the work is progressing economically, with legal officers in the handling of the inevitable claims during a construction, with purchasing
to assure the on-time arrival of equipment and supplies and so on. This function is a vital part of the important project coordination and control process described previously. The breakdown just outlined, can only hint at the complexities involved yet the failure to properly execute this function exerts a tremendous impact on the airport, and more seriously on the aviation system viability.

3.9 **Airside Operations**

This is of course quite obvious and refers to the managing of the "airplane part" of the airport.

3.10 **Landside Operations**

This is equally obvious and deals with the managing of the "people and land transport" part of an airport, including the all-important subject of facilitation.

Both of the functions just mentioned cover the implementation of two of the principal roles the airport plays as we reviewed earlier.

3.11 **Public Relations**

This varies all the way from the establishment and enforcement of the standards of service at the airport to the performance of community service including liaison with such community leaders in such difficult areas as noise control, and so forth. It includes promotional activities, the preparation
of speeches and publications, and the writing of reports. With the rise in environmental concern in recent years the public relations function, particularly in community service aspects, has assumed enormous proportions. Public relations can only function when it is backed up by unquestioned product performance. The successful introduction of the DC-10 and L-1011 into La Guardia during the last year is a case in point. The big problem and task facing public relations - and all of us for that matter - is to prevent wrong decisions from being made based on erroneous data whipped into a tidal wave of opposition by mostly innocent but sometimes erroneously inspired leaders. The rapid rise of opposition to a STOL-port in the New Jersey meadows is a good example. Another is the threatened political closure of a beautiful downtown airport at Rotterdam ideally situated and sized not only for V/STOL but also for DC-10 and L-1011 and Airbus operations. The reason? Present operations by BAC-11's and Caravelles are noisy and the officials in charge lack knowledge of what QTOL's and the DC-10 and L-1011 can do to alleviate the strong bias in the population against the airport. We did furnish the low noise footprint and pollution characteristics of these new aircraft to the leaders and may possibly have contributed to an avoidance of this closure.
These are some of the problems engendered and the processes that must be followed in planning, managing and operating airports today. As in everything else the resulting rise in complexity is immense and new solutions and new technology are in urgent demand.
Airport Economics:
Management Control Financial Reporting Systems
Allen Buchbinder

As our three major airports and their related facilities grew, the Aviation Department of the Port Authority was faced with many new and varied problems in developing and maintaining a comprehensive system of reporting financial data and results to management.

Port Authority operation of the airports commenced in 1948 and during the intervening years to 1971, these airports experienced a 10 fold growth in passenger traffic to 38,000,000. Plane movements accelerated from approximately 1/4 million per year to approximately 850,000 per year, and Port Authority airport investment expenditures increased to such an extent that it now exceeds one billion dollars.

Concurrent with this growth, evolutionary technological changes took place in Electronic Data Processing and in its application to accounting and financial control.

Years ago, as we all remember, the hardware consisted of a reliable #2 pencil, long pads of paper, green eye shade, and a manually operated calculator that cranked into operation somewhat like a Model T Ford. A raft of work paper was produced by hand, typed in the proper format, and subsequently transmitted to management. It took a long time before these reports were received and, in many cases, corrective action would be too late to be effective.

In 1956 the Port Authority acquired an IBM 650 machine, and a transformation from a manual to electronic/manual preparation took place. Off came the green eye shades, and our accountants were able to provide instructional data to our electronic data specialists who programmed computer equipment to procure the same and better reports so that timeliness was improved and the accountants could devote themselves to analysis work. The gains were considerable but the reports were generally in summary fashion and did not really lend themselves to relaying detailed net operating results. Many calculations still had to be made due to limitations of the 650 and
the green eye shades were more often on than not.

In 1961, the 650 was replaced with an IBM #7070 which had greater capabilities, and net operating results were accomplished with the accountants furnishing instruction to the programmers for most all the essentials of the reporting procedure.

Keeping pace with the Data Processing technology, conversion to an IBM #1401 with tape processing capabilities used in conjunction with the 7070 was accomplished in 1963. Utilizing the 7070/1401 "hardware", Aviation Department operating and financial staff introduced a change in both the basic format and content of control reports in the attempt to assess operating results more precisely by pinpointing responsibility through the detailing of expense incurrence. From an operating standpoint, the reports served a useful purpose, but it was still felt that improvements could be effected and an all-inclusive system of reporting could still be developed.

The system that we were directly concerned with had to provide a more meaningful report for all levels of Aviation Department management and still be separate and distinct from the Authority's general accounting system. The general accounting system is uniform for all our facilities: Marine, Aviation, Tunnels and Bridges, etc.

The Management Financial Control System (our name) that we undertook to establish and perfect was designed to provide the Director of Aviation and his operating management with quarterly reports that would enable them to determine those specific revenue producing facilities of the airports where net revenue production was less than the minimum standards established by Departmental or Port Authority policy. We wanted a system of reports, which when promptly and accurately provided, would supply management with a means to pin-point net revenue deficiencies and point the way for corrective action. Moreover, it was also planned that future budgets for each facility at each airport would be evaluated on the basis of net revenue production. A periodic review by management of financial results would identify specific areas of and reasons for variance from goal.
The first step in setting up the Management Financial Control System (MFC) was the remumbering of what we refer to as the Airport's cost centers into a codified system that would allow for a more uniform and systematic evaluation of an airport. This had to be accommodated within the parameters of the existing Port Authority account coding system. This system had already been established and was in use for the accumulation of construction costs and for the recording of revenues and expenses by Data Processing. Our approach was first to group all homogeneous geographical areas, services, structures, facilities, etc. into a 3-digit numbering system identified by a "100" series. This we referred to as "Management Control Groups."

Next in the program we sub-classified the Management Control Groups into what we refer to as "Management Centers". This was accomplished by dividing each "100" series into a series of "10".

Within each series of "10" further identification was enabled by assigning single digits to individual "Cost Centers" of Airport.

The broad Management Control Groups ("100" series) were given titles which, are self-explanatory:

100 General Airport Operating Expenses, Systems, Port Authority occupied areas
200 Public Aircraft Facilities
300 Passenger Terminal Facilities and Services
400 Hangar and Cargo Facilities
500 Other Aviation Facilities
600 Industrial and Commercial
700 For accumulation of Special Items of Expense
800 For expenses recoverable from Tenants and Others
900 For Accumulation of expenses included in Major Work Program
Selecting, for example, the Hangar and Cargo Facilities ("400") Management Control Group at JFKIA, we established Management Centers as follows:

400 - Exclusive Hangar - U.S. Flag Carriers
420 - " " - Other

Skipping to Cargo, the following were assigned:

460 - Exclusive Cargo & Cargo Service Buildings
470 - Multi-Occupancy Cargo Buildings

Within the Exclusive Cargo & Cargo Service Buildings' Management Centers, the following Cost Centers would identify the respective structures as follows:

461 - Cargo Building - BOAC
2 - " " - PAA
3 - " " - Emery Air Freight
4 - " " - Air Express Int'l.

etc.

We then felt that the next requirement of the program was to develop a method of arriving at what we in the Port Authority refer to as "Revenue Margin," a measure of a Management Center's Performance. Stated in its simplest terms, "Revenue Margin" is merely the residual amount after deducting expenses from a center's Gross Revenues. However, the determination, if it was to have any merit, had to reflect an assessment of both direct expenses and a distribution of indirect or general airport expenses wherever feasible.

The distribution of these indirect or general expenses (normally coded to the 100 series of Management Control Groups) was considered to be prime objective if the financial results of each Management Center's operation were to be measured in a definitive manner. We were also striving to establish specific guidelines aimed at stating revenues and expenses in a simplified and interrelated set of
reports organized to correspond with management responsibility.

General Expenses were categorized into two basic groups:

1. Costs which could be either directly or indirectly associated with the Revenue Producing Cost Centers of a management center.

2. Costs which would not be distributed but used only in measuring the overall Airport's results. (An example of this type of expense would be the Airport Managerial costs).

In the Port Authority, specific types of work or activities engaged in had already been classified with specific code numbers similar in nature to the previously mentioned Center numerical system.

As an example, the "Activity" number for say Electrical Maintenance is 35 and if the work was undertaken in a specific cargo building, the Electrician would code his time to 462 if it was the Pan American Airlines Cargo Building at JFKIA. This is a direct cost. However, the supervisor or Electrical Foreman who operates throughout the Airport checking on the individual crews would normally code his time to the General Area Cost Center within the General Airport Operating Expenses. The same would hold true for other costs involved in the function for Electrical Maintenance that would not previously be specifically identified with a particular cost Center. This "Direct Supervision" could involve equipment or instructional manual writing, inspections, meter reading, periodic routine servicing on a cyclical basis, etc.

Naturally, over a reporting period these expenses coded to a General Area Cost Center add up to substantial sums, especially so when we take into account the
many similar type Activities that could be involved with the operation of an Airport, e.g., Janitorial, Mechanical Maintenance, Structural Maintenance, Paving Maintenance.

In setting up our control system we proposed that these expenses would be distributed on a direct charge basis as incurred by these Activities for all other cost centers.

Another closely related aspect of supervision that also required distribution since it too was normally coded to a General Area Cost Center is "Unit Supervision". Since I have used Electrical Maintenance as an example, let us continue with it. Within the Electrical Maintenance Unit the Managerial Staff or General Foreman (Unit Supervision) would also code their time to the General Area Cost Center. However, in this case the "Activity" number they would use would be 01 to identify Administrative and Clerical expenses. Naturally it was felt that "Unit Supervision" had a direct relationship to both "Direct Supervision" and the "Direct Cost" of the Electrical Maintenance Unit. Accordingly, the Unit Supervision costs were to be distributed on the basis of all direct and previously distributed expenses.

Following the general rationale of maximum distribution, some determinations had to be made to account for the distribution of other costs coded to the General Area Cost Center. Such costs, for example as:

- Policing and Traffic
- Snow and Ice Removal
- Emergency Service, Etc.
In some cases the coding is done in this manner due to the type of expense involved. In others it is due to what we refer to as an "Ease and Economy" treatment. Briefly, this applies to charges which would normally be broken down daily in the field but which follow a consistent pattern making it possible to get effective distribution to Cost Centers affected.

As an example, no doubt you have all heard how the N.Y.C. areas can be inundated with a blanket of white that can result in a black day for our airport operations. Such being the case, an Airport Manager looks out the window and says "issue mittens and shovels to everyone." Snow Removal gets underway. All crews know the routine -- Runways, Apron, Roads, etc. Now just picture this: A plow operator has removed snow from a runway and is just about to roll on to an apron. He stops, pulls out his time card and says "Now I just left the runway, it is 10:31 PM. I started at 8:14 so that's 2 hours and 17 minutes on Public Aircraft Facilities." Multiply this by the entire snow removal crew, add to it another inch of fallen snow and the result is a financial reporting chaos. If, on the other hand, management knows the routine, priority, total cost involved, etc., predetermined distribution ratios can be calculated and applied to the total cost incurred in behalf of snow removal. By this procedure and with the application of Electronic Data Processing, it is possible to hold field and related office clerical work to a minimum.

In any system such as the MFCS, there are many possible ways of distributing expenses, and there are differences of opinion as to methods. These differences exist within our own staff, among financial people and among airport operators. We recognize that there is no only way nor one best way. The methodology
ultimately used resulted from policy decisions. Our Accounting Department felt, for example, that certain general area charges cannot readily be associated with a specific Management Center either on a direct or indirect basis. Included among these charges were for example, Manager's Office Expenses, Aviation Department Staff expenses, other Department's Staff expense, etc. The accountants felt that rather than attempt to relate these charges to an individual Management Center they should be considered as general costs incurred in operating the airport. Specifically they wanted these costs classified as "General Airport Operating Expenses" and excluded from any determination of the margin for Management Centers.

Many such points had to be resolved. Some fell within the realm of accounting theory, others concerned themselves with technical data processing problems. Once resolved, the point was reached where all basic planning was finished and the Report Format could be developed. The programmers went to work, the 7070 computer was activated and the statements were forthcoming. The basic purpose of each schedule of the report is as follows:

The "Summary Financial Statement by Airport" - Schedule A was intended primarily for the first level of Management (The Director of Aviation) and for each Airport Manager. This statement contains the components that we normally use in determining operating results and is presented for each airport plus the total Department. It is intended only for Aviation Department internal use and does not represent the official Port Authority of New York and New Jersey comprehensive system of accounting and reporting.
These are the components of Schedule A

I - Gross Revenues - A commodity we would like to have more of or, stated in technical terms, monies received from the sales of services, space, or utilities, as well as from the granting of privileges. It excludes interest, investment and other financial income and is stated before any deductions for expense incurred in providing such services, space, materials, privileges, etc.

II - Facility Direct Expenses (segregated into:)

1. "Field Units - Direct" which incorporated all costs directly identifiable with a specific Management Center.

2. "Field Units - Supervision" which includes all facility unit costs (exclusive of the Manager's units and staff units) charged to the General Area and distributed to Management Centers in which direct costs have been incurred.

3. "Field Units - Administration" which includes all Manager's units and staff units considered as the administration cost of the entire airport. As I have previously stated, according to our accounting practice these costs were to be excluded from any determination of a margin for Management Centers. Hence, they are not distributed.

4. "Aviation Staff Direct" which includes all staff costs incurred specifically for an individual airport. (These costs are generally main-office Aviation Department, some of which might be directly charged to Management Centers or on the other hand, coded to Cost Centers classified under General Airport Operating Expenses, with the ultimate effect of not being distributed.)
5. "Other Staff Direct" which includes other department charges also incurred specifically for an individual airport, i.e. Engineering Accounting, Real Estate, Law, etc. As with Aviation Staff Direct, some costs might be directly charged while others remain as General Airport Operating Expense.

6. "Fixed Charges" - The Port Authority Consolidated Bond Resolution accounting principles provide that operating expenses shall not include any allowance for depreciation; that the monies remaining after payment of each facility’s operating expenses shall be pooled and pledged to pay the debt service of the outstanding bonds. It is impossible to identify the individual bond of a particular series that is invested in an airport or other Port Authority Facility. Hence, actual debt service for a particular facility cannot be determined.

In order to overcome this obstacle we have had the electronic people use their machinery to compute, on an equal annual payment basis, an estimated allowance for interest and amortization, over an estimated service life assigned to various types of property. It must be emphasized that these fixed charges are used strictly for management control purposes since the estimated service life of a physical asset bears no relationship to the amortization period of the bond issue. The life of the bond issue, however, will not be longer than the weighted average life of the mixture of properties in which the bond proceeds are invested.

III. "Total Facility Direct Expense" - An acceptable total of II - if they do not exceed I.
IV. "Facility Margin" Being optimistic, we refer to the residual amount (after deducting Facility Direct Expense from Gross Revenues) as Facility Margin. Pessimists might add "or Deficit".

V. "Prorated Expenses" provide for costs related to functions which are centrally performed by Staff and Other Departments for the benefit of Airports and charged to the Aviation Department. Since the costs incurred serve more than a single airport, they are distributed by the Accounting Department to the respective airports on a uniform basis of cost determination which I will go into a little more deeply later on.

VI. "Operating Margin" - At this point, we can now determine the net return from the airport after deducting all directly incurred expenses and expenses prorated to it in accordance with the Port Authority's Accounting System.

VII. "Coverage Ratio x Fixed Charges" - Stated in its simplest terms this is nothing more than a "How goes it?" benchmark or arithmetic tool of measurement, determined by dividing Fixed Charges into Operating Margin. In the general accounting field, it might be likened to the "Acid Test Ratio", other "turnover" ratios or measurements of earnings.

I think you will agree that the summarizing qualities of this statement provide management with a ready relationship of revenues and expenses for assessing effectiveness in achieving a planned operating margin and in determining the major overall results on a consolidated basis.

The next statement Schedule B "Revenue Margin by Management Center and Facility Margin" was designed primarily for the Facility Manager. This report presents sufficient detail for each Management Center so that those not attaining
anticipated results are readily apparent. By segregating the costs - Field, Staff, etc., the reason for deviation can be determined and, if warranted, corrective action taken.

We have also incorporated into this schedule an adjustment or transfer from one center to another. Assume a Terminal Building consists of 10,000 square feet of which 1,000 square feet of its rentable area is occupied by Port Authority staff, a transfer of 10% of all related costs will credit costs out of the Terminal Building and charge them to a respective Cost Center assigned to accumulate these costs. Thus, the margin results of the Terminal Building are not penalized. (Generally, the reassignment would be to one within the "100" series or General Airport expense of the Management Control Groups).

The schedule titled "Field Unit Expenses by Management Center" - Schedule C, summarizes by Center each field unit's actual expenditures for both labor, materials and services and compares the sum to the budgeted amount. Again, we felt that the data presented in this statement would provide a timely feedback of information to the responsible unit head (as well as other levels of management) for problem identification and corrective action.

Historically, airport managers have believed that financial performance should be measured on those expenses for which they could be deemed responsible or over which they exercised control. Unfortunately a line of demarcation is virtually impossible to draw. As an example, in every business or organization, auditors periodically "make the scene". No one ever asks for them but there they are together with their related expense. Accordingly, for the airport manager's benefit we designed and included Schedule D - "Staff Unit Direct Expenses by Management Center". This single source document enables the Manager to determine the impact of expenses charged by Aviation Department Main Office Staff as well as other Department Staff units to his Airport. This report provides the manager with a better means of assessing the benefit derived vs. the cost incurred.
As I stated in the beginning, our concern had been to design and provide a more effective report for all levels of Aviation Department management.

We feel that we have accomplished this objective since the reports:

1. Facilitate better budgeting
2. Provide effective financial control
3. Identify to whom inquiries should be channeled
4. Provide information on a uniform basis
5. Are speedily calculated and produced with the aid of E.D.P.

Naturally, a certain amount of debugging was required once the reports were issued. Most problems were commonplace and easily rectified. However, one factor presented a problem of continuing concern -- The Management Control Reports contained no provision for distributing to Revenue Producing Management Centers either of the General Airport Operating Expenses or Prorated General Expenses which are detailed respectively in Schedule A and Schedule B. For example, within the category of General Airport Operating Expenses are costs coded to such Cost Centers as Air Terminal Highways, Utility Systems, as well as other costs such as Manager's Office expenses, etc. that we code to the General Area Cost Center.

Although I have just touched upon it slightly, Prorated General Expenses could best be explained as costs generated by specialized units serving more than a single airport. This could encompass Other Staff Departments as well as our own main office Aviation Staff.

The method for distributing these costs to each airport is on the basis of the proportion that each airport's payroll costs bear to the total payroll for all airports. Payroll is used as the basis for distribution since it is the largest single item of operating expenditures and a reasonable indication of the size of the airport being administered. Consequently, it is apparent that this type of expense would also require distribution to Revenue Producing Management Centers if we were
to determine net results with reasonable precision. However, due to the complexities involved, the planning and development of myriad formulae, their integration into the Data Processing system and the fact that all this would probably have increased preparation and computer time with resultant report delays, we finally resolved to make the final distribution by hand. This is:

1. Those General Airport Operating Expenses (exclusive of City Rent, Systems and Highways and Facility Occupied Buildings) were distributed on the base of Direct Expenses incurred by each Management Center. Included within this type expense would be such items as Manager's Office, Aviation and Other Department Staff expenses coded to the respective airport, prorated General Expenses, etc.

2. An Airport in providing services such as Systems and Highways has to establish physical Cost Centers which do not, in themselves, produce revenue but serve directly certain Cost Centers involved in revenue production. As an example, an Air Terminal Highway System although not revenue producing, incurs cost in its own behalf and serves Cost Centers such as Vehicular Parking Lots, Terminal Buildings, Hangar Complexes, etc. Consequently, it becomes necessary to relate these general costs to revenues in order to determine "Margin". And in this case "Margin" is applicable to the Revenue Producing Area. We toyed with the idea of distributing these costs on complex bases such as frontage, vehicular pavement and so forth, but for the sake of simplicity and uniformity we decided to spread these costs to Revenue Producing Groups on the basis of land square foot measurements since we felt that a geographical base was a reasonable common denominator and would give us realistic results.

The same would hold true for other Systems such as Electric, Gas, and Water which might possibly be distributed on a consumption basis, but the difficulties and costs of implementation and administration looked onerous. So again we settled on the land base method of distribution. Remember, the application was to be a manual one so not programmed for the computer.
At this point, all appropriate distributions can be considered to have been made and the net results for each Management Center are now determinable.

The computer "produced" reports are circulated to various levels of management while these "net" results which distribute the residual general airport expense are prepared in a condensed format and circulated along with explanatory text only to top Aviation management.

As with any system as time goes by minor inadequacies appear but at the same time auxiliary uses of the report are also found. We gratifyingly enough have discovered that the latter far outweighs the former and it would appear that in the Aviation Department of the Port Authority of New York and New Jersey, the Management Financial Control System is here to stay.

I might add that in 1970 our organization purchased a Model IBM 360/75 Central Processing Unit resulting in an increased throughput capacity of between 16% and 19%.

In anticipation of the wonders of this new hardware, our analysts immediately made ready a proposal to our Electronic's Division for inclusion of the "Net" reports into the new computer program or we would request a pre-game analysis of next year's football games as compensation for the extra work involved in cranking out the "net" reports manually. We met resistance on both scores and accordingly, my staff investigated the possibilities of utilizing "time-sharing" computer services. This has lead to further developments in connection with our proposed computerization of the "net" reports. Although some of our endeavors are in the embryonic stage we are rapidly progressing - to the extent that the distributions that were formerly performed manually are now a routine function on a "time-sharing" computer.
We feel that a wide range of applications are available in the future since the "Stored" data could probably be extrapolated and utilized in many variegated ways: e.g., as an aid to rate making; determining cost effectiveness of proposed projects on existing or estimated returns, establishing indices and developing subsequent trends, etc. It is unfortunate that our procedures, which are for the main in the financial field, do not lend themselves to what is commonly referred to in data processing and programming as "canned" or routinely performed established programs. As a consequence, we are doing our own programming and experimentations - oft times on a trial and error basis.

In summation, our computerizations' attempts are starting to be productive. The pencil is being replaced by electronic buttons and keys and hopefully, the end result will allow our staff to spend more time on analytical work.
Market Research Approach

The forecasting procedure often referred to as "The Port Authority Model" can basically be defined as a "market research" approach. It differs from most other air traffic forecasting "models" in that it relates air travel growth to detailed socio-economic and demographic characteristics of the U.S. population rather than to aggregate economic data such as GNP, personal income, industrial production, etc.

A series of national household surveys conducted intermittently over a period of some 15 years, demonstrates consistently, although not surprisingly, that a number of basic socio-economic and demographic characteristics have a strong bearing on people's air travel behavior. Chart I demonstrates clearly that such characteristics as age, occupation, education and income are prime determinants of whether a person is a "flier" at all or has as yet never travelled by air. Chart II demonstrates that the number of air trips taken for personal reasons (vacation, visiting relatives, etc.) varies by the same kind of characteristics. Air trips for business reasons, on the other hand, are closely associated with a person's occupation, his level of responsibility, and the type of industry with which he is affiliated (Chart III).

It is for this reason, that the Port Authority forecast divides the air travel market into a large number of travel "cells", for personal travel each defined by a cross classification of age, occupation, education and income criteria, for business travel by criteria of industry, occupation and income.
For forecasting purposes, however, not only differences in levels of air travel propensity are critical, but also differences in growth rates. Chart IV demonstrates that increases in the number of "fliers" in certain economic and demographic groups such as professionals, high income and higher education groups, over the past 15 years have been much greater than in others, such as lower income or education groups, housewives, etc.

Given the historical air travel survey observations over time for various socio-economic groups, the forecaster's problem is to extrapolate these data in some kind of a rational way to a future forecast year.

The initial Port Authority air passenger forecast of 1957 assumed that the rate at which people enter the air travel market (become "fliers") would more or less follow a declining straight line logarithmic function, the so-called "learning curve", i.e. the attrition of the "non-flier" portion of the population was assumed to drop at a constant annual rate, at a fast rate for some cells, at a slower rate for others, (it was assumed that the starting point was 1935). The "flier" portion, being the complement of the "non-flier" portion, was thus assumed to increase at a decelerating growth rate (Chart V).

With respect to the frequency with which air trips for personal reasons are taken, the 1957 Port Authority forecast assumed that the travel frequency within each "cell" would remain more or less constant at the level observed in the 1955 survey. This assumption implied that the most significant factor in the further growth of personal air travel would be the rate of acceptance of air as a mode of travel by former "non-fliers," rather than an increase in the number of trips per 'flier.'
By 1955, business travel had already reached a fairly high degree of maturity, and the survey showed that most of the people taking business air trips in that year were already "experienced" air travelers. The 1957 forecast simply assumed that the number of business trips per 1,000 people employed in each business travel cell would continue to increase with the same amount per year as it had done prior to 1955 (it was assumed that the number had been zero in 1935).

Actual experience as demonstrated by subsequent survey findings indicates that some of those assumptions were valid, but others required modification.

Chart VI shows that the "learning" curves pretty much have been developing along straight line declining logarithmic curves, although at a somewhat different slope than initially anticipated.

The assumption of a stable trip frequency for personal trips appeared to be reasonably validated by actual survey results up till the year 1965. The more recent surveys suggest, however, that in certain demographic groups, particularly the younger groups, a sizeable increase in trip frequency is occurring, possibly as a result of promotional "youth fare" plans (Chart VII). The most recent forecast incorporates an adjustment for these changes on the assumption that such promotional fares, in one form or another (of equal impact), are here to stay and that their long range impact will spread through the air traveling population.
With respect to business travel frequency, every survey since 1955 has shown that, within each business travel cell as defined by occupation, industry and income, there is a strong tendency for the number of air trips per 1,000 population to stabilize (Chart VIII). This should not be interpreted to mean that business air travel has not grown over the past 15 years. The population in the high travel business cells has increased substantially (particularly with respect to income), and thus, up till now, business travel has managed more or less to hold its own in the air travel market. (a)

Problems an approach like this has to contend with, are those of sample size and sampling variability. The high air travel propensity groups, by definition, find only a relatively small representation in a household survey drawing a cross section sample of the total U.S. population. Moreover, surveys of this nature are costly in any case, and procedures for over sampling the high travel groups usually strain the budget limitations of most forecasters.

At least two approaches offer some relief to this problem. One is to subject the survey data to a regression analysis of one form or another to determine significant relationships between air travel and economic/demographic characteristics on a statistical basis. (b) A second one is to consolidate data from successive surveys. If it may be assumed that no significant trend

(a) Part of the leveling off of the trend in business travel frequency should undoubtedly be attributed to the shortcomings of income as an indicator over time of people's level of responsibility in a business organization. Besides the problems of inflation of dollar incomes, the continued increase in the general level of real income per capita over time also tends to bring more and more people into higher income groups without a commensurate increase in business responsibility, and therefore, business travel propensity. Nevertheless, under the assumption that this trend, implicitly included in the survey data in the past, is to continue in the future, the procedure should produce an acceptable forecast of future business air travel volumes.

developed over the period under observation, this may take the form of simple averaging. If trends are evident, trend estimates in most cases will represent more reliable estimates than those provided by the individual survey observations.

A long range air travel forecast should not only concern itself with travel trends within the present demographic and economic groups but also should take into account changes in the socio-economic structure of the population which are expected to take place in the future. Here, the Port Authority relies primarily on the many forecasts prepared by experts in each field, such as population projections and projections of age distributions and education levels by the U.S. Census Bureau, labor force projections by the U.S. Bureau of Labor Statistics and economic projections by government bodies and private organizations.

Those familiar with these data sources will recognize that the combination of the various population data into a format which meets the requirements of the Port Authority air travel forecast (the "cell" format) sometimes poses problems and requires some approximations in the details. Nevertheless, it is felt that the data are fully adequate to arrive at a projection of the future air traveling population, even though various travel cells may continue to pose statistical problems. As an example, a table is attached from the 1957 forecast report which shows the initial breakdown of the personal travel market population into 134 cells.

By applying the data on air travel experience and air travel frequency to the projected future population for each travel cell, the future trip generation for all cells (essentially sub markets) can be estimated (Chart IX). It should be mentioned that to the extent that individuals are moving up the socio-economic ladder, which is primarily through age, increasing income and, to a lesser extent, continued education, the forecast assumes that they adopt the air travel characteristics of the socio-economic cell into which they move.
In combination, the total of these cell estimates produces a national air travel forecast in terms of the number of trips to be taken in the forecast year.

The most recent Port Authority forecast which was prepared in 1968 and based on data through 1967, indicates that by 1980 the "U.S. non-institutional population of 18 years and over" (the population covered by the national travel market surveys) would generate:

- 94,000,000 personal domestic air trips
- 45,000,000 business domestic air trips
- 139,000,000 domestic air trips

After an adjustment for air travel by population groups not included in the surveys, such as children under 18 years of age, servicemen living on post, etc., this number should represent some 165,000,000 domestic air trips by 1980.(a) As almost all domestic air trips are round trips, this equates to some 330,000,000 domestic passenger enplanements at all continental U.S. airports, which represents a more than doubling of the 150,000,000 U.S. enplanements reported during the last couple of years (Chart X).

The principal merits of the market research approach outlined are two-fold:

First, it enables the forecaster to identify in considerable detail which market segments have generated most of the air traffic growth in the past. By inflating the survey data to reflect the total U.S. population in actual numbers in the survey year, it is possible to find the approximate representation of each population component in the air travel market in any given survey year and, from the changes over time, to determine which segments have contributed most of the traffic growth.

(a) The 1968 forecast was reviewed in 1970 when new survey data for the year 1969 became available. The new data appeared not to warrant changes in the 1968 projections. A new travel market survey is planned for the second half of 1972.
Secondly, the approach enables the forecaster to identify which market segments offer the best prospects for further traffic growth and which markets don't. The growth markets of the past do not necessarily constitute the growth markets of the future. The very fact of their rapid growth may indicate an approaching level of saturation, limiting the potential for future growth. Other markets will have a limited growth potential by the very nature of their composition such as low income, low education levels, less mobile occupations etc.

The forecaster's objective should be to identify those markets which, because of their demographic and economic composition and their stage of development, offer the best opportunities to produce the traffic growth of the future, and to measure the most likely magnitude of that growth.

A weak point of the "model" is that it does not include any explicit expression of past or expected changes in air fares or some other measure of the cost of air travel. This does not mean that it does not recognize the effect of such changes or assumes no changes in the future. As all observations on the growth of air travel in the various market segments (cells) were taken under varying levels of air fares and other cost elements, an extrapolation of the trend in the observed data does mean that the forecast implicitly assumes some kind of a continuation of the past trend in the cost of air travel (depending on the "shape" of the extrapolation).

A similar comment could be made with respect to the trend in improvements in service such as reduced travel times, greater dependability, improved comfort etc. Also here, the implicit assumption is that such improvements will continue to occur more or less at the same rate as they occurred in the past (again, depending on the shape of the extrapolation). If anything, one may be tempted to characterize this at the present stage as an optimistic assumption.
Some Econometric Approaches

It is especially the lacking of an explicit price factor in the market research method, as it now stands, that has led the Port Authority to explore some avenues of the more conventional econometric techniques as supplementary forecasting tools.

Chart XI shows the results of a (percentage) first difference regression analysis ("delta-log-model") to deseasonalized quarterly U.S. domestic passenger miles data over the period 1949-1969. As variables, this particular model includes (deflated) national income, (deflated) average yield per passenger mile and a (logistic) trend. The analysis also provides for distributed lags of the "Almon" type for the income and price variables.

Even if a "first difference" formulation is in the first place a short term forecasting tool, it is helpful in evaluating observations in any individual year in their relationship to the long range trend as it attempts to determine which part of the fluctuations in the growth rates is caused by short term fluctuations in the economy and changes in air fares (it is recognized that first difference models may have "bias" problems). This is particularly helpful in evaluating more precisely specific observations in each of the successive market surveys as to their meaning in relation to the long range trend.

Chart XII shows the results of a logarithmic "level" (rather than first difference) equation, including the logs of (deflated) GNP per capita and average yield per passenger mile, a trend and three quarterly dummy variables. It also provides for distributed lags of the "Almon" type for GNP and air fares. Whereas a "first difference" model may have bias problems in the estimation of
of the coefficients, a "level" model in a case like this has to contend with the familiar problems of inter correlation between variables. The values of the coefficients and standard errors appear, however, acceptable and the overall "goodness of fit" is extremely good ($R^2 = .99$).

An equation like this is in the first place, again, most helpful in evaluating short term observations in their relationship to the long range trend, where one probably could live with some multicollinearity problems.

One is, of course, easily tempted to make a long term projection on the basis of an equation of this kind. Although multicollinearity problems should be recognized and the risk they involve for long term projections, it is encouraging to find that under two alternate assumptions with respect to GNP growth (high: 5 per cent annually, low: 4 per cent) and with respect to the future level of air fares (optimistic: 3 per cent reduction annually in constant dollars; pessimistic: constant level in constant dollars throughout the forecast period), the 1980 forecast level ranges between 459 and 284 million passengers (Chart XIII). Although the wide margin between the two estimates is concerning, it is at least reassuring that the high and the low estimates bracket the results of the market research approach. It appears that by now the data base for both methods is sufficiently broad that they produce results in the same general area.

Basically, the present status can be summarized as follows:

The market research approach deals explicitly with considerable detail

(a) This assumes an increase in average length of passenger trip of 12 per cent over the period 1970-1980.
in socio-economic and demographic trends but lacks explicit expressions for short term fluctuations in the economy and for the cost of air travel.

The most commonly used aggregate econometric approaches, on the other hand, deal explicitly with aggregate economic indicators and with the level of air fares, but lack the significant socio-economic and demographic detail which in long term projections may be of overriding importance.

Obviously, a promising avenue for further development work in the area of forecasting techniques would appear to be to search for some merger of methods which employ aggregate economic data and data on the cost of air travel as well as socio-economic and demographic data as developed by travel surveys.

One such approach which the Port Authority is currently pursuing is to analyze historical trends on principal New York routes (city pairs) using both regional economic data and demographic and socio-economic data on air travelers on such routes as collected in the Port Authority in flight surveys. This work has, however, not progressed far enough that results can be reported at this time.

The Port Authority of New York and New Jersey Aviation Economics Division
July, 1972
Seven Surveys Show Similar Relationship Between Selected Characteristics And Flying

EXPERIENCED FLIERS AS PERCENT OF TOTAL POPULATION

### Relationship Between Ages And Flying

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### Occupation And Flying

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### Education And Flying

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### Income And Flying

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<tr>
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</table>
CHARACTERISTICS AND TRIP FREQUENCY
(Personal Trips per 1000 "Fliers")

AGE AND TRIP FREQUENCY

0 200 400 600
18-24 25-44 45 +

INCOME AND TRIP FREQUENCY

0 200 400 600
UNDER $3,000 3,000-5,999 6,000-9,999 10,000 + OVER

EDUCATION AND TRIP FREQUENCY

0 100 200 300 400 500
NON-HIGHSCHOOL  H.S.

OCCUPATION AND TRIP FREQUENCY

0 100 200 300 400
PROF. MG'L  CLERK, SALES  FARM  HOUSEWIFE, ETC.
Characteristics And Business Trip Frequency

BUSINESS TRIPS PER 100 ADULTS

INCOME AND TRIP FREQUENCY

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INDUSTRY AND TRIP FREQUENCY

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OCCUPATION AND TRIP FREQUENCY

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<td></td>
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</tr>
</tbody>
</table>
Occupation

100% over Professional, Technical

50% over Clerical, Sales

10% over Over Age

Education

100% over High School

50% over Non-High School

10% over Education

Income

100% over $0-$2,999

50% over $3,000-$5,999

10% over Income

Over Age

100% over 18-24

50% over 25-44

10% over 45 & Over
A constant percent decrease in non-fliers is a declining percent growth in fliers...
Recent Survey Findings Show Increased Trip Frequencies Particularly in Youngest Age Group.
RECENT SURVEY FINDINGS REFLECT RELATIVE STABILITY IN BUSINESS TRAVEL FREQUENCY.
FOR --- A PERSONAL CELL, 1975 ---

2,068,000
\[ \times 75\% \]
\[ \text{Number of people in population.} \]

1,550,000
\[ \times 268 \]
\[ \text{Number of fliers.} \]

415,000
\[ \text{Round trips per thousand fliers in year.} \]

\[ \text{Number of trips.} \]
COMBINATION OF UPDATED POPULATION "CELLS" AND NEW TRAVEL FACTORS YIELDS ESTIMATED DOMESTIC AIR TRIPS BY SURVEY POPULATION IN 1980...

\[
\frac{94,000,000}{45,000,000} = \frac{139,000,000}{164,000,000} \times 2 = \frac{328,000,000}{ENPLANEMENTS}
\]

ADJUSTED TO INCLUDE ALL DOMESTIC TRAVEL
U.S. PASSENGER MILES

\[ P = 6.24 - 0.62t + 0.30t^{-1} - 0.09t^{-2} - 0.02t^{-3} - 0.06t^{-4} - 0.04t^{-5} - 0.01t^{-6} - 0.07t^{-7} - 0.14t^{-8} - 0.19t^{-9} - 0.19t^{-10} - 0.13t^{-11} \]

\[ + 0.63t - 0.28t^{-1} - 0.07t^{-2} - 0.03t^{-3} - 0.04t^{-4} - 0.00t^{-5} - 0.06t^{-6} - 0.13t^{-7} + 0.16t^{-8} + 0.12t^{-9} \]

\[ - 0.004t + 1.38 \]

\[ \text{Sum} = -1.61 + 1.38 \]
U.S. PASSENGER MILES

Actual
Forecast
<table>
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<th>Total Passenger Mi.</th>
<th>Number of Passengers</th>
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<td>529.2</td>
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Table IV-2 Long-Term Forecasts
By way of an outline, I would like to mention the administrative framework of the Civil Aeronautics Board, the type of cases that fall within the purview of the Board's jurisdiction, and then discuss in some detail a few specific cases in terms of a civic party's participation.

The Board itself is composed of five members who are appointed by the President and confirmed by the Senate. No more than three can be from any one political party and they are appointed for six-year staggered terms. The six-year terms are not really as firm as they sometimes appear. When I first became involved in the Civil Aeronautics Board work back in late 1967, John Crooker was Chairman of the Board. Under some political pressure, however, he resigned shortly after President Nixon came into office.

The Board itself is composed of five major bureaus: the Bureau of Accounts and Statistics; the Bureau of Economics; the Bureau of International Affairs, which is intimately connected with bilateral treaties; the Bureau of Enforcement; and the Bureau of Operating Rights. The Bureau of Operating Rights, in proceedings before the Board, represents the public interest. The private, profit-motivated sector of the economy is represented in effect by the airlines. The geographic areas are represented by civic parties such as the Massachusetts Port Authority and the Bureau of Operating Rights participates in all of these cases representing the public interest. They are an active party just the same as any airline or just the same as any civic group.

In terms of the types of cases that the Board hears, there are
essentially three types: (1.) merger or acquisition cases, which are according to priority in the terms of the Federal Aviation Act of 1958; (2.) route proceedings; and (3.) rate proceedings. The overwhelming majority of cases which civic parties have been involved in are route proceedings. Over the last four years that I've been involved in cases before the Board, we have been involved in all three types of cases and to that extent I would like to direct just a few brief remarks to rate proceedings and to merger cases and then get into route proceedings.

In terms of rate proceedings, generally speaking, civic parties do not become involved with rate proceedings before the Board. This is left to the airlines, the Bureau of Economics, and the Bureau of Operating Rights. The Massachusetts Port Authority and several other civic parties have, however, participated in recent rate proceedings. This participation was essentially one of low profile, wherein we urged the Board to approve rates which would assure a sufficient rate of return to airlines so that the industry would remain viable and thereby be able to provide the type of service that is needed in the various markets. Beyond that general participation, the only other case that I can think of of recent vintage that we were involved in was the North Atlantic Air Cargo Rate Investigation, which is still pending before the Board. This case involves the question of Transatlantic Cargo rates. The Massachusetts Port Authority has actively participated in this case, urging that rates be based upon mileage rather than a common rating type approach because Boston is
closer in terms of mileage to most of the European points than other East
Coast Gateways.

We at the Massachusetts Port Authority have been actively in-
volved in several merger proceedings over the last several years and I do
think it would be appropriate to comment briefly on these. Specifically, the
five merger cases that we've been involved in are the Northeast-Northwest
merger case, the Northeast-Delta merger case, the American-Western mer-
ger case, the Allegheny-Mohawk merger case, and the National-Northwest
merger case. I think that for purposes of our discussion we can group these
into two areas. On the one hand there is Northeast-Northwest and Northeast-
Delta, and on the other hand Allegheny-Mohawk, American-Western, and
National-Northwest. In the latter group, we became involved and participated
in all three of these cases on a somewhat lower profile than we became involved
in Northeast-Delta and Northeast-Northwest. Allegheny, Mohawk, National,
Northwest, and American all serve Boston. We became involved in this later
group of cases because if these mergers became effective, there would be sub-
stantial service benefits accruing to Boston. This would result because of the
combination or tacking of the route systems such that Boston would get new or
additional one-stop service or first or additional single carrier authority. We
became involved and we participated by way of statements of position to the
Board. Now the Northeast-Northwest and Northeast-Delta cases were quite
a bid different. Northeast is the only trunkline carrier with Boston as its home
base. It leases a substantial amount of space at Logan International Airport and has a large labor pool in the Greater Boston area. Northeast has for years been in serious financial condition. While there are a lot of arguments as to what precipitated this, I think a great deal of it can be traced to its route structure, which is essentially a seasonal type of route. It has New England-Bahamas, New England-Florida, and more recently, New England-Bermuda authority. When the Northeast-Northwest merger case came before the Board, the Massachusetts Port Authority actively participated and, I think, aggressively participated and filed extensive exhibits and spent a great deal of time and money in its participation, urging approval of this merger for essentially two reasons: (1.) because Northeast would be saved financially by the merger, with its route structure preserved and its labor pool preserved to some extent; and (2.) because Northwest would be certificated to serve Boston. Over the last few years, Northeast had cut back employees, service, and even stopped serving a lot of smaller New England communities. It was obvious that it was going right downhill and that it was in need of some type of help. For this reason we urged the approval of the merger. In addition, Northwest is a strong, financially sound carrier and it would provide substantial service benefits to Boston. It wasn't long after the Northeast-Northwest merger case was filed before the Board, however, that the Miami/Los Angeles route of Northeast was brought into sharp focus. The Miami/Los Angeles route was awarded to Northeast Airlines in the Southern Tier Route Investigation, which was a route proceeding
before the Board. One of the issues in the Southern Tier Investigation was which carrier would be authorized to provide non-stop Miami/Los Angeles service. There were several applicants, including Northeast, Delta, and Continental. At the hearing before the Board, the Hearing Examiner recommended awarding this route to Continental Airlines. At the Board level, however, the Board reversed the Hearing Examiner and awarded the route to Northeast Airlines on the basis of a route strengthening argument. This idea of a seasonal nature of Northeast routes is one that was pretty well accepted and it was argued on behalf of Northeast that if they could get this major East/West route, they would be able to make it on their own two feet. During oral argument before the Board, Counsel for Northeast Airlines was asked by one of the members whether or not they had any intention to merge and the Counsel replied that they had merger intentions and they felt that if they could get this route they would be on their way to financial security. The Board bought the argument and four days after the Miami/Los Angeles route certificate became final, the Northeast-Northwest merger case was announced. The Airlines opposing the Northeast-Northwest merger jumped right into the picture arguing that the integrity of the Board's process required the Board to withhold the transfer of the Miami/Los Angeles route to Northwest. At the pre-hearing conference stage it became obvious that one of the issues was going to be the question of whether they were going to transfer the Miami/Los Angeles route to Northwest. Northwest, throughout the course of the case continued to emphasize the fact that the Miami/
Los Angeles route was an integral part of what they bargained and negotiated with Northeast for and without this route they were not interested in the merger. In the Authority's participation, we tailored our presentation to urge the transfer of this route to Northwest for reason that we were taking Northwest representation at face value and that without the transfer of this route there would be no merger. Throughout the entire case, Delta was standing in the wings maintaining that they were the most appropriate merger partner for Northeast and that they were ready, willing, and able to merge with Northeast. It came down to the wire and the Board approved the merger, but withheld transfer of the Miami/Los Angeles route. Northwest held true to its word and walked away from the merger, so it fell through. Then along came Delta and a merger was negotiated and has been approved by the Board and the President. We also participated in that case extensively.

Q. Who got the line?
A. The route has not been transferred. It has been withheld, but when Delta and Northeast negotiated their merger, it was specifically provided that they would accept the merger without the Miami/Los Angeles route.

Q. Who's flying that route?
A. I don't believe anyone is right now. That route has been withheld and there is going to be a further proceeding before the Board to determine which carrier is going to be certificated in this market. Throughout the case, Delta pushed for the route and argued that they should get it even on an interim
basis, pending subsequent hearings before the Board. But, the merger has been approved and Delta is going through with it.

In terms of Boston, I think we benefited greatly because we not only got Northwest by way of another case, but we also got Delta and Delta and Northwest are probably two of the strongest financially sound airlines going, plus they serve major areas of the country, wherein Boston previously had serious service deficiencies. Delta is in Boston by way of this case and Northwest is into Boston by way of the Twin Cities-Milwaukee Long Haul Investigation.

This case brings up another matter that I just want to briefly touch on because it has to do with an exception to participation by civic parties in cases before the Board. Generally speaking, civic parties are in route proceedings before the Board, argue only the need for new and/or additional service. The Board is not interested in having a civic party come in and push a particular carrier. That is left up to the airlines. The Twin Cities-Milwaukee Long Haul Investigation was an exception as far as Boston was concerned. At issue in this case, among other things, was the question as to whether or not the Board was going to authorize non-stop service between Boston-Milwaukee and between Boston-Twin Cities. The Authority's participation in this case, which was once again quite extensive, urged two things: (1.) that there should be such non-stop service in these markets; and (2.) that Northwest Airlines, as the carrier in this market, thereby deviating from the Board's philosophy that
civic parties stay out of the area of carrier selection, can all be traced to the famous or infamous Trans-Pacific Route Investigation. Back in 1961, the first Trans-Pacific route case took place. At that time, a hearing was held and substantial findings were made by the Hearing Examiner. Boston was, in effect, awarded its first direct access to Japan and the Orient. In any route awards that involve service to foreign points, the President must approve the award and the President, in this first Trans-Pacific route case, disapproved with minor exceptions, the entire international phase decision in that case for foreign policy reasons. Then, along in the late 1960's comes the second Trans-Pacific Route Investigation. It was probably the largest route proceeding in terms of numbers of parties, hearings, poundage of exhibits filed with the Board, and whatever other standard you wish to use. After the hearing, Boston was recommended for its first direct service to points in the Pacific on Northwest's System, including Japan, Korea, Okinawa, Taiwan, Hong Kong, and the Philippines. Boston was recommended for its first direct service to the South Pacific, American Samoa, Australia, the Fiji Islands, etc. on Eastern Airlines. This was the high point as far as Boston was concerned in this case. The Board deleted Northwest at Boston on the theory that Northwest did not currently serve Boston and it would be a financial burden to establish a station there.

Q. How can the Board make such a decision when truly Northwest has such reasonable management and ought to know what it's doing? The Board seems to be acting as a kind of parent.
A. Well, the Board has the statutory authority to determine such issues. Their statutory mandates are to promote, develop, encourage Civil Aeronautics and they have control over the rates and over the routes. The parties come before them in an adversary process to try to put forth their positions and, of course, there is the necessary self-interest contained in all of these positions. The balanced system envisioned by the Federal Aviation Act is theoretically based upon the Board's independent decisions in such instances.

Q. Are they in fact saying that the Northwest management is incompetent?

A. No, I don't think they were saying that. I just think that they consider that Northwest, like all other carriers, are anxious and aggressive in seeking to get new routes and that there are considerations that transcend the basic route strengthening desires of the airlines.

The Board also changed the award to Eastern and gave it to Continental and Boston once again lost out because Continental doesn't serve Boston. So, for reasons completely unrelated to what we felt was an assessment of the service needs of the Boston area, Boston had lost these two route awards. When the award was made to Continental and was approved by President Johnson, it was just before the end of President Johnson's term in office. There is a 21 day period to file petitions for reconsideration with the Board and of course these 21 days overlapped the change of administration. President Nixon reopened the entire South Pacific and Central Pacific phases of the case,
so it started all over again with briefs and arguments before the Board. Boston did not make out any better during these subsequent phases, however. This gives you the background reason that Boston supported a particular carrier (Northwest) in the Twin Cities-Milwaukee Long Haul Investigation. What Boston lost in the Trans Pacific case would be regained in large measure if Northwest came into Boston on the Twin Cities case, because it would open up to Boston the entire Pacific system of Northwest.

Another area that civic parties can get involved in is bilateral treaties. Before a carrier can serve a foreign point it must have authorization by way of a bilateral treaty with a foreign nation. Once such a treaty is approved, there is a proceeding before the Board to determine what specific carrier flies that route. The Authority has become involved in this in a couple of instances and the one that seems to come most significantly to mind is the Boston-Toronto market. This is a major market in terms of Boston O & D passengers and yet there is no non-stop service in this market. We took the initiative back in 1969 when there were scheduled U.S.-Canadian Bilateral Treaty Negotiations coming up. The two arms of the government which are involved in this are the Bureau of International Affairs of the Board, which is one of the five bureaus that I mentioned before, and the Department of State, the Division of Aviation. What the Authority did as a civic party was to file an application with the Department of State and the Civil Aeronautics Board documenting the need for service on a non-stop basis in the Boston-Toronto market. We submitted direct
exhibits similar to what we were doing in regular route proceedings before the Board. After the Bureau of International Affairs and the Department of State receive all this data and their own input from their own staffs, they review these and make their own analysis and draw up a list of markets which they seek authorization for when the treaty is negotiated. The Authority filed its application in March or April of 1969. Treaty negotiations have been one of these on again-off again type of things. They convene and then recess and reconvene and I think they are scheduled to reconvene once again in August. We don't care if the carrier authorized is a U.S. or Canadian carrier. We are only looking for the service and if Boston-Toronto is included in this treaty for non-stop service, then there will be a proceeding before the Board solely to determine what carrier should fly this route. We would, by way of token representative, participate in that because of our participation at this level and once again we would not care which carrier flies the route. Route proceedings are the next area I would like to discuss. Any carrier wishing to fly interstate scheduled air service, unless it's an air taxi, needs a certificate of public convenience and necessity from the Civil Aeronautics Board, in accordance with the Federal Aviation Act of 1958, as amended. There are guidelines which have been put forth by the Board and which are used by civic parties, as well as airlines, in terms of deciding when and how to argue the need or lack of need for non-stop or any other type of service in a particular market. The guidelines essentially are 50 O & D passengers per day in any
market and the Board will consider the need for non-stop service. With 100
O & D passengers per day in any market the Board will consider the need for
competitive non-stop service in the market. Both of these standards arose by
way of Board decisions and while the Board says these really aren't standards
but only general guidelines, they are nevertheless what is used by parties be-
fore the Board in urging various types of service. O & D passengers, a sta-
tistic I've mentioned several times, are origin and destination passengers.
In its simplest terms, if I were to fly from Boston to Washington and back
again in one day, then I would appear as two Boston-Washington O & D pas-
engers. Boston is in somewhat of an anomalous position in terms of origin/des-
tination passengers because of the proximity of New York and the air shuttle
service. We continually argue to the Board why Boston's O & D traffic in any
particular market is substantially understated to the extent that many Boston
passengers will utilize the shuttle service to New York and then take the ser-
vice out of New York. For example, if I'm going to Chicago and I go to New
York on the shuttle and then catch a New York-Chicago flight, I appear in terms
of O & D traffic only as a Boston-New York passenger, and I appear in terms of
the Chicago market as a New York-Chicago passenger, so Boston, in a sense,
does not get credit for that Boston-Chicago passenger in the O & D traffic
surveys. I'm not sure whether this is an advantage or disadvantage because
we take a position in case after case that Boston's O & D traffic is understated
because of the number of people using the shuttle service. In terms of deciding
when to participate in any particular case, and the type of service that we're seeking. Boston, as do most major civic parties employs economic or airport consultants. Boston has for some time utilized the firm of Landrum & Brown of Cincinnati, Ohio. They have prepared for Boston, back in 1965, a Boston Master Air Service Plan, which is an analysis of most of the domestic market in the United States in terms of the levels of service in 1965, the projected levels of service in subsequent years down the line, what is anticipated, what we should have, what we want to have, and so forth. This Plan has been updated on at least one occasion. This Master Air Service Plan is not always the determining factor as to whether or not we jump into a particular case, but it is a guideline. However, in many cases, especially the more important ones and more significant ones, we have utilized Landrum & Brown to prepare our direct exhibits.

Sometimes the mere inception of a case is sufficient to get the desired service results from a particular carrier. An example is the Boston-Bermuda Service Investigation, which was going on back in 1968. In this case at issue was whether or not a second carrier should be certified to provide non-stop service in the Boston-Bermuda market. At the time, only Pan American provided service in this market. The overwhelming number of Boston passengers in this market were either honeymooners or vacationers going to Bermuda. In terms of flights, Pan American had one a day, which left at something like 4:15 in the afternoon. This was inconvenient because passengers going down
there would waste a day. They would arrive down in Bermuda at 6:30 p.m. or so and by the time they got to the hotel or wherever they were going, it would be too late to really do much of anything. Pan American wasn't overly interested in these considerations, for the simple reason that they were the only carrier in the market and they felt that if you wanted to go to Bermuda, you were going to take their 4:15 p.m. flight. All of a sudden, once the case started, and with no major announcement, Pan American started flying two flights a day, adding an early morning flight. Their somewhat belated efforts didn't pay off, however. A second carrier was certified to provide non-stop service in the market.

Route proceedings frequently start with an application to the Board by a carrier for additional service rights or for the removal or restriction on one of their routes so as to provide new and/or improved service in a particular market or markets. This route application can sit with the Board for what seems like years. Whatever criticism is leveled at the Civil Aeronautics Board, and there is some from time to time, I can assure you that it is entirely unfounded to the extent that it says that the Board acts irrationally or without sufficient time to consider the issues. Often, an application of this type is accompanied by a Motion for Expedited Consideration. This is acted upon by the Board with somewhat more dispatch and oftentimes civic parties will jump into the case by way of an Answer to Motion for Expedited Consideration. The case that comes to mind, as far as Boston goes, was an application
filed by Pan American about a year and a half ago, to remove certain restrictions from their Latin American route certificate which would provide improved service in certain Latin American markets for Boston area passengers. Pan American accompanied the application with a Motion for Expedited Consideration. There is a provision that any interested party can answer such a Motion in seven days. The Authority filed an Answer supporting the Motion on the basis that there would be improved service if this relief were granted. The Board granted the Motion for Expedited Consideration, but in so doing they reduced certain points or eliminated certain points from being at issue in the proceedings and in effect, eliminated from the entire proceeding the service benefits as far as Boston goes. The Authority's participation in the case concluded therefore.

Once the Board sets down a case in terms of the civic parties situation, there are three possible sets of circumstances: (1.) The civic party is specifically made a party at this stage. There is nothing further to do at that point until the pre-hearing conference; (2.) Boston, for example, would be mentioned as one of the city pairs at issue in terms of new authority, but the Massachusetts Port Authority is not made a party to the proceedings. We have to file a petition for leave to intervene, which is in effect a request that the Board permit the Authority to become a party in the case; and (3.) The route proceedings set down for investigation do not name your city as the city pair point, but it is pretty close and it is arguable that relief could be granted
in that type of investigation. The civic party will then file a petition for leave to intervene and a motion to expand or modify the issues to bring that particular city into issue in the proceedings. The next step in the process is the pre-hearing conference. To my knowledge the Civil Aeronautics Board was the first administrative agency to make use of this proceeding and I know that there is a similar procedure now in the Federal Courts for a pre-trial conference. This is a very useful vehicle. In essence it's an informal hearing, so to speak, before the hearing examiner. The hearing examiner sits as judge, so to speak, in these cases. When the case is set down for investigation, it is assigned to one of the hearing examiners and he stays with it for the entire case. Prior to the pre-hearing conference, the Bureau of Operating Rights sends out to all the parties a document which lists what the Bureau feels are the issues. They also list what they feel are appropriate information requests. These are requests for information from the various parties, be they airline applicants or civic parties. Any party has a right to comment on this submittal by the Bureau or submit their own suggested issues or their own recommended procedural dates or their own requests for evidence. When the parties sit down before the hearing examiner at the pre-hearing conference in Washington, the hearing examiner usually uses the submittal of the Bureau of Operating Rights as a guideline, goes through it, the parties argue about it, and the Examiner decides what the issues are going to be. The issues really establish the outside guideline of the case. If what you seek introduced in evi-
dence is not relevant to the issues in the case, it will be excluded. If you want to put forth some position, therefore, you have got to make sure that it is covered by the issues in the case. It is my impression that a great number of civic parties do not make sufficient use of the pre-hearing conference. For example, there are oftentimes boiler plate requests for evidence for specific areas, which in many cases don't apply to the larger cities. They want to know the capacity of the airports, etc. Oftentimes civil parties waste money, time, and effort in furnishing information that no one really needs.

Following the pre-hearing conference is the report of the pre-hearing conference. This is the decision by the hearing examiner with regard to the issues, the requests for evidence, and the procedural dates.

Next comes the exchange of information responses. Once again these are requests that parties are required to comply with supplying information. It is a very useful vehicle for civic parties. If you are interested in getting some data from an airline, specific or otherwise, you seek the hearing examiner to include this in the pre-hearing conference report and if he does, then the airline has to provide you with the data. Often this is very helpful in terms of putting together your presentation.

After the exchange of information responses comes the dates of direct exhibits. This is really the crux of the case as far as civic parties are concerned. Whatever argument you want to make in terms of service needs
has to be based upon the evidence submitted at the hearing. If you want to argue the need for service in a particular market, you've got to make sure that you get into your direct exhibits sufficient data to back up the needs of this service.

Following the exchange of direct exhibits comes a date for rebuttal exhibits. This is an opportunity to rebut by direct exhibits so to speak, any particular exhibit or exhibits of parties. This exhibit must specifically rebut another party's exhibit and you have to specifically mention what exhibit you are rebutting.

Next comes the hearing, which differs in some respects from a trial in that there is no direct testimony. What you do is you bring to the hearing the individual or individuals who prepared your direct exhibits. He gets on the witness stand and testifies as to who he is and what his background is and that he prepared these direct exhibits either directly or that they were prepared under his supervision and that they are true and correct to the best of his belief. Then the witness is made available for cross examination.

Essentially, the hearing is comprised of cross examination of witnesses with regard to their direct exhibits. There is a provision in the rules of practice before the Board for accepting into evidence a party's direct exhibits without the need of a sponsoring witness, but to do this, you must file an affidavit at the time of the exchange of direct exhibits, setting forth the fact that the direct exhibits were prepared under the witnesses' direction and are true and correct.
to the best of his belief. Also, a formal request that the direct exhibits be accepted into evidence without the witness being at the hearing must be made. This, of course, serves several uses or functions. On a pragmatic basis, it saves you the expense of bringing the witness to Washington. In a theoretical sense, it saves you potential embarrassment in having any weaknesses in your direct exhibits pointed out. If any party objects to such a procedure, all they have to do is file a notice and you have to bring the witness to the hearing.

Following the hearing, the hearing examiner sets a date for briefs. This is where you make your substantive argument. This is where you argue the need for service based upon your direct exhibits and other evidence in the record. After the briefs are submitted, the hearing examiner comes down with a recommended decision or an initial decision and then the parties have a period of time in which to file exceptions or objections to this decision. Following the exceptions, the parties file briefs to the Board and then oral argument is scheduled before the Board. Following this oral argument, the Board makes its decision.

I have just three or four more brief points before I close and I will be available for any questions. One of them is that there is a provision in the rules of practice before the Board, for what is known as Rule 14 Participation. Any party can participate under Rule 14 by merely showing up at the hearing and presenting a statement of position. That is the extent of your participation, however. You have no right to participate in the hearing, to file a
brief to the examiner, no right to participate in oral argument. Many civic parties do use procedure just because they employ Washington counsel and find that it is too expensive to participate all the way down the line and they just want to get into the record, so to speak, with their statement of position.

There is also a show cause order which is a relatively new procedure before the Board which permits an airline to file an application for a show cause order, whereby the Board would send out an order directed to any interested parties requesting that they show cause why a route restriction should not be lifted. An example of this is Allegheny Airlines following the consummation of their merger with Mohawk, has filed an application with the Board for a show cause order, seeking to consolidate thirty-three individual segments on their Route 97 into one combined segment. The effect of this as far as Boston is concerned is that it would provide new non-stop service between Boston-Louisville, Boston-Toledo, and substantial new one-stop service. This filing by Allegheny was accompanied by a motion for expedited consideration. We are filing tomorrow an answer in support of both the motion for expedited consideration and the issuance of the show cause order. This is a useful procedure and can sometimes be accomplished so that relief can be granted without the need for a hearing; provided no one strenuously objects.

The last point I want to touch upon before closing is what can you do in terms of service improvement for a civic party. I think, first and most obvious is to go to the airline certificated to provide the service you're interested
in. You might want more service in the Boston-Dallas market. You find that one carrier is authorized to provide this service and you go to that carrier and try to convince it to provide the necessary service. This is not frequently very successful. Larger communities have somewhat of a better chance because they have a little bit more bargaining strength with the carriers who want new space, more space, new terminals, etc. The other two alternatives are for a city to file a petition for the Board to establish a route investigation for that particular geographic area. The only one I know of is Albuquerque. They filed an application which became the Service to Albuquerque case. Beyond this the only thing a city can do is to urge an airline, if the airline is not authorized, to provide service in a particular market, to file an application. One point in this regard is that civic parties have to be very careful in their participation in route proceedings. They cannot jump on any particular airlines band wagon. Any time there is a route proceeding pending, the airlines come knocking at your door and they have in their little briefcases, your petition for leave to intervene, your information responses, your direct exhibits, your briefs to the Board, and even your oral argument. They tell you all the wonderous things they are going to do and they have schedules printed showing how they are going to fly 16 flights out of the city. Any civic party that is seriously interested in participating in proceedings before the Board has to establish some sort of integrity of approach that you're an independent party and that you are only representing your own interest. I can remember attending a seminar out in
Minneapolis, Minnesota two or three years ago, at which time the now Chief Hearing Examiner, Mr. Ralph Wiser of the Board, spoke to the participants regarding one of the very first cases he had with the Board. A civic party filed a petition for leave to intervene and in the petition there were blanks where the city was to have filled in its name. The city, however, overlooked this and filed their petition with parentheses saying (fill in the name of your city). This is something that civic parties have to be careful of in participating in route proceedings.
THE ECONOMICS OF AIR CARGO

and

AIR CARGO MARKETING DEVELOPMENT

Massachusetts Institute of Technology/NASA Workshop

Waterville Valley, New Hampshire

Presented By: John W. Kersey
Division Vice President
Cargo Sales & Services
Eastern Air Lines, Inc.

Dates: July 17, 1972
       July 18, 1972
Air Cargo has been in existence on scheduled carriers on a regular basis for about 28 years - Mail and Express for a much longer period. It's interesting to note that the scheduled airlines of the United States came into being not to carry passengers but to carry mail and later express for American Express, the predecessor of the present REA. Our basic route awards were in fact authorized with the basic requirement that the mail be carried. To this day, mail has priority of accommodation over all other classes of traffic.

In discussing the economics of Air Cargo from the carrier point of view, the first premise is that the combination carriers (that is, those who carry both cargo and mail) really do not know precisely the costs associated with providing a viable cargo service; thus, the debate rages as to the profitability of cargo -- the result, an unwillingness to make commitments to the cargo business as freely as they are made to passenger development.

In spite of the airlines' origins in cargo, as the airline industry evolved, the advantages to the traveler of speed of air became more quickly apparent than to the shipping public, and the logistics of providing service to passengers seemed to be far less complicated than development of a cargo system. A simple example would be that there already were the private car and public ground transportation available to the passenger so that, generally, ways of moving people to and from airports were already established.

On the cargo side, there was no ground transportation available to shippers because the volume of business available when air freight was established would not justify the operation of regular trucking services between the airports and shippers and receivers. Thus, ground transport for cargo was
a logistical hurdle that did not exist, essentially, for the developing passenger market.

Then, too, the passenger market was and is more flexible than the cargo market in terms of availability for carriage. By that, I mean that passengers have varying needs for time of departure and arrival, so that much of a day can be covered with schedules with some assurance that there will be a demand for those schedules, thus providing utilization opportunities for passenger aircraft that have not, until recently, been recognized for cargo. And I parenthetically state that utilization becomes an increasingly dominant economic factor as the aircraft get larger and more expensive.

In air cargo, unfortunately, the shipping public historically has had a pattern of production and order processing that takes place during the business hours, Monday through Friday. Most of their traffic is not available until late each day and their daily shipments are greater in the latter part of each week. Also, there is very little originating traffic available during the weekends.

The end result is a series of peaks and valleys that provide a very difficult logistics problem which has two parts - schedules and manning.

Also, the airline costs and, hence, degree of profitability have been difficult to determine, especially for carriers who transport both passengers and freight.

The economic studies that have been undertaken, have snagged on the problem of allocation of costs as between passenger and cargo operations, which does, in fact, defy easy analysis -- example:

Allocation of costs of crew, manpower, cost and amortization of
aircraft, direct operating cost, i.e., gas and oil on an L-1011 carrying 26,000 pounds of cargo with a full passenger load.

Also, since passenger revenues had so dominated in terms of contribution to total carrier revenues, particularly domestic carriers, a major portion of management time and corporate resources were dedicated to the passenger side, with cargo treated as a by-product.

Incidentally, in international air transport, one major foreign flag carrier derives about 35% of its total revenue from cargo.

Now let's look at the current situation. Managements are becoming increasingly aware of the air cargo product and are asking questions about the economics of carrying cargo for a number of reasons, which include:

- The annual dollar volume of air cargo is more than one hundred million dollars for several airlines, and is fast approaching that volume for others.

- The rate of growth of cargo is substantially larger than passengers and the percentage of cargo to total revenue within the airlines is becoming larger each year.

- With the introduction of wide-body aircraft, which have between 225 and 350 seats, management is looking for revenue which will decrease the passenger breakeven load factor. Air cargo is now looked at as a large potential contributor to reducing the passenger breakeven load factor.
Last year's recession and large losses of the airlines made managements search for all sources of business which contribute to covering airline costs. On some route segments, the full use of the available cargo space can reduce the breakeven load factor by 10 percentage points.

Our most recent studies, done with the help of an outside consulting firm, uncovered the following:

1. Basically, at least one half of total costs are in ground handling; productivity per employee is low, and our ground handling is inefficient. Looking into the reasons for this, we found that we have severe peaks and valleys at freight terminals which are more difficult to control than for motor carriers. For example, the majority of motor carrier vehicles are owned by the motor carrier so it can control its flow into and out of the terminal, thus maintaining a stable flow of traffic. In the trucking industry, there is a standard of pounds handled per man hour of about 3,500 pounds. The airline industry is lucky to get 350 pounds -- 1/10th as much. We in the airline industry do not own our own pick up and delivery trucks and, thus, vehicles arrive and depart our terminals on schedules reflecting historic shipping patterns of our users which is afternoon pick up for evening delivery to the airports -- night time
and early morning arrivals for a.m. delivery. We are testing a system of RDT in New York City to reduce peaking. The RDT system, meaning "Reserved Dock Time", is a simple system whereby we reserve space at a dock for regular shippers of air freight -- including forwarders. We have found this system produces less congestion and more balance of traffic arrivals and departures. More than anything else though, it is the pattern of shipping on the part of our users that imposes the peaking that is so costly to the airlines. This is compounded by the type of labor contracts in existence, which call for eight hours pay, once an employee reports for a shift.

2. We found that there are a substantial number of ways in which to allocate our costs for line flights, paperwork, management, etc. We also found that it was impossible to get complete agreement for one method of allocation.

3. We found that in certain areas where there were much higher costs than anticipated, the responsible department producing these costs were overly critical of the study methods used to determine costs and fought the principles of the study -- rather than analyzing the problems and taking actions to lower their costs.

4. We found that after the consultant left, there was improper update.
Very few actions were taken on the initial cost study performed. Not until the end of last year did we embark on another cargo cost study which, I am happy to state, is producing good results, including the preliminary estimate that cargo is profitable.

Because of the problem encountered in the last cost study, we took the following actions:

1. The new study was performed inhouse, with a small degree of outside consulting.
2. The study was presented to corporate management, rather than department heads.
3. Corporate management agreed that cargo on line flights produces relatively little incremental cost.
4. The effect of allocated charges for overhead and administration was minimized. We did not try to zero in to the nearest percent, the time a person spends in cargo activities.

Some of the conclusions of the study were:

1. That cargo is more profitable on passenger flights than on freighters. (Parenthetically, again -- the ideal all-cargo aircraft is still on the drawing boards)
2. That cargo is more profitable when it is moving to longer haul market, rather than shorter haul.
3. That cargo is more profitable when we receive unitized shipments, rather than non-unitized shipments.
4. That cargo is more profitable when we receive higher weight shipments rather than lower weight shipments.
One of the most important points was that cargo, in total, is potentially profitable on passenger flights. Of course, this raises the question, "is cargo profitable on freighters?" Airline information forwarded to the C.A.B. shows that freighters are unprofitable on a fully allocated cost basis, and that a high breakeven load factor must be achieved before cargo becomes profitable. But, the most important point, as far as economic is concerned, is that freighters, marketed properly, generate traffic for the total fleet. As a simple example, there are freighter segments, New York to New Orleans/Houston, where on most days, the amount of cargo brought out for freighters exceeds demand. Thus, the traffic which cannot be boarded on freighters because of weight or space limitations, is "forced" on to passenger flights. Also, the New York shippers who bring traffic out to the New Orleans/Houston freighter do not like to make a large amount of costly stops at various airlines, and thus tender the freighter operator traffic for the many destinations the carrier serves. Therefore, on a direct cost basis, the New York to New Orleans/Houston freighter may not produce a profit; but, the generative effect of the freighter producing traffic for combination flights over the same segment, as well as many other segments, yields a substantial amount of incremental revenue to other flights.

Whether the airlines make money or not is not the key questions of the economics of air cargo. The primary question within the airlines is how do we make cargo more profitable than it is today, and in this way make cargo more economical to the shipper and more competitive with surface modes of transportation.
Tomorrow, when I speak of Air Cargo Marketing Development, I will present some new marketing ideas which we have developed that make cargo more economic for the airlines as well as shippers. But today, let's just look at the areas of reducing the costs of the carriers and making air cargo more economic.

As we look at the economics of cargo within an airline, we will deal with four principal areas, including:

1. Paperwork costs
2. Terminal costs
3. Line haul costs
4. Claims cost

In each of these areas, the air carrier can make major improvements.

**Paperwork**

The cost of paperwork is very high within the airline industry, as well as the entire transportation industry. Consider that when we pick up a shipment, a bill with eight copies is completed. When the packages get to our terminal, lot labels are placed on the shipment if it contains more than one piece. Reserved space or other types of labels are also placed on the shipment in many cases. Special labels showing date of shipment, color coded by day of week, are also placed on packages. Paperwork is completed at transfer stations and at destination stations and documents must be signed when shipment is delivered. But, this does not end the paperwork, because we now get into accounting procedure. We must bill a shipper, in some cases several times; collect his money; send an audit bill through accounting to make sure the proper rate was placed on the shipment and, finally, close out the account for
a particular shipment.

All of this paperwork is expensive and the basic costs do not materially change whether the shipment weighs one pound or 10,000 pounds. This is why we have a high cost for minimum charge shipment. We must establish more simple procedures within the airline industry for paperwork. This is the key way to reducing costs. United Parcel Service has an excellent low cost paperwork system. I believe that the airlines must analyze their procedures and others with efficient warehouse or terminal operations and implement a simpler paperwork system such as that used by UPS. If we do not do this, the paperwork for handling shipments will grow greater each year, especially because people make out the paperwork and the cost of labor keeps increasing every year.

There is advanced technology which is partly on-line now and will be implemented more fully by late 1973 or early 1974 that should provide lowered handling and administrative costs as well as better customer service. Essentially, it is a highly sophisticated communications system tied to data processing, which will provide instant routing and tracing information as well as automatic rating and billing, thus considerably reducing paperwork and attendant costs.

**Terminal Costs**

The more lighter weight packages that an airline handles, the higher the costs we incur. It takes time to handle each package and we must expedite the answer to reducing labor cost within our terminals through greater containerization or some other form of unitization. Consider an example ---
a truck pulls up to our dock with 100 pieces. We must off-load these 100 pieces. Thus, we have 100 handlings. Later, we place these 100 pieces on a cart. The cart goes to an airplane and we place the 100 pieces on the aircraft. Therefore, at the originating station, we have 300 handlings. Hopefully, the shipment will not transfer at another station where we would have another few hundred handlings. If the freight goes directly to the destination station, we have 100 handlings off-loading to a cart, another 100 staging pieces on a pallet, since we must empty the carts, and then another 100 to place the pieces on to a truck. Thus, from origin to destination, without any transfer, we have 600 handlings.

Consider the shipper who uses one container for 100 pieces. We take the container off the truck, place it on an airplane, take it off the airplane and put it on a truck for delivery at destination station. Thus, we have 4 handlings; a reduction of 596. Believe me -- this saves money.

We all too often look at containerization as reducing handlings of shipments from 100 to 1 piece, but what we are really doing with containers is reducing the handlings from 100 to 1 during many handling steps. Containerization and other forms of unitization, such as palletization, is now growing rapidly, especially because of the initiation of reduced rates for shippers who tender unit loads to the carriers.

While we are speaking of the area of terminal cost, I would like to state that the most grossly unfair practice of all transportation companies is to increase their rates on an across-the-board basis. Rates are primarily raised to pass on increased costs of doing business; mostly, these days, effect of inflation and labor costs.
There are some shippers who tender traffic to the airlines that is highly unprofitable and other shippers who tender traffic to the airlines that produces large profits. Should we increase, by 5%, the cost to shippers who tender undesirable traffic to us, and also increase the cost by 5% to shippers who give us profitable shipments?

We have been studying a new concept in rate-making which is based on the following:

1. For shippers who tender us tonnage with characteristics of two pieces per cwt., we will establish a basic rate.
2. For shippers who tender us traffic with more than two pieces per cwt., each piece over two pieces per cwt. would incur an extra charge of $1 surcharge.

If a shipper tenders us ten pieces for a 500 pound shipment, he will incur the basic cost. If a shipment tenders 15 pieces for a 500 pound shipment, he will incur a surcharge of $5 additional cost.

Thus, the shippers who tender us traffic and incur a surcharge will be paying for the extra handling cost. But most important, he will have an option of not paying this surcharge by consolidating his pieces through containerization, strapping, palletizing, etc., to reduce his piece count. I think this makes sense since this proposal penalizes shippers who raise the costs to the airlines and allows these shippers, as well, to reduce their costs by tendering the airlines traffic which we can handle more efficiently and thus reduce our cost.

At this point, I know that many of you would state that we should just not deal with the characteristic of number of packages but should also concentrate
on density. Generally, we cube out our aircraft capacity before we reach maximum weight. It is important to note that we have a density rule in the tariff that penalizes shippers who tender less than seven pounds per cubic foot domestically and less than nine pounds per cubic foot traffic internationally.

**Line Haul**

We find that the key characteristic is density of traffic. The higher the density, the more profitable the traffic. As an example -- we have freighter planes which can carry 39,000 pounds. We find that we bulk out at between 32,000 and 34,000 pounds and, therefore, lose between 5,000 and 7,000 pounds of utilization per flight. The airlines must attract higher density traffic in order to make cargo more profitable.

**Claims**

I am sure most of you have read about the high cost of claims in the transportation industry. This, of course, is partly because we handle, on the average, higher value shipments than surface, thus increasing exposure. Actions must be taken to reduce these claims. During 1971, Eastern's claims costs were half of what they were during 1970 and during the same time we experienced the highest increase in revenue traffic for any domestic carrier. Two actions we took to reduce claims include:

1. Charging claims to destination station, rather than originating station. This focuses the destination station on proper handling and they communicate with origin stations to make sure the traffic is loaded and handled properly so that when it
arrives at destination station, they are not charged with a claim.

2. We implemented procedures for special handling of high value shipments. We found that by having air freight supervisors and other competent employees watch the loading and unloading of these shipments and follow them to the high value rooms in our terminals, we were able to experience a substantial reduction in cost of claims for these valuable shipments. Claims are a significant part of cost of doing business that can affect both carrier cost and the price charged to the customer.

Today, we are faced with several extraordinary challenges --- getting better utilization from our current aircraft - Eastern alone produces 3 trillion ton miles of belly capacity annually with a utilization of 20%; developing "cargo hour" scheduling; working toward more economical cargo aircraft; achieving better efficiency on the ground.

Tomorrow, in the context of our discussion of Air Cargo Marketing Development, we'll discuss marketing solutions to, particularly, capacity utilization, containerization, and pricing elasticity.
First, let's define marketing as it relates to Air Cargo; better yet, let's define air cargo -- Air Cargo is a service that provides time and place utility to goods - it principally serves the commercial and industrial economies of the world and includes movement of industrial components, manufactured goods, consumer goods and agricultural and horticultural products, almost all of which do not go to the end user. When considering the market development of air cargo in the context of the workshop entirely dedicated to air transport, it is well to keep in mind that passenger service is essentially a consumer product, while cargo is essentially an industrial product. In terms of marketing techniques, then, the passenger product is marketed like other consumer goods such as soap and cereal -- the cargo product should be marketed using industrial marketing techniques similar to business machine and computer manufacturers. In other words, bringing shippers and receivers to the regular use of air, requires an economic justification -- a trade off of higher base costs versus competitive surface forms for which there are overall total distribution cost savings and/or increased sales and profits. Air cargo marketing, just as any other product or service marketing should follow certain patterns.

We feel that marketing should start with a definition of customer wants and needs, which is acquired by research. In a transport industry environment, as opposed to manufacturing industry, this means that the time and place requirements of the prospective user must be first defined and a product created to produce what the market or at least part of the market wants. Unfortunately, for the most part, the cargo product of the airlines has been
essentially a by-product of the passenger product, has not necessarily been
designed based on customer want and need. This approach has produced a
relative ability to produce speed-in-transit far in excess of anything previously
offered in surface transportation - and relative speed of transportation has
proven long since to have varying user values. If speed-in-transit were not
economically significant, and direct cost dominated selection of transportation
mode, then everything moving from New York to San Francisco would still
be on the ocean, since ocean freight carries the lowest rate of any transpor-
tation mode.

So -- As an industrial product, requiring economic justification for
its use, cargo marketing's goal is to demonstrate the profit potential of
spending more money on transportation costs but achieving cost offsets or
increased sales that end up contributing incremental income to the bottom line
of the Profit and Loss Statement.

The most effective way in which to achieve that objective is to analyze
or convince prospects to analyze their total physical distribution costs, which
can represent as much as 50% of total costs for many industries. Of course,
transportation costs are only one of many components of physical distribution
because distribution is made up of series of interdependent components. A
change in any one has a direct or indirect effect on the whole physical dis-
tribution system.

So - marketing starts with a product design based on customer wants
and needs and production of that product. It then progresses into a deter-
mination of cost of producing the product, taking into consideration the fixed
costs, adding the impact of volume on cost and establishing the cost/volume relationship necessary to produce at least breakeven - hopefully a profit -- more important - a reasonable return on investment. These considerations produce a price which the customers will pay for services rendered.

We now have established what the customer will buy (we could call it product design) through market research, an integral component of marketing; the price to be charged, another function of marketing, aided by financial analyses and, hopefully, the result is a product and price that can be taken to the marketplace with reasonable expectation that sufficient prospects will purchase the product offered - and presenting the product to the marketplace is the primary and most commonly recognized function of Marketing. Most of the marketing techniques used by the Air Cargo Industry are very similar to those used in most industrial marketing activities. That is, marketing tools such as direct sales (unlike many consumer marketeers, we feel strongly that the Sales Representative is our most important marketing tool), advertising, sales promotion, direct mail -- Advertising, however, is placed much more in industrial publications such as Iron Age, Purchasing Magazine, Traffic World, etc., rather than consumer magazines, i.e., Life or even general business magazines such as Fortune, Business Week, etc.

We feel that of the three basic ingredients of marketing transportation, the Sales Representative ranks first in importance; direct mail is second because it can be targeted and selective; and media advertising ranks third.

In cargo marketing, there are some unique factors that complicate the execution. One is that almost everybody who grows, breeds or manu-
factures something has to ship it somewhere - without quantifying it, this means that our theoretical total market potential is vast (today, the domestic air industry carries less than 10% of total intercity traffic) and reaching that total market is an enormous challenge. The second is that not all of the potential market is necessarily desirable or profitable to handle. Unlike a producer of goods where almost the only thing that makes a customer undesirable is that he's a poor credit risk, there is a great variation in the profit or loss potential inherent in the infinite variety of goods that are shipped. Thus, we do not want to market our product to a great many customers; we want to handle some products at different price levels than others, based on varying costs and risks to the carriers - examples - very bulky goods, fragility, special handling, and varying values to the users. So we really want to market our product selectively, which is not easy under our obligations as a common carrier. We constantly research our market to determine the relative desirability of prospective accounts and establish marketing goals based on selectivity.

The second problem that is unique is that there is a minimum of two buying influences in each transportation purchase, the buyer (the shipper) and the seller (the consignee). This is further complicated by the fact that in some cases there are third and fourth influences, neither of which are either direct shipper or receiver. A third party influence can be a general traffic office who routes traffic from vendors to facilities scattered nation or worldwide -- or an export cargo agent acting on behalf of the shipper or receiver.
Finding and reaching the correct buying influence, then, is a little more difficult than merely seeking out the Traffic Manager of each account. Many small and medium-sized businesses don't have a Traffic Manager per se. Often the strongest transportation buying influence comes from the purchasing or production departments of the consignee.

When attempting to justify the use of premium priced transportation based on reduction of distribution costs, it is usually necessary to involve the financial management of the prospect -- if it appears that air can contribute to increased sales and profit, then we want to involve the sales management of the prospect.

Historically, air cargo was marketed with emphasis on three areas:

1. Freighters
2. Emergency freight
3. Distribution analysis

Why was the emphasis placed on freighters, rather than line flight equipment -- because we firmly believe the following:

1. It is the best approach to servicing a broad cargo market. It deals solely with cargo and is, at worst, a loss leader.

We believe that we must meet the shippers' needs. The freighter, basically, moves at night when the customers' traffic is available. It has the size to carry the weight and dimensions of all or almost all the freight moving to destinations important to the freight customers. Therefore, the freighter meets a marketing need because it meets the customers' needs.
2. Placing the emphasis on freighters means that we are, in fact, in the freight business and a good way to demonstrate it is to promote and advertise our freighters. We've found that the all-cargo capability has a halo effect that generates traffic for our passenger aircraft as well. While much of the marketing thrust emphasizes freighters today, 60% of the total traffic moves on line flights. But, with the introduction of wide-body aircraft, we anticipate that there will be a substantial increase in cargo traffic that will be carried on combination equipment and a basic shift in emphasis is already taking place.

As far as emphasis on emergency traffic is concerned, this is basically what we deal in today. Our rates are two to three times the cost of using surface transportation (although closer to class 100, and over, truck rates than many people think) and for many products, it is not economical to ship air freight on a straight transportation cost basis.

Thus, much emphasis is placed on distribution analysis which isolates total distribution cost, including logistical costs such as transportation, inventory, materials handling, packaging and order processing. When impacting the effect of faster transportation on these costs, it can often result in savings in the other areas of distribution that result in net reductions in overall distribution costs. In other cases, when we deal in distribution analysis, we prove that air freight means a higher market penetration, increased sales and increased profits. But we feel that historically we have
come too close to offering air as a panacea for distribution ills. For years, when advertising the total cost concept, slogans were used such as, "We have a warehouse in the sky", or "Let us eliminate your distribution center and increase your profits".

This was the wrong approach. Let's look at an example -- let's say we are able to convince a shipper to eliminate a warehouse. This would create a tremendous problem for the shipper because when we eliminate the warehouse, what do we do with the inventory? The usual reason for a warehouse is to protect service and sales inventory in a geographical area. Therefore, the approach that should be used is -- 'reduce' inventory because when a large portion of inventory is reduced or eliminated, there is no need for a warehouse and its high costs", assuming the service to the customer is not reduced. Again, let me point out that the key to air freight marketing in the total distribution approach should be the reduction of inventory. This, then, generates a reduction of labor force, lower warehousing requirements, etc., and can make air freight more economical with surface freight.

Now let's deal with how we will market air freight in the future. Many people have stated that the wide-body aircraft, in configuration, will reduce the cost of shipping air freight and thus result in decreased rates to shippers. Yesterday, I stated that we probably make more money in combination equipment than on freighters and it is our contention that the wide-body passenger schedules will result in decreased costs to airlines as well as a reduction of rates to shippers.
The following is a marketing thrust that demonstrates the potential of creative pricing.

Recently we filed for approval with the CAB, a unique tariff which became effective on July 9, 1972. This tariff is the forerunner of the new marketing thrust in air freight.

Most airlines have, or will shortly have quantities of wide-bodied aircraft. Let's take a look at what a plane of this type, the Lockheed L-1011, does for air freight in a long distance market of 1,605 miles. Over this length of haul, it can carry 73,000 pounds of passengers, baggage and cargo. With 226 seats on this aircraft, an average weight per passenger of 170 pounds and 35 pounds for baggage, we are left with 26,670 pounds of weight to fill up with cargo if we achieve 100% passenger load factor.

The key point is that we have 1,280 cubic feet available for cargo, with 26,670 pounds of allowable cargo weight with a 100% passenger load factor. This translates to a weight/cubic foot relationship of 22 pounds per cubic foot. For comparison purposes, let me cite the weight/cubic foot relationship for freighter aircraft. The 727 freighter has 4,100 cubic feet and a maximum allowable payload of 39,000 pounds or a 9-1/2 pounds per cubic foot weight space relationship. The 707 has a weight space relationship of 10-1/2 pounds and a DC-8 stretch aircraft has a weight space relationship of 11.2 pounds per cubic foot. Again, the L-1011 relationship of weight and space is 22 pounds per cubic foot. These figures lead to an obvious conclusion -- we must get away from selling weight when we sell containers in 1011 passenger aircraft. What we must do is sell space.
It is interesting to note that the average density of cargo traveling today is about 10 pounds per cubic foot. With 1,280 cubic feet of usable space, the 1011 would handle only 12,800 pounds, which is less than half of the allowable weight of lift for cargo with a 100% load factor. Thus, the marketing thrust must be toward products of high density and high volume in regular movements. The airlines have an opportunity to attract products and customers who do not utilize air freight on a regular basis at the present time. But, we must present them with an economic cost. Let's look at the New York/San Juan market again. The present tariffs for the container units of 160 cubic feet over this segment state that we will allow the shipper to load 1,120 pounds for $148.50; a cost to the shipper of 13¢ a pound.

With the present average density of air freight of 10 pounds per cubic foot, a shipper could load a maximum of 1,600 pounds in one of these containers.

Eastern's new tariff, effective July 9, permits a shipper to place 3,000 pounds in a 160 cubic foot container for $198.40. While this is an increase of $51.90 in the price of the container to the shipper, or somewhere in the order of 35%, he is able to obtain an increase in weight of almost 200%.

Thus, the airline achieves an increase of price in unit while the price to the shipper of dense traffic can achieve a level of 6.6¢ per pound, instead of 13¢; a reduction of approximately 50% over the price paid by the shipper of average density freight.

Also, a new container has been developed for this aircraft which is 242 cubic feet and allows a shipper to place 6,000 pounds in the container for $300 -- this brings the cost down as low as 5¢ a pound.
These rates are competitive with surface and these are the types of rates that wide-body aircraft will generate for shippers.

Too often in the airline industry, we concentrate our marketing development on the airplane and thus don't expand our thinking beyond the air terminals. The shipper is not interested in flying his traffic from the San Juan International Airport to Kennedy. He is interested in moving the traffic from his plant in San Juan to his customer in New York. Our industry is now recognizing the total user need by doing the following:

2. Establishing container rates with decreases for both pick up and delivery.
3. Working with truckers to stuff and unstuff containers when shippers do not have facilities to handle containers for distribution centers and plants.

Thus, we are coming closer to the service of meeting total requirements of the shipper.

There are other features of product design that have been stimulated by sales needs and marketing research -- shipper needs. As I stated, we are working with truckers to establish door-to-door service and door-to-door rates for customers. The shippers may book their freight on most airlines--just as a passenger seat is booked. We have telephone centers to provide information to shipper to answer any questions they may have. We are adapting our ground equipment to shippers' needs. As an example -- rates are published for a multitude of types of containers with varying weight limits.
If a shipper only has 200 pounds of traffic to forward to a destination, we provide incentive rates for small containers. There are rate incentives for 500 pounds, 1,000 pounds, 1,500 pounds, 2,000 pounds, and 3,000 pounds or more. Most important, we are adapting our containers to meet specific requirements of shippers, such as, insulated units for shipment of frozen perishable products, including meats, poultry and fish, with compatible transport equipment provided for container movement off-premise.

The majority of freight is handled by combination (passenger/cargo) airlines. Most combination airlines, while having cargo salesmen who devote 100% of their time to selling the cargo product, also insist that what we call "combination sales representatives" sell cargo in areas where cargo salesmen are not domiciled. The combination salesman is supposed to sell both passenger and cargo, but almost always, we find that the combination salesman representing domestic carriers, pays less attention to cargo for several reasons, i.e.--it is more technical; they are usually hired primarily as passenger personnel and remain so oriented; and, very important, for most carriers, cargo represents less than 10% of total revenue. Numerous attempts have been made to educate combination sales reps in technical areas and the industrial sales techniques inherent in presenting the cargo product. Most of these efforts have proven to be of little value.

It is our contention that in order to be dynamic and to universally sell the cargo product of a combination airline, we must have cargo sales specialists. This has been proven historically. But, there is no need to have cargo salesmen in every city we serve. Cargo salesmen must work
not a city nor a metropolitan area, but a regional area because inevitably, in the transportation business, we have hubs with large peripheral areas. Consider Atlanta, like Chicago, a major transportation hub. Only 25% of the originating traffic handled in Atlanta originates in the Atlanta metropolitan area, while the remaining 75% is trucked in to this giant hub from the Carolinas, Tennessee, Alabama, Mississippi, northern Florida, eastern and southern Georgia. Atlanta cargo salesmen should not only cover Atlanta, they should cover the entire geographical area. These are the people that concentrate their efforts on cargo and are the most successful in selling our product.

Gentlemen, a new era in air cargo is being initiated. I am sure that I have not over-estimated the potential of wide-body aircraft making a breakthrough for cargo. It allows us to compete with surface carriers for the first time in air cargo history and next year at this time, I do hope that we can meet at another session and that I can show you the successful results of the airline industry in marketing this new revolutionary product.
The past four years have been very active for the Civil Aeronautics Board in the regulation of domestic passenger fares and airfreight rates. There have been numerous tariff filings by most of the domestic air carriers aimed at making basic changes in domestic fares and rates. These changes involved general, across-the-board increases, selective increases and decreases in particular markets, or for given services or types of products, and finally, fundamental modifications of both the fare and rate structures. These filings, many of them made in the context of a generally depressed airline economic situation, were intended to attract new traffic, to improve the cost-revenue equation with respect to given services or traffic, and in the end, to improve the filing carrier's "bottom line."

The CAB reviewed each such tariff within a short period of its filing, permitted some filings to become effective but suspended others pending investigation. This evolutionary process has already resulted in quite significant fare and rate changes in terms of both level and structure. For example, the domestic passenger fare structure has become much more "tapered" than previously. That is, the basic coach fare, on a per mile basis,
now declines much more rapidly as distance increases than it previously did. Such "taper" is generally believed to be present in airline unit costs, though its degree is subject to some controversy. Therefore, we believe today's passenger fare structure is better cost-oriented than it has been in the past. Similarly, the differential between first-class and coach fares has been increased while the discounts inherent in the extensive promotional fare structure have been moderately reduced. Important changes in the domestic freight rate structure have also been made during this period, about which, more later.

At this point, I would like to discuss briefly the respective roles of the carriers and the CAB in the establishment of domestic rates and fares. Let me say first that I do not speak for the Board itself. My views are my own and I welcome your questions. The air carriers initiate their own rates and fares by filing, on an individual basis, tariffs showing their rates and any changes they propose to make. Such tariffs presumably reflect each carrier's best judgment in light of its costs, competitive situation, the shipper's or traveler's requirements, and the like. These tariffs are publicly filed in advance of effectiveness and may be protested by competing carriers and by users. The CAB comes into the picture at this point in the process. We review the filing in light of the economic justification furnished and any protests filed against it. We then decide whether the filing should be allowed to become effective immediately, or if there are problems with it sufficient to require suspension pending investigation.
Parenthetically, a third alternative exists, namely, we can also permit the tariff to go into effect while we investigate it. Basically, the investigation inquires into the question of the rate's reasonableness, that is, is it too high or too low, and whether the rate unduly discriminates against or prejudices persons to whom it is not available. At the conclusion of the investigation, the Board decides whether the tariff is lawful or not, and if not, what the lawful fare or rate is. I would emphasize that it is only after a formal investigation with a hearing that the CAB can establish a rate or fare. Otherwise, rates, fares, and charges are established by the carriers on an individual basis.

As a consequence of numerous domestic passenger tariff filings, as well as other considerations, in early 1970 the CAB instituted a broad investigation of all aspects of domestic passenger fares. Some matters involved in the investigation have already been decided. For example, the Board has set standards for rate-making purposes with respect to aircraft depreciation policies, allowable return on investment, aircraft seating configurations, and passenger load factor. In May, a year ago, the Board permitted the carriers to raise all fares by six percent while it further considered its tentative conclusion that nine percent was required on a permanent basis. Also pending is a decision on the lawfulness of the well-known family fare and youth fares, as well as the individual excursion fare called the Discover America fare.
This decision should issue soon. The final decision in this series, some months away, will deal with fare structure issues including fare taper and relationships between coach, first class, and other fares.

In the airfreight area, the CAB has also undertaken two very broad investigations. One of them, initiated just two years ago, is concerned with the many air carrier tariff rules by which airlines limit their liability for loss and damage to airfreight, establish procedures for filing claims, and set forth the conditions on which the traffic will be carried. The other, begun in December of 1970, is a general investigation of all domestic airfreight rates. This case is obviously similar in many respects to the general passenger fare investigation now nearing completion. I would like to discuss these two broad investigations of freight rates and rules from the standpoint of the major areas of inquiry and what the CAB staff thinks about some of these matters.

The rate investigation will be concerned, of course, with all aspects of the domestic freight rate structure.

For many years airfreight has been viewed as a by-product of the basic passenger services. Since a large proportion of airfreight was carried in the combination aircraft, carriers tended to price the service on a marginal cost and value of service basis. In the Airfreight Rate Investigation decided in 1948, the Board rejected
the added cost approach to rating freight services and established minimum rates geared to the cost of all-cargo operations. The Board stated its expectation that the carriers would evolve a rate structure above the prescribed rate floor. Airfreight rates, however, remained generally at the minimum established by the Board. With the advent of jet aircraft and increased capacity, the Board revoked the minimum rates in 1961, and the price structure continued to be more concerned with developing new traffic and increased volume than with costs of service on a fully allocated basis. Unfortunately, however, while the growth of airfreight has gradually necessitated the acquisition of separate aircraft, facilities, and personnel to handle it, the rate structure has not been overhauled in the light of current facts.

Current general commodity rates vary according to direction, westbound and southbound rates being at a higher level in numerous markets than rates in the opposite direction. General commodity rates are typically quoted for shipments of under 100 pounds, 100 pounds, 1,000, 2,000, 3,000 pounds and over. In a few markets rates are quoted also for higher weights. The highest rates per pound are for shipments under 100 pounds, with lower rates published for successively higher "weight breaks". The differences among the rates at various weight breaks, also known as volume spreads, permit consolidations of smaller shipments by forwarders. These volume spreads vary by distance, the spreads being greatest for the longest hauls.
A minimum charge per shipment assures carriers a minimum revenue for even the smallest shipment. For several years the typical minimum charge for shipments under general commodity rates was the charge for 50 pounds but not less than $10.00. Just recently, however, the Board found the 50 pound element unreasonable and ordered it cancelled. Thus, today the minimum charge is $10.00 in most cases. For shipments at specific commodity rates, the minimum charge is typically the charge for 100 pounds but not less than $10.00.

Specific commodity rates, which apply to named commodities, are normally lower than general commodity rates and for the most part are applicable to eastbound and northbound traffic. They are typically published for the same shipment weights as general commodity rates, except that rates are not usually quoted for shipments below 100 pounds. Other rates applying to individual commodities, but at a premium above general commodity rates, are so-called exception rates. These are quoted as percentages of the general commodity rates, 150 percent, 200 percent, etc. Very low general and specific commodity rates also exist in a few markets for export and import traffic.

Other rates apply only to containerized shipments, involving varying discounts for several sizes of containers. In addition to an allowance for the weight of the container itself, nominal "unitization" discounts from both general and specific commodity rates are offered for traffic having densities of seven pounds or more per cubic foot. An additional discount of 33 1/3 percent is
offered on general commodity traffic having a density of over 10 pounds per cubic foot.

These rates are quoted by the direct carriers for airport to airport service. Pick-up and delivery rates are also published and the service is offered to shippers and receivers on an optional and extra charge basis. Airfreight forwarders, or consolidators, publish their own tariffs reflecting a generally similar rate structure. Forwarder rates are not included in the investigation, however.

Many aspects of the rate structure are subject to question and in some cases involve substantial controversy. For example, the number of specific commodity rates, at significant reductions below the general commodity rate level, is now quite substantial and in some cases the discounts are very large. This raises the question whether so many specific commodity rates are warranted and whether the sharp rate reductions are economically justified. Perhaps most important is what criteria or standards should be used to evaluate specific commodity rates.

Another area of controversy relates to the existing volume spreads, i.e., the differences between weight breaks. Forwarders are interested in greater spreads, between the rates for shipments below 100 pounds and the 100-pound rates, on the one hand, and rates for larger shipments, on the other. Direct carriers generally are concerned that spreads not be so large as to result in undue diversion of traffic to forwarders and uneconomic rates for large shipments consigned by forwarders.
forwarders, of course, tend to favor a direct carrier rate structure with frequent weight breaks and substantial volume spreads applicable to most if not all commodities. Cost data have been developed by some carriers which indicate that unit cost savings are minimal above 3,000 pounds.

Eastbound and northbound rates have long been lower than westbound and southbound rates, respectively, and presumably are below fully allocated costs of service. This structure was developed because the predominant traffic flow has been in the westbound and southbound directions and reduced rates were necessary to develop traffic for the backhaul directions. At present there is currently no significant difference in volume eastbound v. westbound. Nevertheless, it is claimed that if eastbound rates were not lower than westbound, eastbound traffic would be much less than now. This problem is quite complex and deserves careful analysis.

Another important problem that has been recently focused on by a number of carriers is the level of rates for small shipments and the level of rates for all sizes of shipments for short hauls. It is claimed that such rates are below costs and should be raised significantly. Yet many shippers have come to depend upon the current rates and significant increases would have a serious impact upon them.
During the past few years, the principal carriers of domestic airfreight have proposed a series of broad and substantial changes in their rates. For the most part, the filings would have effected large increases in rates for the smaller shipments, including minimum charges, and would have made small cuts or no change at all in rates for large shipments. These filings drew numerous complaints from shippers objecting to the increases. The Board generally permitted somewhat smaller, across-the-board increases in both general and specific commodity rates.

These filings reflected a concern by carrier management for the persistently marginal economics of domestic all-cargo services. Despite rapid growth in the volume of airfreight carried over an extended period of years, a solid profit basis has not been achieved. All-cargo services are and have been a drag on over-all domestic earnings and during the past year or so the declining profit in passenger services caused increasing attention to be focused on the cargo side. Moreover, the carriers are reluctant to commit the very substantial investments required for both cargo aircraft and terminal facilities in the face of the prospect of continued marginal earnings.

For example, the volume of airfreight transported in the domestic scheduled services of the trunkline and all-cargo carriers increased from 418 million ton-miles in 1960 to 2.1 billion in 1970, an increase of 400 percent. The growth rate was even greater for the freight carried in the all-cargo aircraft. By 1970, the latter carried about 50 percent of the domestic total.
The profit picture, however, is another story. For a number of years, domestic all-cargo services have generally been conducted at operating losses. For only two 12-month periods since 1963 (those ended December 31, 1966, and June 30, 1967) have the operating revenues from such services, including a minor proportion of mail and express, exceeded operating expenses. For the 12 months ended December 31, 1971, domestic trunk and all-cargo carriers reported operating revenues of $259 million and operating expenses of over $294 million, resulting in an operating loss of $35 million.

The rate increases made in the last few years have had the effect of generally raising the over-all rate level and leaving largely undisturbed, except for the minimum charges, the relationships among the various rates comprising the rate structure. While these rate increases should certainly bring revenues into somewhat better balance with costs, they did nothing to effect the improvements in the rate structure which are needed for the longer term. For example, air carrier costs in the terminal area are more affected by the number of pieces in the shipment than by the shipment's weight. Yet under the current rate structure, rates are determined almost entirely by the weight of the shipment. In the aircraft, costs are greatly affected by the density of the cargo, yet the price structure is concerned with traffic density only insofar as a minimum density requirement is concerned. There is considerable
controversy whether the current domestic minimum density rule, which imputes a weight of 6.9 pounds to each cubic foot of space displaced, is realistic in light of the traffic carried and the lift capacity of the jet aircraft in current use. It would seem that the advantages of air transportation would be optimized by a rate structure which contained incentives to the shipper to minimize the number of pieces tendered, e.g., by using containers, and to maximize the density of the shipment. However, the total air transportation system should not ignore the small shipper or shipment or price this service unreasonably.

In this connection, I would observe that meaningful study of this whole area is hindered, if not precluded, by the lack of factual data. Traffic, revenue, and cost data are reported by the carriers essentially on a domestic system basis. Traffic data are limited to tons enplaned by station and system ton-miles carried. Data are not available as to the kinds of commodities carried, the number of shipments, number of pieces, volume by weight, etc. A breakout between traffic carried at general commodity rates and specific rates is not even available. Cost data are by and large limited to the over-all costs of the all-cargo services and, without a good deal of the statistical data enumerated above, not much can be done by way of more detailed costing, for example, costs of handling small v. large shipments.
We know that the various carriers maintain their own records, in varying detail and that they have attempted some cost studies. However, these data and studies are not generally made available throughout the industry and they are probably far from uniform as among the carriers.

The initial phases of the rate investigation are being devoted, therefore, to developing necessary but presently unavailable data. We and the carriers have devised a method for sampling 10 percent of their airfreight shipments. This study should reveal a good bit about traffic patterns and markets, including the origin and destination points of some 120 different airfreight commodities. Other information will be the rating basis, that is, whether the general commodity or a specific commodity rate was used, shipment size, and number of pieces.

To afford some new insight into the important area of terminal costs, we and the carriers have contracted for a $200,000 study by an independent consultant. This firm will study operations at 23 airline cargo terminals plus two airfreight forwarder terminals. The purpose is to study the influence on terminal costs of handling the various types of shipments with different characteristics. A corollary purpose is to develop a reliable methodology by which carrier-reported traffic servicing expenses can be fairly allocated among the various types of traffic handled, including mail and express.
Thus armed with much new, and hopefully useful information, we, the air carriers, and the shipper parties will begin the hearing phase of the rate investigation sometime early next year. Each of us will introduce reams of evidence calculated to prove conclusively that our conclusions and recommendations are reasonable and that the other fellows' aren't.

One of the matters we can expect to be sharply contested is the basic question whether airfreight is to be viewed as a by-product of the much larger passenger services or as a joint product. This is a fundamental issue since it affects the amount of jointly produced costs of operations -- and this would include most airline costs -- to be assigned to airfreight. This in turn affects freight rate levels -- assuming rates in the aggregate should cover costs in the long run -- and, through the rates, the demand for airfreight services. The real life implications are most important. Rates that are unnecessarily high are unfair to present shippers and will inhibit market growth. Rates that are too low, that is, rates which do not cover the true, full costs of service, will inevitably burden other airline traffic and lead to a misapplication of resources.

This issue will be sharpened by the existence of very substantial amounts of cargo capacity provided by the wide-body aircraft. These belly compartments are fully capable of containerized operations
on a scale comparable to the narrow-body all-cargo aircraft. The argument will be made -- and it's a compelling one -- that such capacity is produced as a by-product of the extensive passenger services and can be used for carrying large volumes of airfreight at little or no additional capacity cost.

My own tentative and personal view on this question is that the airfreight rates should bear an appropriate share of the costs of operating the passenger aircraft. First, I would venture the opinion that by-product pricing of airfreight -- which in essence says that the passenger will pick up the difference between total costs and the amount paid by the airfreight shipper -- represents no meaningful standard at all to judge the reasonableness of airfreight rates. This approach would result in airfreight rates fluctuating inversely with passenger revenues. Carrier management would be in a poor position to make economic judgments concerning the provision of additional airfreight services which, to an increasing degree, involve separate and costly aircraft, terminal facilities, and people.

During the past several years, I have become quite skeptical of the viability of the "any-how" theory of setting airline rates and fares. The nub of this theory is that the seat or flight is being operated anyhow and that almost any rate will therefore cover out-of-pocket costs and make a contribution to profit. This theory has been used to justify many a discounted fare and rate,
but it is by no means clear that carrier profits have been thereby improved.

In my opinion, it is extremely difficult to demonstrate, one way or the other, the effect on capacity costs of carrying belly cargo. Airline capacity costs are mostly variable, except in the very short-run, and vary principally with the volume of miles or hours flown. The latter are quite responsive to traffic and relatively small traffic increases seem to generate the operation of additional flights. Moreover, it is quite doubtful that flight schedules catering to the needs of the passenger markets would adequately serve to develop potential airfreight markets. For one thing, the timing of most passenger flights is not well suited to the next-day-delivery requirements of many shippers. But, pricing the cargo services as a by-product of the passenger schedules will reduce the economic viability of all-cargo flights and tend to increase reliance on passenger flights. This will in turn increase the likelihood that belly capacity on passenger flights will in fact be provided at times, not as a pure by-product, but specifically for the airfreight market.

Other fundamental issues in the investigation include the specific commodity rates, weight breaks, and directional rates. Specific commodity rates are principally promotional devices to induce new shippers to use air transportation for their products. Historically, these rates have been used most in the eastbound and northbound directions to help counterbalance the normally heavier
traffic flows in the opposite directions. The specific commodity rate structure today includes a wide range of discounts from general commodity rates reflecting carrier judgments as to the rate level necessary to attract the traffic. They are largely unrelated to costs of service and are inherently discriminatory among shippers of different products.

In my opinion, specific commodity rate pricing makes sense only in small doses. But when numerous such rates are established and the traffic volume becomes quite large, the carrier's average freight rate, or yield, is diluted. Eventually, increases in other rates, or in all rates, become necessary to recover the over-all costs of the airfreight service.

I would like to see less reliance on this type of pricing and more use of the general cargo rate structure. Rate variations should be encouraged to reflect different traffic characteristics--its density, relative fragility, perishability, and the like. For example, because of the significance of traffic density in present-day aircraft, a price incentive should be given to encourage higher density traffic, and the reverse. By the same token, because terminal handling costs are substantially influenced by the number of pieces in the shipment, I would like to inject a "piece" charge in the rate structure.

Weight breaks, that is, unit price reductions for larger shipments, present somewhat similar issues. At one time, weight breaks were mostly a promotional device and bore little resemblance to cost savings inherent in larger shipments. In the last few years, the domestic carriers have largely eliminated weight
breaks above the full-sized pallet or igloo -- about 3,000 pounds. This is quite sound, in my view, since I do not believe that the cost per pound is measurably less for shipments of, say, 5,000 or 10,000 pounds than for 3,000 pounds. Below 3,000 pounds, however, it is my opinion that costs per pound rise quite sharply as shipment size declines because ground handling costs, documentation, billing, etc., do not closely correlate with shipment weight but represent more of a constant factor influenced by the number of pieces in the shipment and special handling characteristics of the traffic. We hope the terminal cost study, I mentioned earlier, will develop a good basis for determining how much weight taper should be reflected in the rate structure. The same basic information as the terminal handling costs should also provide guidance with respect to the appropriate degree of distance taper in the structure.

Summing up, I believe that a well-designed container program and price structure would meet most of these objectives and would afford advantages to both carriers and shippers. It would offer incentives to the shipper to reduce the number of pieces and increase the density per shipment. This would reduce carrier costs of operation. Eventually, perhaps, this type of structure could replace much of the present specific commodity rate structure. Corollary benefits would include much safer transportation with fewer instances of loss, pilferage, and damage and fewer claims.

This leads me to our second major investigation relating to airfreight -- namely, our inquiry into the reasonableness of the carriers' tariff rules governing their liability when a shipment
of airfreight is lost or damaged. The domestic airlines basically limit their liability for loss and damage to 50 cents per pound or $50, whichever is greater. There are exceptions for certain items for which a lower limit is prescribed. In most cases, the shipper at his option may declare a higher valuation on his goods subject to payment of an additional charge. The carriers also publish tariff rules on packing requirements as well as rules governing the filing of claims. The 50 cents per pound liability limit differs from the practice in surface transport where the carriers are responsible, with some exceptions, for the full value of the goods lost or damaged.

During the last few years the CAB has received many complaints from shippers about the arbitrary liability limit, the bases on which claims were denied, and the lack of uniformity of rules among air carriers and with surface carriers. The CAB instituted the present investigation two years ago to look into these matters.

As was the case in the rate investigation, our first step was to undertake a comprehensive survey of shipper claims. This is the first such survey so far as I know. Our survey covered the periods January to June and September-October 1971. It covered some 8,400 claims which were analyzed to determine the amount of the loss, the reason for the loss, the commodities involved, the amount paid, and other information.

For domestic claims over $25, 9 percent were denied in full, 27 percent were paid or denied in part, and 64 percent were paid in full. Those percentages are based upon the number of claims
in the various categories, irrespective of the dollar amount claimed. When you make a similar analysis on the basis of the dollars represented by these claims, you get a different picture. On that basis, 10 percent were denied in full, 52 percent were partly paid, partly denied, and only 38 percent were paid. For goods with a value of 50 cents per pound or less, a much higher percentage of the amounts claimed was paid (about 70 percent) reflecting the fact that such traffic was not subject to the arbitrary valuation limit. Above 50 cents per pound, only one-third were paid, reflecting, of course, the impact of the valuation limit.

The 50 cent per pound valuation limit goes back to the early days of civil aviation and is, in my opinion, no longer valid. It should be changed. It may be contrasted, for example, with the $8.00 per pound limit which applies internationally pursuant to a treaty among most nations.

In my judgment, it is simply not in the public interest or conducive to the development of a sound airfreight transportation system to perpetuate a rule which denies in whole or in part a substantial portion of claims filed. It is bad enough to lose or damage the customer's goods but to deny the ensuing claim on the basis of an arbitrary valuation limit is adding insult to injury. Many shippers are unaware -- at least the first time -- of such limit and the necessity to declare and pay for added protection. Moreover, most claims stem from loss not damage. This would suggest that most of the problem arises from the carriers' own negligence not some frailty inherent in the goods.
In fact, I have heard it suggested that the 50 cents per pound limit means it is cheaper for carriers to pay claims up to that amount than to protect the property entrusted to their care. Whatever the truth of that assertion, it is clear that carriers should and, in fact, can better protect airfreight -- witness the progress made at JFK -- and a higher limit on their liability would increase their economic incentive to do so.

In place of the present rule, I believe a rule of substantially full common carrier liability should apply. In other words, a carrier should be responsible for damages due to his negligence, with some exceptions, up to the value of the goods lost or damaged. However, I would not expect a carrier to assume full liability for commodities of very high value -- for example, currency, jewels, art works -- especially when the carrier has no knowledge that such articles are being carried.

There are, I believe, two ways to solve this problem. The first would allow a carrier, upon proper documentation, to establish liability limits on a limited number of specifically identified articles of very high value. At the same time, the carrier would provide the shipper the option to declare a higher valuation at an additional charge. The second approach would be simply to substitute a much higher limit, say $8.00 to $10.00 per pound, for the present 50 cents, coupled with the option to declare a higher value at extra cost.
Both approaches would afford most shippers and shipments coverage for full value. Both approaches would protect carriers against very large claims on very valuable goods. We hope to explore the pros and cons of both alternatives in the pending investigation with the full participation of the carrier and shipper parties. At the moment, I lean toward the second alternative mostly because it seems a little simpler to me.

In closing, I hope that I have given you some insight into airfreight tariff problems now pending before the CAB. While we may tend sometimes to make these matters sound very complicated, what is really involved is the price for a service and the terms under which it will be performed. As such, these matters vitally affect the interface between carriers and users of air transportation as well as their individual interests. Our purpose is to see that such prices and rules are fair to both parties and consistent with the public interest.
THE FUTURE OF THE U. S. DOMESTIC AIR FREIGHT INDUSTRY

A Presentation at the Summer Workshop on Airline Systems Analysis and Economics
Flight Transportation Laboratory
Massachusetts Institute of Technology

Introduction

This paper will present some of the findings of the author's recently completed research project on the future of the U. S. domestic air freight industry. The research questions of the study were: a) during the period 1965-1969, when the airlines introduced jet freighters into domestic service and air freight traffic growth continued at a high rate, what strategies were employed by management and with what results, and b) what are the opportunities and problems confronting the domestic air freight industry during the 1970's and 1980's?

The U. S. Domestic Air Freight Industry

Between 1959 and 1969 U. S. air freight traffic increased at an annual rate of almost 15%. During shorter time periods, the growth was even more dramatic - for example, between 1964 and 1968 scheduled air freight traffic carried by the combination carriers increased at an annual rate of almost 22%. Most forecasts of U. S. air freight growth made during the mid and late 1960's anticipated that air freight traffic would grow at annual rates of 19-22% per year.

Over one-half of the freight ton miles moved in freighter aircraft by the end of the study period and four carriers - American, United, Trans-World, Flying Tiger - accounted for over 83% of the scheduled domestic freighter revenue ton miles. U.S. air carriers now gross over $1.2 billion per year in their domestic plus international freight, express, and mail traffic. Scheduled freight revenue of the domestic trunklines plus Pan American for the twelve months ended March 31, 1972, alone totaled $662 million. The aforementioned four carriers analyzed in this study grossed almost $200 million in the domestic freighter operations in 1971.

The Results of Management Freighter Strategy 1965-1969

This study focused primarily on the strategies employed by airline managers in their freighter service because a) the author believed that the principal measure of corporate commitment to air freight was the percentage of freight carried on freighters, b) the importance of freighter traffic as a percentage of total freight traffic and c) the availability of CAB data on freighter operations.

The use of the percent of freight carried on freighters proved to be somewhat controversial. Some maintained that aggressive solicitation of belly cargo was legitimate evidence of a commitment to air freight.

Yet, traditionally, the airlines have rewarded their managers on the basis of performance in passenger operations. Many times during the course of the author's interviews, comments of this type were heard: "air cargo is a second class citizen", and "the passenger group does all the planning, we have to do the selling", etc. No combination carrier has established air freight as a separate and distinct organization with complete return on investment responsibility. In the author's opinion, investment in freighter planes is the next best measure, for it indicates the degree to which management has "cut the cord" and ceased to think of air freight as a byproduct of the passenger business. It should be noted that during the mid-1960's, aircraft manufacturers were predicting that by 1975, 80% of the U.S. domestic cargo would move on freighter flights.
Other management input variables analyzed besides "commitment to air freight" included equipment, routes and schedules, pricing (that is, the decisions concerning target traffic mix, scheduling, and choice of equipment which ultimately led to an average yield per revenue ton mile), and other marketing expenses (advertising, promotion, and sales).

The Results of Management Freighter Strategy

The results were reported under the headings of a) traffic and share of market, b) operating efficiency, and c) financial. Statistical analysis revealed that freighter market shares were almost directly proportional to freighter capacity shares. There appeared to be little, if any, disproportionate returns to capacity increases. (Slide 1)

There was little evidence of economies of scale (marginal costs declining as volume increased) in freighter service once jets were introduced. Deflated total operating expenses in 1958 dollars increased proportionately to increases in available ton miles during the period. (Slide 2)

On the other hand, there was some evidence that the traffic service component of operating expenses did display economies of scale. (Slide 3)

But, perhaps the most interesting findings were financial, and the implications for the future of the U.S. domestic air freight industry are extremely important.

Despite the five year period of substantial traffic growth, only American Airlines was able to show a cumulative profit from its freighter operations. (Slide 4) In no instance was the return on investment satisfactory. Indeed, United's freighters showed a cumulative loss of almost $7 million between 1965-1969 on a $142 million investment. For the twelve months ending December 31, 1970, U. S. domestic freighter planes lost $45.2 million before taxes, and for the twelve month period ending June 30, 1971, the operating loss climbed to $54.8 million.²
Two financial ratios of significance in the transportation industry are the operating ratio (operating expenses divided by operating revenue) and the capital productivity ratio (revenue to net investment). As indicated in Slides 5 and 6, domestic air freighters had the unenviable distinction during the study period of combining the operating ratio of the motor carrier industry with the poor capital productivity of the railroad industry!

Within this general pattern of financial distress, evidence was obtained which linked some of the output measures with management inputs. For example, there was a positive correlation between percentage of cargo carried on freighters by the combination carriers with freighter operating profit lending support to the proposition that strong management commitment could influence profit performance to an extent. Clearly, increases in capacity resulted in increased market share, although profits were not guaranteed. United, for example, found that its freighter traffic, market share, and profits improved substantially during the period 1965-1968, but a combination of reduced traffic growth and substantial increases in operating expenses caused profits to plummet in 1969. It then compiled the worst profit record of the study domestic freighter carriers in 1970 and 1971.

As indicated in Slide 7, profits were highly volatile and responded dramatically to relatively small changes in the relationships between percentage change in capacity, traffic, operating revenue, and operating expenses. Efforts to derive statistically formal relationships between profits and the management inputs proved impossible.

One is left with the intriguing question of why management chose to make substantial investments in air freighter service in the face of such risky and unappealing economics. Were they in effect following a "buy in"
strategy so as to achieve strong market shares before the introduction of jumbo jet aircraft, and further hoping that the jumbo jets would generate the adequate return on investment so conspicuous by its absence in the history of the industry?

The second section of the study was designed to analyze the outlook for the U. S. domestic air freight industry keeping in mind its performance over the previous decade.

The Future of the U. S. Domestic Air Freight Industry
The study analyzed the future of the U. S. domestic air freight industry with three underlying questions in mind: a) will air freight traffic continue to display the high growth rates as in the past, b) what will be the competitive cost relationships between the domestic modes of transportation, and c) how will the economics of the industry depend upon future costs, prices, industry structure, and intra-industry competition?

Traffic Projections

At the risk of oversimplification, air freight traffic was divided into three basic categories for analysis: a) emergency traffic which is unplanned and highly time sensitive, b) routine perishable which is time sensitive but planned, and c) routine surface divertible which is planned but less time sensitive. A recent speech by an official of United Airlines suggested that the growth opportunities for emergency and routine perishable may not be as dramatic as many had hoped. He also questioned the ability of domestic air freight to divert substantial amounts of surface traffic. He concluded that domestic passenger traffic would grow at an annual rate of 10% with cargo traffic lagging behind.

A revised forecast of domestic air freight plus express ton miles by the CAB in 1971 also lowered expected growth rates from those developed during the 1960's. The CAB staff study concluded that during the period 1971-1975 annual growth rates would be 10.4%-15.8% per year depending on air freight pricing policies.
In short, the traffic growth picture is what might be termed variably optimistic. All studies predict growth, with the most likely rates over the next several years falling into the 8-12% range. But, the important question for the industry is not one of traffic growth, rather it is whether this traffic will be carried at a satisfactory return on investment.

**Comparative Transportation Costs**

In order to better understand the probable competitive environment of the domestic air freight industry, projections of transcontinental operating costs were made on the basis of historical costs and factors which would affect these costs in the future. Because of the many uncertainties - not the least of which is the future policy of the Pay Board - a parametric approach was taken which in effect spotlighted competitive relationships under a range of assumptions as to changes in annual costs.

As indicated in Slide 8, line haul costs for air freight and trucking could overlap if the airlines introduced jumbo jets. On the other hand, most likely trucking costs will still be below that of air freighters utilizing 707 or stretched DC-8 equipment. But, more significantly, transcontinental rail container trains would undercut both competitors by a substantial margin.

When projected terminal costs are added to line haul, rail's competitive advantage is amplified, and trucking maintains a slight edge over even jumbo air freighters. (Slide 9) Should the pricing policies of the carriers reflect their relative costs, it would be difficult for air freighter rates to be reduced to levels sufficient to attract substantial routine surface divertible traffic unless jumbo jets were introduced.

**Financial Issues**

Depending on assumptions as to costs, load factors, and yield per revenue ton mile, it is possible to project a variety of financial scenarios for air freighter service in the decade ahead. For example, at 50% load factor and yields of 10.5¢, 12.5¢, 14.5¢ and 16.5¢ the time adjusted return for 747 freighter aircraft would be 0%, 4%, 20%, and 35% before taxes respectively during the 1970's.
With return on investment potential of greater than 20%, what are the risks of investing in jumbo freighters? There are many as noted in the following:

1) Ironically, despite the greater capacity of a jumbo freighter, one can demonstrate that on the basis of historical performance, the carriers might price their service so as to reduce the capital productivity of the 747's below that of the turbo-prop CL-44's. (Slide 10) For example, had the 747 jet freighters been introduced in 1969-1970, it is not unreasonable to predict that average yields would have declined to 12¢ per revenue ton mile. The capital productivity would have declined from 1.52 (CL-44 at 20¢ per RTM) to 1.46 (747F at 12¢ per RTM) despite the massive investment. As we have seen, the ratio of air freighter revenue to net investment slide 6 is not impressive. Indeed, air freighters are perilously close to becoming "railroads with wings" on the basis of capital productivity.

2) The jumbo jet operating costs estimates are predicted on dramatic reductions in terminal costs stemming from containerization. One recent study warns that terminal investment and operating costs may be substantially higher than anticipated. In view of the fact that most air shipments weigh less than 100 pounds, there will have to be changes in the industry structure so that the container stuffing takes place at a distance from the expensive airports. This implies even greater responsibilities for the forwarders and consolidators, and the airlines may not be willing to let intermediaries play a larger role.

3) The jumbo jets will require a massive investment in new rectangular containers. It is still not clear how well these containers will withstand the rigors of over-the-road feeder service, nor whether the problems of scheduling their use will be difficult.

4) Perhaps, most crucial, are the assumptions as to actual load factor. Containerization has promised great cost savings benefits to all modes of transportation, but the need to make substantial capital investments has led to rate cutting and overcapacity as well. The recent "over- tonnaging" on the North Atlantic was a familiar and painful story to observers and participants alike. Unless schedules are regulated, load factors could plummet to uneconomic levels. Although the breakeven load factor
of a jumbo freighter is below that of 707's, the cost per aircraft mile increases, substantially magnifying the risks. At least when the airlines went from piston freighters to the 707 they could hedge their risks with the knowledge that costs per plane mile and per available ton mile would decline.

In addition to the pressures on load factor from the introduction of jet freighters, the airlines operating freighters face competition from private air carriage and the substantial amount of belly capacity available to the combination carriers operating the new wide-body passenger jets.

5) Factors in the external environment will also affect the potential profits. On the positive side are regulatory decisions which will promote intermodal transportation and make combination air-truck service more viable. If the economy continues to recover in a satisfactory manner and renew its long run growth pattern of 4-5% per annum, air freight traffic should continue to grow at a pace greater than most industries in the nation.

Yet, the problems of noise pollution and restraints on the availability of land in urban areas will affect the air freight industry substantially. There is a high probability that flights will be restricted between 11 p.m. and 6 a.m. at major urban airports, precisely the prime time for freighter departures. This will create even more pressure for all-cargo airports in rural areas fed by surface transportation. Although this system might work well for freighters, it would prevent the combination airlines from spreading their terminal costs over freighter and belly volume.

**Marketing Implications for the Carriers**

As shown in Slide 11, customer requirements and the management responses differ dramatically depending on the nature of the air freight traffic. Clearly, a universal set of policies - price, pick up and delivery,
special services, schedules, etc. will not meet the diverse needs of the shippers. Also, it is highly unlikely that these three classes of traffic are equally profitable. Finally, the degree to which a carrier decides to concentrate on any one or more of the three categories has important structural implications for the industry.

For example, carriers that strive for routine perishable traffic will not have to make the same investment in educating their sales force in the difficult "industrial marketing" task of selling the service through a total cost analysis. On the other hand, routine perishable traffic is time sensitive, is often seasonal, and can lead to volatile profit performance, even though the traffic as a whole represents routine decisions.

When the spatial as well as the time element is included in the analysis, institutional responsibilities become very important. A shipper who tenders surface divertible cargo destined to off line as well as on line points may prefer to work through one of the large forwarders, who specialize in controlled routings via several carriers.

Pricing of routine perishable traffic requires knowledge primarily of demand factors, but pricing of routine surface divertible must consider cost trends throughout the alternative distribution systems.

In summary, the degree of sophistication of selling ranges from low to very high as one moves from emergency to routine surface divertible. On the other hand, the response and speed requirements move in the opposite direction. Thus, it would seem reasonable for the airlines to develop broad goals as to what percentage of shipments, tonnage, and revenue fall into these three broad categories, before moving ahead to price out individual shipments. The analogy might be made with the decisions of a manufacturing company to generate a given percentage of its revenue from one broad product line. This strategic decision has major policy implications in terms of selling policies, pricing, channels of distribution, etc. Within the broad product line more specific individual product decisions can be made subsequently.

Unfortunately, it will not be easy for the airlines to establish these broad policies, for some carriers don't know how much of their traffic
is truly emergency, perishable, or could move by surface. In one instance the author had the opportunity to ask several airline executives in one company what proportion of the air freight traffic they thought was emergency versus surface divertible. They answered 25% to 40%. The cargo manager then spoke up and said that on the basis of a recent survey, over 75% of the traffic was in fact moving because of a shipper perceived emergency. Without special studies, perceived impressions of traffic may be completely erroneous.

Strategic Decisions

Yet the marketing decisions are but one aspect of what can be called strategic decisions. The airlines have just emerged from one of their cyclical periods of overcapacity, reduced traffic growth, and staggering deficits. Now is the time for them to plan their strategy, lest they again be lured into the high growth, high risk of overcapacity scenario.

In the air freight segment of the industry, this will require specification of a variety of strategic decisions, each of which can be measured and monitored. Eleven of these choices have been arrayed in slide 12.

High Risk Scenario

The high risk scenario for the combination carriers is to repeat the strategy of the past; namely, cut rates on belly cargo to stimulate volume, over-invest in a new generation of freighters, and price their service at rates which are insufficient to yield a favorable return on investment given the patterns of competition and the economics of the aircraft and ground systems.

Any pricing policies based on short run by-product costs of belly operations will threaten the potential profitability of freighter service for both the combination and all-cargo carriers and impair the ability of the industry to develop its services around a sound base of freighter operations.
Another component of the high risk scenario would be for the carriers to integrate vertically and provide a full range of services including ground transportation, terminal services, and inventory control. The airlines, in contrast to major surface carriers or forwarders such as United Parcel Service, have had difficulty in operating efficient surface logistics systems. In large measure, this has been because of the nature of air freight - small shipments, often perishable commodities, etc. The surface carrier or forwarder can depend upon a large volume of surface traffic to absorb overhead costs, whereas the airline or specialized air freight forwarder often does not have the volume which can produce economies of scale.

Low Risk Scenario

A highly controversial, but low risk strategy for the combination carriers would be to phase out their traditional competitive air freigher service, spinning off terminal operations to the forwarders, motor carriers, or warehousemen, and promoting containerized belly service. Or, if they wanted to continue both belly or freigher service, they could follow a policy of accepting cargo tendered only in containers for freigher flights, with the combination flights handling belly containers and loose packages. The extra handling expenses incurred in the processing of packages would be traded-off against the fact that the line haul combination aircraft flight costs would be borne primarily or even exclusively by passengers.

A third low risk strategy for the combination carriers would be to submit a proposal to the CAB to pool their freigher operations and create a strong all-cargo competitor to Flying Tiger for domestic traffic. The objective would be to have two domestic all-cargo carriers with broad route authority operating at profitable load factors.7

A final low risk strategy for freigher operators would be to investigate the possibility of moving transcontinental "route surface divertable traffic" by rail container, rather than by air. If our estimates of costs are correct, rail will have a substantial competitive advantage.
Perhaps a "super forwarder" owned and operated by a consortium of airlines and surface carriers could provide the traffic and management necessary to insure that the railroads exploit their ability to provide fast service at low cost. There will be problems, to be sure, not the least of which is that the current level of traffic will support probably only one rail route. Yet, if successful, it could mean that domestic air freight would be restricted to emergency and routine perishable traffic by 1980.

Implications to the Civil Aeronautics Board and U.S. Department of Transportation

Many of the issues discussed in this study involve the promotional and regulatory policies of the Federal government. Industry structure (entry, merger, exit), routes, pricing, and scheduling in the passenger sector directly require action by the CAB. An additional function which is crucial to the future of domestic air cargo is suggested by the analysis and findings of this research, namely that a series of alternative scenarios for the industry must be developed in sufficient detail so as to guide the carriers, regulatory and promotional agencies, and other interested parties in their future activities. The CAB and DOT must individually or jointly take the lead in providing the environment and support for long range planning. If the industry continues to rely primarily on individual decisions by a host of competitors, goaded by the sales efforts of the aircraft manufacturers, the prospects for financial success seem poor.

Currently, the CAB has reactivated its study of the air freight industry. The emphasis is to be on rates including commodity discounts, distance taper, weight breaks, density incentives, etc. Although pricing is obviously important, the findings of this study suggest that the investigation should be broadened to include the fundamental questions of industry structure, competition, and economics.

Rather than an exercise in legalistic maneuvering, one would hope that the investigation could provide the setting for the following kinds of activities:
1) Development of alternative financial futures for domestic air cargo using simulation techniques including assumptions as to price, load factor, scheduling, equipment selection, costs and load factors of competitive modes, nature of traffic (emergency, routine perishable, routine surface divertible), industry structure, and environmental constraints.

The cost of this kind of analytical exercise might appear to be substantial, yet in comparison with the operating losses to date from freighter service, and the prospects of future losses, the true costs would be low.

2) Provide an open forum whereby the key assumptions underlying domestic air freight profitability could be aired in a manner conducive to specific actions which could resolve the problems. Too often the various forums on air cargo have been either opportunities for the aircraft manufacturers to promote a new generation of aircraft, sessions where the "have-nots" complain about unfair treatment from the "haves", (e.g., all-cargo versus the combination carriers) or sales efforts to woo new shippers.

Perhaps a series of workshops utilizing presentations, case studies, computer exercises and the like, attended by representatives from the air carriers, suppliers, and government could bring the issues to the surface and contribute to the debate necessary for restructuring.

Obvious topics would include the future of Air Express, the existing air freight forwarders, the railroads and motor carriers acting as the "new" air freight forwarders, the role of the all-cargo carriers, strategies for the combination carriers, a timetable for the introduction of a new generation of freighter equipment, and perhaps most important, a better feel for the future mix of air freight traffic - emergency, routine perishable, and routine surface divertible.

One would hope that the Air Transport Association of America and the major carriers would take the lead in broadening and structuring the CAB investigation in this direction. Otherwise, the regulatory agencies will be left in their usual unenviable position of scrutinizing the short term decisions, while the long term strategic issues - primarily choice of equipment - go unquestioned. Yet, once the equipment choices are made, it's often too late to prevent competitive chaos.
It will not be easy for this kind of long range participatory planning activity to take place. It is not unreasonable to assume that the individual airlines within the air freight industry are skeptical that joint planning could really succeed. It's almost a question of ideology. The pragmatic behavior of management to date almost assumes from the outset that cooperative planning with strong inputs from centralized government are doomed to failure.

The time for resolution of the problems of the air freight industry is running short. One hopes that a new spirit of cooperation will emerge to challenge the assumptions of the past and recast the structure and practices of the industry for the future.

Otherwise, the U. S. domestic common carrier air freight industry will remain frustrated and confused. In the midst of technological progress and traffic growth, profits will be found wanting. The optimists will look to the future for salvation but their hopes will not be realized.
U. S. DOMESTIC AIR FREIGHTER SERVICE
1965-1969
MARKET SHARES - CAPACITY vs. TRAFFIC
STUDY CARRIERS

SHARE OF MARKET
TRAFFIC
Revenue Ton Miles

SHARE OF MARKET CAPACITY
Revenue Ton Miles

• American
△ TWA
★ United
○ Flying Tiger
✗ Other Carriers
U.S. DOMESTIC AIR FREIGHTER SERVICE 1965-1969
STUDY CARRIERS
OPERATING EXPENSE DEFLATED vs. CAPACITY

OPERATING EXPENSE DEFLATED
Constant $1958 (Millions)

CAPACITY
Available Ton Miles (Millions)

- American
- United
- TWA
- Flying Tiger
- Other Carriers
Slide 3

U.S. DOMESTIC AIR FREIGHTER SERVICE 1965-1969
STUDY CARRIERS
TRAFFIC SERVICE EXPENSE DEFATED vs. CAPACITY

TRAFFIC SERVICE EXPENSE DEFATED
Constant $1958

CAPACITY
Available Ton Miles (Millions)

- American
- United
- TWA
- Flying Tiger
- Other Carriers
CUMULATIVE PROFITS BEFORE TAX 1965-1969
and INVESTMENT IN AIR FREIGHTER OPERATIONS 1969

STUDY CARRIERS

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<thead>
<tr>
<th></th>
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<tr>
<td>American</td>
<td>$3.022</td>
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<td>United</td>
<td>$-6.981</td>
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<td>$-18.530</td>
<td>$54.7</td>
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<tr>
<td>Flying Tiger</td>
<td>$-4.679</td>
<td>$54.8</td>
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Source: CAB

Net Investment includes working capital, flight and ground equipment, investments and special funds, long term prepayments, developmental and pre-operating costs, and unamortized discount and expense on debt.
COMPARATIVE OPERATING RATIOS
RAIL * TRUCK * AIR FREIGHTER
SELECTED YEARS

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<th>High Profit Year</th>
<th>Low Profit Year</th>
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<td>.962 (1970)</td>
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Air Freighter Operations:

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<td>1.095 (1969)</td>
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<td><strong>United Airlines</strong></td>
<td>.970 (1967)</td>
<td>1.136 (1965)</td>
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<tr>
<td><strong>Trans World</strong></td>
<td>1.127 (1968)</td>
<td>1.196 (1965)</td>
</tr>
<tr>
<td><strong>Flying Tiger</strong></td>
<td>.871 (1966)</td>
<td>1.160 (1968)</td>
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Sources:


CAB, Form 242.
<table>
<thead>
<tr>
<th>Class</th>
<th>Operating Revenue ($Billion)</th>
<th>Net Investment in Operating Property ($Billion)</th>
<th>Ratio Revenue to Net Investment in Operating Property</th>
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<td>$.053</td>
<td>$.098</td>
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<td>TWA</td>
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<tr>
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<td>.022</td>
<td>.043</td>
<td>.512</td>
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**Sources:**


CAB, Form 242.
PERCENTAGE CHANGE FROM PREVIOUS YEAR
SELECTED OPERATING AND FINANCIAL STATISTICS - STUDY CARRIERS
SCHEDULED ALL CARGO SERVICE 1966-1969

<table>
<thead>
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<th>Carrier &amp; Year</th>
<th>Capacity</th>
<th>Traffic</th>
<th>Oper. Revenue</th>
<th>Oper. Expenses</th>
<th>Profit Before Tax</th>
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<td>1967</td>
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<td></td>
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<td>1969</td>
<td>4</td>
<td>- 4</td>
<td>- 2</td>
<td>4</td>
</tr>
<tr>
<td>United</td>
<td>1966</td>
<td>+27%</td>
<td>+35%</td>
<td>+48%</td>
<td>+31%</td>
</tr>
<tr>
<td></td>
<td>1967</td>
<td>65</td>
<td>63</td>
<td>53</td>
<td>48</td>
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<td>24</td>
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<td>1969</td>
<td>12</td>
<td>13</td>
<td>17</td>
<td>22</td>
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<td>Flying Tiger</td>
<td>1966</td>
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<td>1969</td>
<td>18</td>
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<td>5</td>
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Note: All percentages are rounded to the nearest percent.

TWA and United on strike 43 days in 1966.

NM: Not Meaningful
Slide 8

COMPARATIVE LINE HAUL COSTS per AVAILABLE TON MILE
AIR * TRUCK * TOFC

TRANSCONTINENTAL SERVICE 1975
@ Varying Cost Increase Factors

<table>
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<tr>
<th>Cents per Available Ton Mile</th>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
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<th>12</th>
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<tr>
<td>TRUCK - Weight Basis</td>
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<td></td>
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<td></td>
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<td>10%</td>
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<tr>
<td>Density Basis</td>
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<td></td>
<td></td>
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<td>10%</td>
<td></td>
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<tr>
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<tr>
<td>Density Basis</td>
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<td></td>
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<td>8%</td>
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<tr>
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<td></td>
<td></td>
<td>3%</td>
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<td>RAIL - TOFC</td>
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<td>5.5%</td>
<td>8%</td>
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Notes:
- Air Density Costs are based on Cargo with on-board densities of 8.6 lbs./cubic foot.
- Truck Density Costs are based on Cargo with on-board densities of 15.3 lbs./cubic foot.
- Rail Costs are based on Cargo with on-board densities of 14.6 lbs./cubic foot.
- Indicates most likely value in 1975.
REVENUE PRODUCTIVITY OF FREIGHTER AIRCRAFT
COMARED TO ORIGINAL COST

<table>
<thead>
<tr>
<th>Type of Aircraft</th>
<th>Orig. Cost</th>
<th>Year of Orig. Cost</th>
<th>Mil. All./Year</th>
<th>REVENUE POTENTIAL 100% Load Factor at Yield/Rev. Ton Mile</th>
<th>RATIO Revenue Potential to Original Cost - 100 Load Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20¢</td>
<td>15¢</td>
</tr>
<tr>
<td>DC-7F</td>
<td>$2.6</td>
<td>1956-59</td>
<td>8.2</td>
<td>$1.64</td>
<td>$1.23</td>
</tr>
<tr>
<td>L 1049 C</td>
<td>2.0</td>
<td>1955</td>
<td>4.5</td>
<td>.90</td>
<td>.68</td>
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<tr>
<td>CL-44 D</td>
<td>3.8</td>
<td>1960</td>
<td>28.8</td>
<td>5.76</td>
<td>4.32</td>
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<tr>
<td>707-320 C</td>
<td>7.0</td>
<td>1963</td>
<td>58.1</td>
<td>11.62</td>
<td>8.72</td>
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<tr>
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<td>6.5</td>
<td>1962</td>
<td>55.7</td>
<td>11.14</td>
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<td>87.8</td>
<td>17.56</td>
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<td>B 747F</td>
<td>19.0</td>
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<td>231.3</td>
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<td>L-500</td>
<td>21.5</td>
<td>1970 EST</td>
<td>234.7</td>
<td>46.94</td>
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Notes:

Aircraft original cost data from Lloyd's, Aircraft Types and Prices (1970).
Costs do not include allowance for spares.
Available ton miles/year derived from several published sources.
Slide 10

RANGE OF LINE HAUL + TERMINAL
OUT OF POCKET COSTS / REVENUE TO: MILE
SURFACE vs. AIR TRANSPORTATION
1975

<table>
<thead>
<tr>
<th></th>
<th>Line Haul*</th>
<th>Terminal**</th>
<th>Range</th>
<th>Most Likely</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trucking</td>
<td>2.67-4.23¢</td>
<td>.97-1.39¢</td>
<td>3.64-5.62¢</td>
<td>4.9¢</td>
</tr>
<tr>
<td>Rail TOFC</td>
<td>1.17-1.38</td>
<td>.34-.40</td>
<td>1.51-1.78</td>
<td>1.8</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Air Freight</th>
</tr>
</thead>
<tbody>
<tr>
<td>707</td>
</tr>
<tr>
<td>DC8-63</td>
</tr>
<tr>
<td>747</td>
</tr>
</tbody>
</table>

* Truck + Air based on 100% load factor (weight basis). 
  Rail based on 70,000 lb. shipments.

** Rail Terminal excludes platform handling
  Air Terminal includes only traffic service expense.
AN APPLICATION OF A MARKETING MATRIX TO AIR FREIGHT

<table>
<thead>
<tr>
<th>Nature of the Traffic</th>
<th>Emergency (Unplanned)</th>
<th>Routine Perishable (Planned)</th>
<th>Routine Surface Divertible (Planned)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Needs of the Customer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Costs</td>
<td>Low</td>
<td>Medium</td>
<td>High</td>
</tr>
<tr>
<td>Airline or Trucker</td>
<td>Medium Customer</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Pick Up &amp; Delivery</td>
<td>Delivers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Speed</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>Tracing</td>
<td>Low - It can't afford to get lost</td>
<td>Low - It can't afford to get lost</td>
<td>High</td>
</tr>
<tr>
<td>Territorial Coverage</td>
<td>Low</td>
<td>Medium</td>
<td>High - Wants full coverage</td>
</tr>
<tr>
<td>by Individual Airline</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Availability of</td>
<td>Medium - Usually space for emergencies</td>
<td>High</td>
<td>High</td>
</tr>
<tr>
<td>Capacity from</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Specific Airline</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Information on</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>“Total Cost Approach”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Responsiveness of</td>
<td>High</td>
<td>High</td>
<td>Medium</td>
</tr>
<tr>
<td>Total System</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Response by the</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Airline</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pricing</td>
<td>High</td>
<td>Medium</td>
<td>Low</td>
</tr>
<tr>
<td>Type of Equipment for Shipment</td>
<td>Belly</td>
<td>Belly or Freighter</td>
<td>Freighter</td>
</tr>
<tr>
<td>Personal Selling</td>
<td>Social*</td>
<td>Social-Technical</td>
<td>Technical*</td>
</tr>
<tr>
<td>Schedules</td>
<td>Passenger</td>
<td>Passenger or Evening Freighter</td>
<td>Evening Freighter</td>
</tr>
<tr>
<td>Promotion</td>
<td>Schedules and Service Area</td>
<td>Schedules, Price and Markets</td>
<td>Total Cost or Profit Analysis</td>
</tr>
</tbody>
</table>

*Social skills include maintaining favorable image, supplying simple information etc. Technical skills include training in logistics analysis, knowledge of competitive
<table>
<thead>
<tr>
<th>Nature of Strategic Decision</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Carriers of loose packages</td>
<td>1. Percent of shipments and tonnage that is containerized</td>
</tr>
<tr>
<td>2. Carriers handling a wide range of general commodities</td>
<td>2. The percentage distribution of tonnage and revenue by commodity</td>
</tr>
<tr>
<td>3. Carriers generating growth from air oriented commodities</td>
<td>3. Percentage of shipments and revenue which is emergency, planned perishable and routine surface divertible</td>
</tr>
<tr>
<td>4. Carriers who view freight as a byproduct of the passenger business</td>
<td>4. Percentage of traffic carried on freighters and pricing policy based on freighter or combination service</td>
</tr>
<tr>
<td>5. Carriers offering scheduled service</td>
<td>5. Percentage of flights which are scheduled</td>
</tr>
<tr>
<td>6. Carriers with direct customer contact</td>
<td>6. Nature of marketing expenses</td>
</tr>
<tr>
<td>7. Carriers offering line haul service only</td>
<td>7. Percentage of shipments handled door-to-door</td>
</tr>
<tr>
<td>8. Carriers only in the transportation business</td>
<td>8. Percentage of operating revenue generated from transportation</td>
</tr>
<tr>
<td>9. Carriers with the capability of intermodal operations using rectangular containers</td>
<td>9. Investment in &quot;jumbo&quot; freighters plus percentage of shipments, tonnage and revenue associated with rectangular containers</td>
</tr>
<tr>
<td>10. Carriers experiencing high growth rates e.g. 15%-20% per year</td>
<td>10. Growth rates of shipments, tonnage and revenue</td>
</tr>
<tr>
<td>11. Carriers willing to bear losses pending the development of a new generation of aircraft</td>
<td>11. The use of &quot;profitability load factors,&quot; operating ratio and ROI data</td>
</tr>
</tbody>
</table>
FOOTNOTES

1 E.W. Eckard, Air Cargo Growth Study MRS-49, Marietta, Lockheed-Georgia, 1965, p. 63 and McDonnell-Douglas, Advanced Cargo Systems Report Cl-801-1610-1, Long Beach, 1969, p. 27. The reader should be aware of the distinction between freigher planes and "all-cargo" airlines. Freigher planes are aircraft which carry freight only as contrasted with combination aircraft which carry passengers and belly cargo. Freigher planes are operated by the combination and all-cargo carriers. The all-cargo carriers, including Flying Tiger, Seaboard World, and Airlift International, provide scheduled certificated all-cargo service in freigher planes, as well as passenger and freight service under charter.

2 In view of the fact that there is vigorous debate as to the true profitability of belly cargo (see Frank M. Lewis, "Is Belly Freight Profitable?", Transportation Research Forum Proceedings Twelfth Annual Meeting, Oxford, Richard Cross, 1971), the domestic freigher losses raise questions as to the over-all profitability of U.S. domestic air freight. On the other hand, there are also disagreements as to the validity of the CAB formula for costing freigher service. But in the absence of other published data, it must be assumed that despite a variety of strategies, airline managers have not succeeded in producing substantial profits from freighers, and perhaps even from total air freight.


6 Within the past few years, several major truckers and railroads have been granted authorization to experiment as air freight forwarders and two air freight forwarders have been permitted to operate as surface forwarders when carrying traffic having a prior or subsequent movement by air (see 339 ICC 17).

7 Perhaps a reconstituted Airlift International could serve as the nucleus for the strong all-cargo competitor to Flying Tiger.

8 For a summary of a study of transcontinental container trains linking a national warehouse system see, Jack W. Farrell, "Domestic Containerization - A Possible Breakthrough?", Traffic Management, July, 1971, pp. 55-57.
Commuter air carriers operate in what approaches a free market environment. Unlimited market entry is permitted, and there is no chance for subsidy. The commuters are transitioning from scheduled air taxi services to miniature local service airline operations. There is pressure for relaxing capacity and weight limitations so that markets inherited from the regional carriers can be profitably served. Profits are sought in longer hauls and denser markets.

When serving the low-density markets, the cost of establishing successful routes and purchasing aircraft severely tries the capital resources of these small corporations. The traditional business oriented feeder operations involve services over less than 200 miles with very small aircraft. Costs must be cut to the bone.
1. The Market for Commuter Air Service

Commuter air carriers serve short haul low density air transportation needs. In 1971 they carried 3% of the domestic passenger trips while generating .33% of the passenger miles. The average length for a commuter passenger trip is only 90 miles. For the trunk airlines this figure is 800 miles.

Commuters today provide air service to approximately 200 cities that would otherwise do without. They carry mail and freight as well as passengers.

90% of the commuter business is under 200 miles. This short haul market is difficult for air transportation. At short trip lengths the cost of initiating the journey - the cost of ticketing, boarding, baggage handling, and taking-off - dominates the economics. Neither cruise speed nor cost per mile is as important as per trip costs.

The other important item in short haul travel is the schedule since nobody is going to wait two hours for a half hour flight. Thus the frequency of service must be high.

In order to match the ruthless requirements of the short haul market the commuter air carriers run a simple transport service. By straight forward operations they are able to keep costs down to $5.50 per passenger boarding plus 9¢ per passenger mile. For comparison trunkline costs are twice as high per boarding, but half as high per mile. As a consequence commuter service is cheaper for trips under 150 miles.

The commuters also keep the frequency of service up. Their markets are extremely small, but by using aircraft with capacity between 5 and 19 seats a satisfactory frequency can be maintained.

By keeping costs down and frequencies up commuters enter a market that is dominated by automobile travel. With luck a small percentage of the automotive passenger flows divert to commuters.
FARE STRUCTURES FOR COMMUTER AIRLINES AND TRUNKS

Commuter airlines: $5.50 + $.096/mi
Trunk airlines: $9.54 + $.0636/mi
This is particularly likely if the passenger is making a longer trip by air. 80% of commuter passengers are connecting to other flights. There is also an advantage if the trip is over water; the Bahamas and the Virgin Islands have considerable commuter service. Commuters, therefore, serve feeder markets or provide access to remote vacation areas. In general they carry only a small fraction of the passengers travelling. What percentage or how many people ride the commuters is strongly dependent on the special characteristics of each market. Commuters consider 20 passengers a day sufficient for profitable service.

2. Commuter Aircraft

It is the nature of a short haul market to have dramatic variations in traffic during the day or week. These traffic flows are directional - one way in the morning, the other in the evening. The shortest travel market, the automotive rush hour, is similar. In such a situation a public transportation system is flying aircraft full one way and empty the other. Also vehicles are busy at nine in the morning and six at night, but idle in between. The problem is particularly acute for commuters where it forces low load factors and poor utilization.

As a consequence the aircraft used by the commuters have special requirements. Because of the low utilization, the aircraft must not be expensive to purchase. Capital ownership costs are important. The commuter carriers pay high interest rates on their borrowed capital, when they can get it. Because of the directionality of the market the aircraft must break even at very low load factors. The cost of flying around empty must be low.

In exchange for these two requirements commuter aircraft operations are not so sensitive to speed or DOC (Direct Operating Costs) in cruise. Short trips are made at low altitudes, so there is little need for pressurization. Nor is cabin comfort as important as it is on longer rides.
Trip Time for a Short Haul Trip

Access & Egress

Cruise Flight

Take off and Maneuver

Schedule Delay = 1/2 Headway

Trip Cost for a Short Haul Trip

Access & Egress

Cruise Flight

Take off & Maneuver

IOC
A number of light twin aircraft are used by the commuters. Four of the most popular made today top the list in table 1. The sleekest is the Beech 99 with retractable gear and a high cruise speed. The other work horse is the DeHavilland Twin Otter. This aircraft has fixed landing gear and a high wing with struts. Nevertheless it is quite successful for short haul air operations the world over. For comparison table 1 also includes a variety of larger and more modern aircraft designed for the same short haul air market.

Since financing is difficult to find, the commuter carriers, like under-capitalized countries, prefer used aircraft to expensive new ones. In the short haul market, cost means more than time.

3. The Commuter Air Carrier Industry Today

There are between 100 and 150 commuter air carriers in existence today. In January of 1962 there were only 12 companies carrying mail or offering more than 5 round trips per week between two cities. The growth of the industry in recent times has produces 50 more or less permanent corporations who today do 90% of the commuter business. The remaining 50 to 100 companies are air taxi operators who get in and out of the commuter business as time and fortune permit.

This transience, which seems strange to the air carrier industry as a whole, is encouraged by the unregulated nature of the commuter industry. The commuters operate in a free market with unlimited route entry and exit and no fare regulation. They file little or no information with the Civil Aeronautics Board (CAB) or anyone else, and in no way can they receive federal subsidy. The only rule is the 12,500 lb. weight limit.

This weight limit allows commuters to operate without CAB certification with any aircraft under 12,500 lbs. gross weight. This limit also coincides with a break even point in the Federal Aviation
<table>
<thead>
<tr>
<th>Aircraft</th>
<th>Seats</th>
<th>Cost (000)</th>
<th>Speed</th>
<th>Range</th>
<th>Gross Wt.</th>
<th>In Use '71</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piper Aztec</td>
<td>5</td>
<td>$113</td>
<td>210mph</td>
<td>700mi</td>
<td>5,200lbs</td>
<td>74</td>
</tr>
<tr>
<td>Cessna 402</td>
<td>9</td>
<td>$150</td>
<td>190</td>
<td>700</td>
<td>6,300</td>
<td>37</td>
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<tr>
<td>Beech 99</td>
<td>15</td>
<td>$455</td>
<td>284</td>
<td>500</td>
<td>10,400</td>
<td>82</td>
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<tr>
<td>Twin Otter</td>
<td>19</td>
<td>$550</td>
<td>210</td>
<td>700</td>
<td>12,500</td>
<td>51</td>
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<td>Swearingen Metro</td>
<td>19</td>
<td>$600</td>
<td>390</td>
<td>500</td>
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<td>DC-3</td>
<td>25</td>
<td>$40</td>
<td>190</td>
<td>1500</td>
<td>24,500</td>
<td>5 (+3)</td>
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<tr>
<td>Falcon 20T</td>
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<td>$2400</td>
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<td>854</td>
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<td>1000</td>
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<td>$3000</td>
<td>450</td>
<td>400</td>
<td>41,000</td>
<td>0</td>
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<tr>
<td>Convair 440</td>
<td>44</td>
<td>$50</td>
<td>289</td>
<td>1300</td>
<td>48,000</td>
<td>3 (+2)</td>
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<td>$4000</td>
<td>510</td>
<td>510</td>
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<td>280</td>
<td>1280</td>
<td>38,500</td>
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</tr>
</tbody>
</table>

**Table 1** Some Aircraft for the Commuter Markets
Administration (FAA) definition of equipment and pilot requirements.

The freedom from constraint when operating small aircraft dates back to 1952. It was felt that the air taxi operators should be given the freedom to seek out new markets or to serve markets of small profitability to the airlines. The lack of control over routes and prices was essential to such experimental activities. These activities strengthened the overall air industry. The weight limit served to restrict air taxi operations to equipment noticeably less magnificent than the standard local service airliner, the DC-3.

For a period of 15 years the third level air carriers either made it or went broke operating feeder service from smaller cities and providing access to remote areas for vacation travel. For the most part, these were small operations associated with a fixed base operator. These mama papa airlines were called scheduled air taxis.

In the last four years the picture has changed. The commuters still serve the same markets - feeder and vacation access travel - but the air taxis have become miniature airlines.

At present there are three types of commuter air carriers. The most mature are really commuter airlines.

The commuter airlines are in the third level business for good. They do not want the CAB in their lap. They operate a no frills transport service; government paperwork would kill them. "Bus service with an aircraft", one man called it.

Perhaps 30 of the 50 largest commuters fall into this highly professional category. Their managements are aware of the cost structure of air transportation and sensitive to the importance of the frequency and timing of service. They use simple unpressurized aircraft to keep operating costs, particularly time and flight cycle costs, down. Such operations could not support the highest airline comfort
or speed standards. Similarly, viable operations keep boarding and ticketing costs down to $2 a head. Trunk airlines spend $7 to $8.

What these commuter airlines offer is a new style of air travel, a style particularly suited to markets with ground competition: offer a service with emphasis on schedules.

Typically these miniature airlines build a route structure around feeder service to a large metropolitan area. For example, Executive Airlines feeds Boston's Logan International and Golden West feeds Los Angeles and San Francisco airports. The route maps are presented in Figures 1 and 2.

The other half of the large commuter air carriers is on a different tack. These companies want to become certificated air carriers as soon as they can develop their markets enough to justify CAB route awards. Route protection is desired. The commuters can reduce their capital investment and increase their airline image by purchasing used Convair 440's and DC-3's to replace their fleets of smaller light planes.

Operations of this sort can be built on the exploitation of a single market. Usually the market is one which might justify airline service, but which has one or both terminals off the established airline airports. Remember, half of the communities served by commuters receive no certificated service.

For example, Wright Air Lines is making a business out of the downtown Detroit to Cleveland market. In a more developed route network, Joe Mackey is establishing his second airline in the Bahamas, having sold his first to Eastern.

The third and last type of commuter air carrier is the old scheduled air taxi service. In remote areas the 15 seat Beech 99 and the 19 seat DeHavilland Twin Otter are too big and expensive to serve
Route Map for Executive Airlines

Source: OAG July '72

FIGURE 1
Route Map for Golden West Airlines

Source: Golden West

FIGURE 2
the thin markets. A five to nine seat aircraft such as the Cessna 402 can be used to ferry passengers to the state capital or other hub. Operations are more economic if combined with charter activities and other services of a fixed base operator or flying service. It is these low density operations which provide politically important links in our national transportation system. They mean a lot to their communities.

All three types of commuter air carriers must borrow to cover the capital expense of aircraft and new routes. In total the commuter industry has 50% more capital investment in aircraft per dollar of revenue than the trunks. This money is often hard to come by. When it is available the interest rates can be as high as 10%. A few months of poor management can have the creditors closing down the service entirely. It is promising to note the relative permanence of the larger commuter air carriers in recent years.

4. Changes in the Regulation of Commuter Air Carriers

The growth of the commuter industry has caught the governmental eye. The first change considered was a relaxing of the 12,500 lbs. gross weight limit on aircraft. This is the Civil Aeronautics Board's restriction designed to prevent competition with the local service carriers. Since the typical local service aircraft is now the 727, not the DC-3, some change in the limit for commuters seemed in order merely to update the requirement. Furthermore a limit on gross weight could force compromises with safety and comfort that were not intended. As a consequence the dual limit of 30 seats and 7,500 lbs. payload has been proposed for commuter air carriers, and is likely to be accepted.

For the commuters operating miniature airlines this will allow the use of larger and more efficient light aircraft. A stretched Twin Otter of 14,000 lbs. has already been talked about. The increase in
capacity is welcome in busy feeder markets where extra sections and back-up aircraft are now used to supplement an already full schedule of departures.

For those commuters aspiring to route certification the move to obsolescent local service airline equipment is envisioned. Since the limit is on seats and cargo weight not aircraft size the smallest pressurized airliners could be converted to luxurious accommodations. These aircraft currently are a tenth the price of a new light plane, so some of the increased DOC is offset by reduced capital charges. Lately the CAB is becoming more open to granting exceptions for the use of DC-3's or Convair 440's in commuter markets.

An increase in the aircraft size limitations has no effect on the smaller air taxi services.

Accompanying the updating of the aircraft the CAB is contemplating increased reporting requirements. In 1969 the commuters began to file simple traffic, aircraft, and schedule information with the Board. There is a possibility that the Board may trade some form of route protection for reporting requirements on finances and costs. Since many of these companies are privately held, this will be the first time much of this information will be known.

Last of all the CAB is experimenting with a form of route subsidy which would impact the smaller operators. The CAB will receive bids for guaranteed service between two points over a period of time. Thus a commuter will offer to serve market A-B four times daily at a fare below $25. for a yearly subsidy of $30,000.

While the CAB is readjusting its sights, the FAA has not been idle on the safety issue. Although commuters are four times as safe as other general aviation aircraft, they are still four times as dangerous, in terms of accidents per take off, as the certificated carriers. Perhaps the most relevant statistic is the comparison with
turnpike automotive travel, which has a quarter the fatalities per passenger mile. The FAA is responsible for aircraft safety, and may very will increase pilot and aircraft requirements in the near future. Particularly likely is a review of pilot qualifications for commuter operation. Pilots with higher qualifications are now generally available at increased expense. Unfortunately the costs of FAA regulations may upset the fragile economics of some carriers. Safety should automatically improve as the commuters move to 30 seat aircraft, which are more strictly controlled, and as equipment at smaller airports is updated.

5. The Commuter's Relationship to the Regional Air Carriers

Lately there has been a move on the part of the commuter carriers to serve routes and markets that earlier were the realm of the regional carriers. The regional carriers used to be called the local service carriers. The regionals have been buying new and used equipment similar to the trunk lines. As a consequence their shortest and lowest density routes can no longer be served economically. They are willing to abandon these routes to the commuter airlines.

What is happening is a giant game of musical airplanes. The trunk carriers have purchases long range aircraft and opened up nonstop and cross country markets that were previously impossible. Average trip lengths grew by a third during the last twelve years. It is the nature of both airline economics and transportation demand that things get rosier for air service as the distance increases. So the trunk lines were delighted to configure themselves to serve longer haul markets.

Meanwhile the local service airlines were busy buying intermediate range aircraft from the trunks. The used aircraft were well suited to the higher densities being experienced in the growing air transportation markets. The local service carriers became the "regionals" and found that they could not serve the thin markets without subsidy. Markets
that would have outgrown subsidy if served by DC-3's could not be profitable using 727's. From 1952 to 1970, 418 points were eliminated from certificated air carriers routes.

Within the last five years the motion at the head of the snake has reached the tail. Air taxi operators, people who had an image of being tied to one or two routes using the part time services of an owner pilot, have moved from 9 to 19 passenger aircraft. They now offer reliable service over a route network using a fleet of aircraft. Once again profits were found in longer haul higher density routes.

The commuters found a fruitful market replacing subsidized regional carrier activity.

The Allegheny Commuters are the most highly developed example of this activity. Eight commuters serve sixteen markets on Allegheny's behalf. This is how the system works: Allegheny wishes to abandon a route it is serving at the minimum level allowed by the CAB, two flights a day. In spite of the subsidy Allegheny is carrying a loss for the operations. A contract is made with one of the local air taxi or commuter operators to replace the airline service. The commuter receives a ten year contract. Allegheny provides ticketing and reservation services as well as gate service at the major airports. The commuter flies Allegheny's colors. He also flies aircraft approved by Allegheny - often Beech 99's. The commuter gains a market, a public identity, and a permanence that permits financing. Allegheny gains reduced losses plus a high number of transfer passengers. The CAB does not have to pay out subsidy. And finally in all cases both frequency and reliability of service to the outlying community improves.

The corner cutting abilities of a small operator are combined with the network of a larger carrier very effectively. Attempts by regional carriers to duplicate commuter operations are normally hindered by
stringent FAA, CAB, and union controls over certificated operations. Other airlines have been substituting commuters with less formality. For instance Northeast Airlines was able to give away a number of routes to Executive Airlines. The CAB permits the substitution as long as Northeast guarantees continued service should the commuter fail. At least 27 commuters have been involved in direct substitution for regional air service. Some 86 markets have been involved. It has been this activity, generally successful on all sides, that has moved the CAB to replace the current subsidy pattern with putting routes out on bid to the commuters.

6. Summary

The commuters are moving from a period of experimental market exploration by small air services to a larger more permanent operation tailored for the ruthless requirements of a low density short haul market. They operate increasing numbers of feeder services to large airport hubs. Some are sticking to no nonsense operations within the institutional structure of the CAB and FAA requirements. Others are trying to grow into certificated airlines. A constant activity of smaller companies still provide vital air links to remote communities.

The vehicle limitation on gross weight will probably be raised and the monitoring and reporting by both the FAA and the CAB increased as the commuters' activities grow in importance.

The commuters are moving to take over the smaller subsidized and unsubsidized markets previously served by the regional carriers.
When the Congress created the Civil Aeronautics Board in 1938, it gave the new creature a series of statutory duties. One of these was to encourage and develop "... an air transportation system properly adapted to the present and future needs of the foreign and domestic commerce of the United States. ..." Under that mandate, the Board has attempted to meet the problem of providing air service to smaller communities at reasonable cost to the taxpayer. Over the years, the traditional approach has been to subsidize certificated carriers for their services to these uneconomic points. The system generally has worked well, and many small towns have air service which would probably not otherwise exist. This is a proper national expenditure, in our view. In many cases, air transportation is a key to economic survival of the communities.

But, in the last few years the traditional method of supporting marginal services does not seem to be working as well as in the past. The subsidy bill has been increasing as small community services have declined.

Throughout the late '60's, the subsidy bill had been going steadily down under the class rate formula then in effect. That only tightened the vise. As the subsidy bill went down (because of the mechanical application of the subsidy formula), the actual need went up. Then the
Board began receiving complaints from the communities and members of Congress. Something had to be done. The locals were beginning to feel the effects of the traffic fall-off. Their new large equipment was flying with more and more empty seats. In an attempt to cut costs, and relieve a pretty desperate situation, the carriers naturally reduced their most marginal services. They either cut back to a bare minimum, or suspended service completely. In some cases, they were able to develop substitute services in conjunction with commuter carriers. Mergers followed. They are products of bad times, and are symptoms, not answers.

In December of 1969, the Chairman asked the staff to put together a top-to-bottom study, with recommendations on how best to deal with the problem of service to small communities. Before the Senate Commerce Committee in May 1970, the Chairman testified about the worsening problem. He outlined the alternatives which the Board would be exploring. The idea was to consider all the possibilities -- including some that could completely scrap the existing system. We considered six alternatives:

1. Changing or abandoning the subsidy class rate;
2. Seeking a subsidy increase;
3. Implementing a non-Federal subsidy program;
4. Subsidizing air taxi operators;
5. Instituting a contract bid system;
Simply changing or abandoning the subsidy class rate, or increasing subsidy funds does not get to the fundamental problem of the inability of the certificated carriers to meet small community needs. A non-Federal subsidy program has obvious financial problems. Doing nothing, of course, leaves us in the unsatisfactory position we're in now. Direct subsidy of air taxi operators would probably be the prelude to an expansion of that system without really focusing on matching service to needs.

We found that the greatest promise for better service at a reasonable cost to the taxpayer seems to be in a new approach -- the contract bid system. This is a major new departure from the usual Board licensing procedures. It is embraced in the bill which the Board put before Congress, for a three-year experimental authorization, and is now pending before the Senate in S. 3460. Let's examine the background for a clear understanding of the Board's proposal.

The Changing System

The local service carriers were given certificates in the '40's and '50's to provide feeder service linking the small communities of a region to central hub points. Over the earlier years they generally responded very well to the needs of the system. But, air transportation is dynamic, and changes have taken place. We're all familiar with those changes.

First, the local service carriers have been transformed into small regional trunklines. Most of their passenger miles are flown on subsidy-ineligible routes between the larger cities of a region. Their smallest aircraft are at least double the size of the 21-seat DC-3's they began
with. And they have fleets of jets seating up to 120 persons each.

Finally, for a variety of reasons, the local service carriers have focused their energies on the needs of their higher density markets. The result has been that the carriers' services to their smaller points have become less responsive to the needs of those communities, even while the carriers' subsidy demands have increased substantially.

No one's to blame for the situation. Yet everyone's to blame. Everyone concerned, including the Board, has had a hand in leading us to our present position. The carriers wanted to expand their systems, and to move on to larger, more sophisticated equipment. The Board gave them the route structures to support big jets. As a result, the carriers originally chosen to provide local service to small communities no longer have the best equipment for the job, and are turning their interests elsewhere. This inevitably shows up in diminished service to small communities, and in increasingly high costs.

The second major change since the certification of the local service carriers has been the vast growth of the air taxi and commuter air carrier industry. A major factor here has been the development of efficient, light-weight turboprop aircraft than can seat up to 19 passengers. Under Board regulations, aircraft weighing less than 12,500 pounds can be operated in common carrier air service without a certificate of public convenience and necessity. The combination of that regulation, plus the new lightweight aircraft, has virtually created a whole new class of
carriers. They are unsubsidized. They are not protected in any way from competition by other carriers. They can often provide short-haul service to small communities a lot more cheaply than can certificated carriers.

In a large number of short-haul markets, air taxis and commuters compete successfully with the certificated carriers, including subsidized local service carriers. In addition, commuter carriers now operate scheduled service to over 200 points small enough for certificated carriers either to have given them up or never to have asked to serve them in the first place.

The third change is the expansion and improvement of the nation's highway system during the '60's. In this country, as nowhere else on earth, the private automobile has become the principal means of short-haul transportation.

The fourth, and very significant change, has been the shift of population in rural America, in the plains and mountain states. These areas need good air transportation. In many cases, it is virtually a matter of economic and social survival. What significant industry would locate in an area without good air service? How can we prevent the continuing exodus to the overcrowded cities unless there is a sound economic base, supported by air transportation, to encourage people not to move to the cities? As a matter of national policy, we think these considerations should weigh heavily.

We believe a contract bid system could deal with the changed system. It would have a number of important advantages over the current system:
1. It would be more responsive to changing local needs than the present approach;

2. It would more directly relate Federal payments to a particular community's air services than the present approach;

3. It could be provided at substantially less cost to the taxpayer, without placing a large new burden on the fare-paying passenger;

4. It would automatically adjust to take account of changing carrier interests and technological improvements;

5. It would go far to insure that the carrier with the most appropriate equipment, experience, and ability is selected to meet the community's needs. It would probably result in greater carrier identification with the small community.

The Experiment

In rough outline, here's how the experiment would work. After receiving the views of interested communities, state authorities, and so on, in each of several geographical areas the Board would select a number of communities to receive the experimental air service by contract. Our current thinking is that we'll have to try the experiment in at least three different areas, with varying economic and geographical features. Necessarily, this will mean some picking and choosing. It's a limited experiment we're talking about. Once the communities were selected, the Board would specify the kind of air service it would support. That would include the maximum fare level, the minimum number of flights, and minimum aircraft capacity. Interested parties -- who could include air
taxi operators as well as certificated carriers -- would be invited to submit bids showing how large a Federal payment they would require to provide the service. The lowest bidders would be selected, provided they were found to be able to provide safe and reliable service. Contracts would run for no more than three years, and the existing contractor would have no greater rights than anyone else to bid on a follow-on contract. Finally, renegotiation of the contract price would be expressly precluded, except to take account of increased costs attributable to governmental actions.

A contract could not be awarded until the Board determined that the carrier was capable of meeting all the requirements of the FAA and the Board as to safety and reliability of operations. We're not interested in buying cheap service at the expense of safety. Marginal operators would be kept out.

In terms of funding, the bill would authorize appropriations of $2,000,000 per year. That level was selected for several reasons: One is that it is large enough to enable the Board to try out the contract method of air service in a number of diverse geographical areas of the country. A second is that until the Board and air carrier industry become familiar with the contract process, it will be difficult to estimate accurately what contract prices will actually be bid.

Air service by contract program should not increase the total Federal outlay for support of small community air service. In fact, the odds are
that the contract program would result in a decrease of Federal expenditures. Our staff studies indicate that, particularly at the local service carriers' smaller points, replacement of certificated subsidized service by commuter carrier operations under a contract could result in some very substantial savings.

For illustrative purposes, the Board's staff analyzed the likely difference in Federal costs between subsidized operations by a local service carrier, on the one hand, and contract operations by a commuter carrier, on the other, at six small communities in Colorado, Kansas, New Mexico and South Dakota. The analysis indicates that at those six points, alone, the Government could save over a half-million dollars per year by using the contract method.

However, we're not talking about saving Federal money by imposing substandard air transportation on small communities. On the contrary, we think that the contract approach would lead to air service more in keeping with what small communities need and want. Admittedly, air service by contract would be on a no-frills basis. A Twin Otter or Beech 99, for instance, isn't as big or as comfortable as a Convair 580 or Fairchild F-227. But they're reliable, suited for smaller airports, and capable of being operated at lower costs than larger aircraft. More importantly, we think that in most instances carriers providing air service by contract would operate more flight frequencies on schedules better attuned to community travel patterns. This has been our experience with replacement
services now in progress. On the short-hops, which are characteristic of small community service, more flights at better times are likely to outweigh the extra comforts of large aircraft service. That's probably a major reason why traffic has increased in markets where certificated carriers have been replaced by third level carriers.

It is important to recognize that the proposal has close relatives throughout the existing small community air transportation system. For instance, at a variety of points, air taxi and commuter carriers are today providing air service under contract with certificated carriers or with Government agencies. The Board's proposal, in other words, is an evolutionary one that is based, to a significant extent, on present day experiences and practices.

What Next?

We have had one hearing before the Senate Commerce Committee on our proposal. Our bill is pending there, but no action has yet been taken on the House side. We have the general support of the Office of Management and Budget and the Department of Transportation for our proposed experiment.

Criticism of our proposal has been fairly light. There is some concern over safety of small aircraft, but we have specifically provided that the operators must meet FAA safety standards to qualify as bidders. Some of the commuter carriers insist that route protection is necessary to insure success. We feel differently. Any successful bidder has an automatic advantage by reason of the financial support he gets. Obviously,
THE SHORT-HAUL AIR TRAVEL MARKET
-- EVALUATION OF NEW FORMS OF SERVICE

Presented by
David A. Couls
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Introduction

What I want to discuss in this paper are some important but neglected aspects of the demand for air travel and an approach for incorporating them in evaluations of new services. The approach as described here is being used to evaluate the market for STOL aircraft in the 1980's but it could just as well be used to evaluate the market effects of schedule changes, equipment changes, new routes, and so forth, if certain basic data relating these changes to demand are available. A most important change in the market which is likely to take place in the next fifteen years, and which is already underway, is the increasing availability of alternative airports in major cities, and I will show how the effects of this change and its market implications may be evaluated.
A distinctive characteristic of the approach is that it requires no elaborate network simulation model -- the evaluations are made for city-pairs. Obviously an airline must make a final evaluation of any major service change in the context of a network, but it is extremely difficult to parameterize a network model so as to obtain realistic estimates of the demand response to service changes. The more elaborate a model, the more assumptions must be made in constructing it, and the less is the ability to represent the effects of service changes, especially changes not anticipated when the model was formulated. Therefore the fact that the approach is not based on a network model requires no apology. The network implications of the analysis can be considered after the main findings are obtained. It would not be surprising if, in some cases, an incidental conclusion from examining the network implications were that changes in the network are required.

Determinants of Demand

Demand for intercity air travel is likely to depend on characteristics of travelers, their reasons for travel, the origins and destinations of their trips, and the characteristics of air travel and alternative modes of travel. There has not been a detailed survey of the characteristics of intercity travelers and their travel behavior. What data are available give a very incomplete description. They consist only of a continuous 10 percent ticket sample, several airport surveys, and a few passenger surveys in which essential
information was either not obtained or lost in the process of compiling the survey results. None of these attempts to obtain and preserve data on the complete trip made by individual travelers, that is, the door-to-door trip. Thus, to piece together a picture of air travelers and trips required some speculation.

Two obvious characteristics of alternative means of travel are speed and fares. It seems from empirical studies that while these are important, their effect on demand is in their contribution to the total door-to-door times and costs of trips. It has been found, too, that demand is more sensitive to trip time than to cost.

It is possible that demand is more sensitive to some elements of travel time than it is to others. For example, the frequently heard complaint, "I spent more time driving to the airport than on the flight," may reflect a greater demand sensitivity to access time than to line-haul time. It is also possible, indeed likely, that demand is sensitive to other characteristics of air trips such as stops and transfers. While these possibilities exist there has been no systematic investigation to test them and measure the demand responses. We must be satisfied with the assumption that a service which provides shorter door-to-door times than is provided by existing air services would have an advantage, other factors of the service not related to travel time being similar.

Other aspects of service that are likely to be important are frequency of service, safety, and reliability. The effect of frequency has been investigated
as a "schedule delay." If a traveler must depart earlier than he would prefer to, because the next flight would cause him to arrive later than he wishes at his destination, then the time between actual departure time and preferred departure time is the schedule delay. It was found that schedule delay had a definite effect on demand and was treated as part of door-to-door travel time. We have no information on whether or not the sensitivity of demand to schedule delay is the same as sensitivity to total door-to-door travel time. We shall assume it is the same.

The effects on demand of safety and reliability have not been estimated. We shall assume that STOL and CTOL aircraft will be equally safe and reliable.

Congestion is an important characteristic of air travel. It is the cause of delays that contribute to door-to-door travel time (although, as before, the demand sensitivity to delay may not be the same as the sensitivity to total travel time). We must consider delay both in the air system, in ground access, and in terminals.

The short-haul air travel market is primarily a business travel market. A person making a short-haul trip on business will generally wish to depart from home in the evening or in the morning, early enough to spend several hours at his destination, and return home on the same day; or, if his trip is for more than one

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1 Demand for Intercity Passenger Travel in the Washington-Boston Corridor, Systems Analysis and Research Corporation, Boston.
days he will wish to spend several hours at the destination city on the last day before returning home. In either case he will probably depart from his home rather than from his employment location, and will wish to return in the evening directly to his home rather than to the location of his employment.

Thus, the most convenient airports for originating short-haul trips will be those easily accessible from residences. The most convenient destination airports for business trips will be close to business establishments. The median annual income of air passengers traveling on business is high, $16,000 to $18,000. Clearly originating airports should have good access to middle- and upper-income residential areas. While actual destinations may not all be close to the business district of a destination city, many of them are likely to be, and therefore a city center airport could be convenient as a destination airport. On the trip home, a business traveler would probably want to retrace his steps, departing from the city center airport (if such exist) and returning to the suburban airport close to his home where he may have left his car or where his wife can meet him conveniently.

While demand is sensitive to differences in travel cost, not all the cost consists of fares. Easier access might be less costly, as well as less time-consuming and, if so, would be an additional advantage of the service. However, even if total cost increased, either because of increased access cost or higher fares, the combined effect of time and cost could still make a new service attractive to passengers. The implication for
service frequency and other aspects of service are obvious. Passengers may be assumed to weigh together all the characteristics of the door-to-door trip, and not to base travel decisions on a single attribute of the service.

**Approach**

The approach uses an air route time and fare model, a city model, and a demand model. The air route time and fare model includes simplified flight profile formulas for CTOL and STOL aircraft, but is otherwise quite conventional and need not be described here. The city model will be described in outline and the demand model will be described in more detail.

**The City Model**

We wish to explore the effect of introducing new services based on airports other than the existing major airports. For this exploration it will be necessary to make assumptions about the locations of airports and the spatial distribution of trip origins and destinations so as to estimate access times and costs for both the new and the existing services. I shall describe the assumptions in terms of a hypothetical, idealized circular city, although an actual city would do just as well. This idealized city consists of a central business district 3 miles in diameter, a ring of inner city zones 10 miles wide, and an outer ring of suburbs, also 10 miles wide (see Figure 1). All except the central zone have been further divided into
Figure 1
THE GENERALIZED CITY

CBD 1.5 miles
10 miles
10 miles

INNER CITY

SUBURBS
four sectors. Thus, there are nine sectors in the city. Sector-to-sector travel between cities will be a function of the population, income and employment in the zones as well as door-to-door travel time and trip cost.

By locating STOL-ports and conventional airports at various points throughout the hypothetical origin and destination cities a variety of route configurations and new services can be tested ranging from conventional aircraft operating from suburban airports, to STOL aircraft operating from special STOL-ports in a variety of direct and indirect route configurations. The existing large conventional airport has been arbitrarily assumed to be located at point C in Figure 1 while short-haul airports, either CTOL or STOL, may be located at any or all of the other lettered locations -- except A, which is assumed to be suitable for STOL only. It is assumed that STOL aircraft can operate from conventional airports but that conventional aircraft cannot operate from STOL-ports.

Residential and employment density distributions were compared for several medium and large cities and were found to be sufficiently consistent to be used in calculating numbers of households (with incomes above $10,000) and the numbers of employees in each ring of the hypothetical city. A rough check of the results was made by comparing the city with Boston. Figure 2 shows the hypothetical city superimposed on a map of Boston. Quite a close correspondence was obtained when it was assumed that population and employment are zero in sectors 4 and 5 and that the population and employment of sector 1 is only 75 percent of that calculated
Figure 2
MODEL ADAPTED TO BOSTON AREA
for the hypothetical city. The correspondence might have been further improved by adjusting the radios of sector 1 to represent the actual size of the Boston CBD.

The city model is also used to generate airport access times and costs. Time and cost were calculated for access to each airport from each sector on the basis of a set of assumptions about automobile speeds and costs, and the costs and times of using taxis, airport limousines and rental autos. The traveler's own auto was considered as an alternative only in the origin city and rental auto was considered only in the destination city. Parking costs and waiting times were assumed where appropriate.

The Demand Model

The obvious effect of introducing any of the services we wish to evaluate is that many trips would then be made with shorter access times and lower access costs. Simply adding a new airport has this effect. Of course, other aspects of a new service may be so inferior to the existing service that the access advantage is insufficient to affect demand. This is part of the question to be answered in the study. But in view of the great importance of access which represents about as much time as the flight for many trips, the models were formulated so as to demonstrate access effects clearly. Thus, the demand model is formulated as 81 separate demand functions representing demand for travel from each of the nine sectors of the city of trip origin, to each of the nine sectors of the city of trip destination.
It is useful to consider trips as round trips from the origin. The purpose of a trip and its destination are obviously closely related to the origin, purpose, and destination of the return trip. In the absence of more detailed information on the actual origins and destinations of trips we will assume that they all originate at travelers' residences. We will assume that destinations are distributed according to the distribution of non-farm employment which may be appropriate for business trips but is not necessarily a very good assumption for other trips. Since the direct demand elasticities with respect to time and cost for air travel are indicated to be similar for various trip purposes we shall assume that all are the same as for business trips. Thus, in effect, we are assuming that all short-haul air travel demand is like the demand for business trips. This assumption can be modified, but it is certainly applicable to the large proportion of trips that are business trips, and it is not obvious what better assumption would be representative of other smaller fractions of the market (the various kinds of personal trips).

The demand model we shall use is a constant elasticity model. This choice is taken because it permits elasticities estimated in air travel demand studies to be used directly, because it has behaved satisfactorily in previous demand studies, and because no other type of model has been found to be superior. We do not suppose that another model will not be found to be better when true origin-destination data become available for analysis, but for now the constant elasticity assumption is at least as good as any.
The demand model is:

\[ D_{ijr} = K \left( \frac{f_{ij0}}{f_{ij0}} \right)^{\eta_f} \left( \frac{t_{ij0}}{t_{ij0}} \right)^{\eta_t} \left( \frac{Y_{ij0}}{Y_{ij0}} \right)^{\eta_Y} \left( \frac{P_{ij0}}{P_{ij0}} \right)^{\eta_P} \left( \frac{E_{ij0}}{E_{ij0}} \right)^{\eta_E} \Pi_{k} \left[ \frac{f_{ijk0}}{f_{ijk0}} \right]^{\mu_fk} \left( \frac{t_{ijk0}}{t_{ijk0}} \right)^{\mu_{tk}} \]  \hspace{1cm} (1)

The variables are as follows:

- \( D \) = demand for air trips;
- \( f \) = trip cost (door-to-door);
- \( t \) = time (door-to-door);
- \( Y \) = family income;
- \( P \) = population with family income > $10,000;
- \( E \) = non-farm employment; and
- \( K \) = a constant.

The subscript \( i \) denotes a sector in the origin city, \( j \) denotes a sector in the destination city, \( k \) denotes a linehaul mode other than air, and \( r \) denotes a time period.

The index \( \eta \) denotes a direct demand elasticity. The index \( \mu \) denotes a cross elasticity, that is, the sensitivity of demand for trips by air to cost or time for making the trip by another mode \( k \). The multiplicative operator \( \Pi \) encompasses all competing linehaul modes.

Let \( D_{ij0} \) be the demand for air trips at time zero, where \( \gamma = 0 \) denotes the time immediately prior to introduction of a new short-haul air service, and let \( D_{ij1} \) be the demand a short time after the new service is introduced. We can write the demand function for air trips at time \( 1 \) in terms of the demand at time zero:

\[ D_{ij1} = D_{ij0} \left( \frac{f_{ij1}}{f_{ij0}} \right)^{\eta_f} \left( \frac{t_{ij1}}{t_{ij0}} \right)^{\eta_t} \left( \frac{Y_{ij1}}{Y_{ij0}} \right)^{\eta_Y} \left( \frac{P_{ij1}}{P_{ij0}} \right)^{\eta_P} \left( \frac{E_{ij1}}{E_{ij0}} \right)^{\eta_E} \Pi_{k} \left[ \frac{f_{ijk1}}{f_{ijk0}} \right]^{\mu_fk} \left( \frac{t_{ijk1}}{t_{ijk0}} \right)^{\mu_{tk}} \]  \hspace{1cm} (2)
For some trips, the time and cost of travel by air will be changed by introduction of the new service, but family incomes, population and employment will not have changed in the interim. We shall also assume that trip time and cost by alternate modes will not have changed. This probably is true of automobile trips, although a diversion of a large number of automobile trips to air might reduce highway congestion and so reduce trip time and cost by that mode. Diversion of bus and train passengers to air might have the opposite effect -- schedule frequencies for bus and train might be reduced and fares increased -- but the effect on the demand for air travel would be small because there are so few intercity bus and train passengers that a very substantial fraction would have to be diverted for the number of air trips to be much affected.

Thus, the instantaneous effect of introducing the new service is to leave the ratios of income, population, employment and fares and times of competing modes all equal to 1.0. Equation (2) may be conveniently rewritten as

\[ D_{ij1} = D_{ij0} \left( \frac{f_{ij1}}{f_{ij0}} \right)^{n_f} \left( \frac{t_{ij1}}{t_{ij0}} \right)^{n_t} \]  (3)

If at some later time 2, income, population and employment will have changed, but fares and travel time will not, the demand will be given by the equation

\[ D_{ij2} = D_{ij1} \left( \frac{Y_{i2}}{Y_{i1}} \right)^{n_y} \left( \frac{P_{i2}}{P_{i1}} \right)^{n_p} \left( \frac{E_{j2}}{E_{j1}} \right)^{n_e} \]  (4)

Now consider the total demand for air trips from all origin sectors in one city to all destination sectors in
another. Let \( D_0 \) be the total demand before a new air service is introduced and let \( D_1 \) be the total demand immediately after. Ignoring competing ground modes,

\[
D_0 = \sum_{i} \sum_{j} \nabla_i \nabla_j f_{ij0} \eta_p \eta_r \eta_y \eta_y \eta_p \eta_E.
\]

\( D_0 \) is a number we can estimate from ticket sample data, but for now assume the value is 100. We can then solve equation (5) for the constant \( K \) and calculate each \( D_{ij0} \) as a percentage of the total \( D_0 \). If a new service is introduced we can use \( K \) to calculate \( D_{ij1} \) for each pair of origin and destination sectors using equation (3) and hence calculate \( D_1 \). The resulting \( D_1 \) expresses the demand when the new service is introduced as a percentage of the previous demand, \( D_0 \). If \( D_1 \) is 140, say, then the effect of introducing the new service is to increase the number of air trips between the two cities by 40 percent.

It is assumed that in choosing which of the alternative routes would be taken for a trip from origin sector \( i \) to destination sector \( j \) a "value of time" evaluation of the alternatives is made. The combination of air route and access modes is selected which results in the lowest total of actual cost and value of door-to-door time. The resulting cost and actual time of that combination then enter the demand model. The appropriate value of time is usually considered to be a multiple of the traveler's annual income, but the exact multiple is a subject of considerable uncertainty. However, we have found the selection of air routes in the model to be not very sensitive to value of time in
the range $0.18$ to $0.50$ per minute, which corresponds to a range of 1.2 to 3.7 times the median income of air passengers.

Other parameters of the demand model important to this discussion are the elasticities with respect to door-to-door cost and travel time. The following are elasticities estimated in the SARC\textsuperscript{1} study.

**ELASTICITIES OF DEMAND FOR TRIPS BY AIR**

<table>
<thead>
<tr>
<th>Trip Purpose</th>
<th>Trip Cost</th>
<th>Travel Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business</td>
<td>-0.891</td>
<td>-2.103</td>
</tr>
<tr>
<td>Personal</td>
<td>-0.914</td>
<td>-2.213</td>
</tr>
</tbody>
</table>

**Results**

We shall consider several scenarios of future short-haul service, each consisting of a combination of routes and aircraft.

Referring to Figure 3, diagrams (a) and (b) in the upper part of the figure represent a short-haul CTOL service; the diagrams in the lower part, (c) and (d), represent a short-haul STOL service; and in both cases the new short-haul service is competing with the conventional major airport service. The STOL service collects passengers from suburban airports in each city and carries them to the central STOL-port of their destination city. We have assumed that on the return trip passengers would find the aircraft had reversed direction on the route so that service would be from A in their destination city to the suburbs in their city of residence.

\textsuperscript{1}Systems Analysis and Research Corporation, *op. cit.*, p. 5-47.
Figure 3
SCENARIO I -- CTOL AND STOL.

(a)

(b) CTOL

(c)

(d) STOL
The demand analysis of Scenario I is summarized in Table 1. The data in the table are for the assumption of an intercity distance of 185 miles. Case 1 is the conventional major airport service whose level of demand (in trips) is assigned the index value 100.

The results indicate that with the FH-227, a 40-passenger jet-STOL having a speed of 400 miles per hour (STOL-40) and the DHC-7 operating on Scenario I, total demand would increase between 9 and 12 percent, and 10 to 27 percent of the trips presently carried by the conventional service would be diverted to the new service. The DC-9 in Scenario I would divert 58 percent and result in an increase in the total demand of 29 percent. A 120-passenger STOL with a speed of 500 miles per hour (STOL-120) would divert 53 percent and increase total demand by 44 percent.

In all the cases shown in Table 1 the proportion of short-haul trips originating at airport D is very small, suggesting that better results might be obtained if the cost of serving airport D were not included in the fare. Scenario II is like Scenario I except that the short-haul route originates at B instead of D. Table 2 compares the two scenarios for two cities 185 miles apart. The fares are considerably less for Scenario II and as a consequence more trips are demanded. Scenario II is clearly the superior. Another observation can be made from the table -- the faster aircraft, the DC-9 and the STOL-120, are superior to the others in both scenarios. It might have been expected that STOL characteristics of the STOL-40 and the DHC-7 might compensate for low speed in flights as short as 185
Table 1
SECNARIO I -- DEMAND
(Intercity Distance 185 Miles)

<table>
<thead>
<tr>
<th>Case</th>
<th>Aircraft</th>
<th>Fare$^{1}$</th>
<th>Origin</th>
<th>Destination</th>
<th>Block Time (Minutes)</th>
<th>Demand Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C.S.$^{2}$</td>
<td>22.00</td>
<td>C</td>
<td>C'</td>
<td>55</td>
<td>100</td>
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<tr>
<td>2</td>
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<td>22.00</td>
<td>C</td>
<td>C'</td>
<td>55</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>D</td>
<td>B'</td>
<td>75</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>DC-9</td>
<td>28.80</td>
<td>B</td>
<td>B'</td>
<td>58</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>E</td>
<td>B'</td>
<td>37</td>
<td>60</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>129</td>
</tr>
<tr>
<td>3</td>
<td>C.S.</td>
<td>22.00</td>
<td>C</td>
<td>C'</td>
<td>55</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>D</td>
<td>B'</td>
<td>99</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>FH-227</td>
<td>30.42</td>
<td>B</td>
<td>B'</td>
<td>79</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>E</td>
<td>B'</td>
<td>59</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>110</td>
</tr>
<tr>
<td>4</td>
<td>C.S.</td>
<td>22.00</td>
<td>C</td>
<td>C'</td>
<td>55</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>D</td>
<td>A'</td>
<td>68</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>STOL-120$^{3}$</td>
<td>34.82</td>
<td>B</td>
<td>A'</td>
<td>51</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>E</td>
<td>A'</td>
<td>35</td>
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<td></td>
<td></td>
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<td>144</td>
</tr>
<tr>
<td>5</td>
<td>C.S.</td>
<td>22.00</td>
<td>C</td>
<td>C'</td>
<td>55</td>
<td>90</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>D</td>
<td>A'</td>
<td>62</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>STOL-40$^{3}$</td>
<td>50.83</td>
<td>B</td>
<td>A'</td>
<td>48</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>E</td>
<td>A'</td>
<td>34</td>
<td>15</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>109</td>
</tr>
<tr>
<td>6</td>
<td>C.S.</td>
<td>22.00</td>
<td>C</td>
<td>C'</td>
<td>55</td>
<td>73</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>D</td>
<td>A'</td>
<td>89</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>DHC-7</td>
<td>38.23</td>
<td>B</td>
<td>A'</td>
<td>73</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>E</td>
<td>A'</td>
<td>56</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>112</td>
</tr>
</tbody>
</table>

$^{1}$All passengers on the short-haul service pay the same fare. Fare includes 8 percent U.S. tax.

$^{2}$C.S. denotes existing "conventional" service connecting major airports.

$^{3}$Jet-STOL fares in this table are calculated on the manufacturing cost only, without allowance for R and D costs.
Table 2
COMPARISON OF SCENARIOS I AND II
(Intercity Distance 185 Miles)

<table>
<thead>
<tr>
<th>Case</th>
<th>Aircraft</th>
<th>Fare</th>
<th>Demand Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DC-9</td>
<td>$28.80</td>
<td>129</td>
</tr>
<tr>
<td>2</td>
<td>FH-227</td>
<td>30.24</td>
<td>110</td>
</tr>
<tr>
<td>3</td>
<td>STOL-120</td>
<td>34.82</td>
<td>144</td>
</tr>
<tr>
<td>4</td>
<td>STOL-40</td>
<td>50.83</td>
<td>109</td>
</tr>
<tr>
<td>5</td>
<td>DHC-7</td>
<td>38.23</td>
<td>112</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Case</th>
<th>Aircraft</th>
<th>Fare</th>
<th>Demand Index</th>
</tr>
</thead>
<tbody>
<tr>
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<td>137</td>
</tr>
<tr>
<td>2</td>
<td>FH-227</td>
<td>27.05</td>
<td>112</td>
</tr>
<tr>
<td>3</td>
<td>STOL-120</td>
<td>31.69</td>
<td>153</td>
</tr>
<tr>
<td>4</td>
<td>STOL-40</td>
<td>44.43</td>
<td>122</td>
</tr>
<tr>
<td>5</td>
<td>DHC-7</td>
<td>34.55</td>
<td>117</td>
</tr>
</tbody>
</table>

\[1\] STOL aircraft operate into STOL-port A'. CTOLs operate into airport B'.

---
miles, but this does not seem to be the case. The FH-227 has neither speed nor STOL characteristics, and that it can offer a relatively low fare is apparently not sufficient to compensate for the disadvantages. The STOL-120 has both considerable speed and STOL characteristics.

At an intercity distance of 500 miles the advantage of speed becomes more pronounced, but the STOL characteristics of the STOL-120 are still more than sufficient to compensate for its cruise speed disadvantage in relation to the DC-9. Table 3 compares Scenarios I and II for this intercity distance. Only the DC-9 and the STOL-120 are able to compete at all effectively with the conventional service, but both do so with comparable success. On a performance basis the STOL-120 appears to have the advantage, but the DC-9 is able to offer service at considerably lower fares.

All the above results were obtained assuming that the STOL-40 and STOL-120 would be priced on the basis of manufacturing cost. If we consider that the cost of research and development might amount to $2 million or more per aircraft, then if this cost were to be passed on to the passengers the fares would have to be higher. Since the STOL-40 is apparently unsuccessful even when priced on the basis of manufacturing cost alone, we will not consider it further. We will also ignore the FH-227 and the DHC-7 in the subsequent scenarios.

Scenario III (Table 4) consists of three cases in which a nonstop short-haul service competes with conventional service. The intercity distance is 185 miles. In Case 1 a DC-9 operates between suburban airports B
Table 3
COMPARISON OF SCENARIOS I AND II
(Intercity Distance 500 Miles)

<table>
<thead>
<tr>
<th>Case</th>
<th>Aircraft</th>
<th>Scenario I</th>
<th>Demand Index</th>
<th>Scenario II</th>
<th>Demand Index</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DC-9</td>
<td>$37.91</td>
<td>128</td>
<td>$36.00</td>
<td>131</td>
</tr>
<tr>
<td>2</td>
<td>FH-227</td>
<td>48.03</td>
<td>100.1</td>
<td>45.95</td>
<td>100.3</td>
</tr>
<tr>
<td>3</td>
<td>STOL-120</td>
<td>47.12</td>
<td>126</td>
<td>44.00</td>
<td>134</td>
</tr>
<tr>
<td>4</td>
<td>STOL-40</td>
<td>-</td>
<td>100.0</td>
<td>69.96</td>
<td>101</td>
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<td>5</td>
<td>DHC-7</td>
<td>-</td>
<td>100.0</td>
<td>-</td>
<td>100.0</td>
</tr>
</tbody>
</table>
Table 4
SCENARIO III
(Intercity Distance 185 Miles)

<table>
<thead>
<tr>
<th>Case</th>
<th>Aircraft</th>
<th>Origin</th>
<th>Destination</th>
<th>Fare</th>
<th>Demand</th>
</tr>
</thead>
<tbody>
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<td>C'</td>
<td>$22.00</td>
<td>23</td>
</tr>
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<td>DC-9</td>
<td>B</td>
<td>B'</td>
<td>20.87</td>
<td>121</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td>144</td>
</tr>
<tr>
<td>2</td>
<td>C.S.</td>
<td>C</td>
<td>C'</td>
<td>22.00</td>
<td>23</td>
</tr>
<tr>
<td></td>
<td>STOL-120</td>
<td>B</td>
<td>A'</td>
<td>24.22</td>
<td>151</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td>174</td>
</tr>
<tr>
<td>3</td>
<td>C.S.</td>
<td>C</td>
<td>C'</td>
<td>22.00</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>STOL-120</td>
<td>A</td>
<td>A'</td>
<td>24.85</td>
<td>176</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td>188</td>
</tr>
<tr>
<td>2A¹</td>
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<td>C</td>
<td>C'</td>
<td>22.00</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>STOL-120</td>
<td>B</td>
<td>A'</td>
<td>28.19</td>
<td>133</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td>158</td>
</tr>
<tr>
<td>3A¹</td>
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<td>C</td>
<td>C'</td>
<td>22.00</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>STOL-120</td>
<td>A</td>
<td>A'</td>
<td>28.82</td>
<td>158</td>
</tr>
<tr>
<td></td>
<td>TOTAL</td>
<td></td>
<td></td>
<td></td>
<td>170</td>
</tr>
</tbody>
</table>

¹Cases 2A and 3A are like Cases 2 and 3, respectively, except that the fares in 2A and 3A are sufficient to recover $2 million for R and D costs in the price of each STOL-120.
and B'. The DC-9 service has a lower fare than the conventional service and is not delayed by the congestion at major airports. It is able to divert 77 percent of the conventional service's demand and to induce an increase of 44 percent in total demand.

Case 2 is a STOL-120 operating from airport B to STOL-port A' and from B' to A. (The hops from A' to B' and from A to B are assumed to attract no passengers.) Case 3 is a STOL-120 service between STOL-ports A and A'. Both of these cases show much greater demand than the corresponding Case 3 of Table 2.

All these cases show that direct flights attract more trips than flights which stop en route. It should be noted that this result is due to the lower fares of nonstop service. In all the scenarios a direct flight is available and, indeed, the calculations show that the airport at which direct service is provided always originates the most trips. The progression through Scenarios I, II, and III is one of decreasing service and decreasing fares, except for Case 3 of Scenario III, the service between Airports A and A' which has no counterpart in the previous scenarios. The significance of Case 3 is that, for our assumed distribution of trip origins and destinations, service between central airports seems to be preferred to service between suburban airports or between suburban and central airports, even though the fare is higher.

Cases 2A and 3A in Table 4 differ from Cases 2 and 3 in that the fares are set high enough so as to recover $2 million of R and D costs on each STOL-120. Even with this higher charge the demand for STOL-120 trips is
### Table 5
SCENARIO III
(Intercity Distance 500 Miles)

<table>
<thead>
<tr>
<th>Case</th>
<th>Aircraft</th>
<th>Origin</th>
<th>Destination</th>
<th>Fare</th>
<th>Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>C.S.</td>
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<td>C'</td>
<td>$43.00</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>DC-9</td>
<td>B</td>
<td>B'</td>
<td>30.53</td>
<td>127</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>139</td>
</tr>
<tr>
<td>2</td>
<td>C.S.</td>
<td>C</td>
<td>C'</td>
<td>43.00</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td>STOL-120</td>
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<td>A'</td>
<td>37.59</td>
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<td></td>
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</tr>
<tr>
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<td>C</td>
<td>C'</td>
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<td>9</td>
</tr>
<tr>
<td></td>
<td>STOL-120</td>
<td>A</td>
<td>A'</td>
<td>38.22</td>
<td>143</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>152</td>
</tr>
<tr>
<td>2A¹</td>
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<td>C</td>
<td>C'</td>
<td>43.00</td>
<td>31</td>
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<tr>
<td></td>
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<td>B</td>
<td>A'</td>
<td>44.60</td>
<td>98</td>
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<tr>
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<td>129</td>
</tr>
<tr>
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<td>C</td>
<td>C'</td>
<td>43.00</td>
<td>25</td>
</tr>
<tr>
<td></td>
<td>STOL-120</td>
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<td>45.20</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>135</td>
</tr>
</tbody>
</table>

¹Cases 2A and 3A are like Cases 2 and 3, respectively, except that the fares in 2A and 3A are increased to recover $2 million for R and D costs included in the price of each STOL-120.
Figure 3
MISCELLANEOUS SCENARIOS

<table>
<thead>
<tr>
<th>Demand Index</th>
<th>185 Miles</th>
<th>500 Miles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>207</td>
<td>172</td>
</tr>
</tbody>
</table>

(c)

(b)

(a)
greater than for DC-9 trips -- or rather, the combination of STOL-120 and the centrally located STOL-ports has an advantage over the DC-9 which is restricted to suburban airports.

Where the intercity distance is 500 miles the DC-9 has the advantage over the STOL-120. Table 5 summarizes the analysis of Scenario III for this distance and shows that if R and D costs of STOL are ignored the STOL-120 has a slight advantage operating between a suburban airport and a central STOL-port, and a distinct advantage operating between two central STOL-ports. However, if STOL fares are increased to reflect $2 million R and D cost per aircraft the demand for suburb-to-suburb service by DC-9 is slight greater than for STOL service between central airports.

Several other scenarios have been considered. Some appear capable of inducing an increase of more than 100 percent in the demand for trips. Three of them are diagramed and their demand indexes noted in Figure 3.

Diagram (a) shows two cities connected by six routes, four of them operated by DC-9s and two by STOL-120s. The conventional service is assumed to be discontinued. In the 185 mile case the two STOL-120 routes have a combined demand index of 127 and the four DC-9 routes a combined index of 80.

Diagram (b) shows a similar demand response to the introduction of 8 new DC-9 routes. The model output for this scenario shows that routes originating or terminating at a major airport (C or C') have the lowest demand indexes (since they are assumed to be affected
by congestion delays and higher landing fees). If airports D and D' were used instead of C and C' the index for this scenario would be higher.

Diagram (c) is the conventional major airport service (C - C') supplemented by three DC-9 suburban airport routes. Again, the results are lower than they would be if the major airport service were replaced by another suburban service. Even so, this CTOL scenario has a demand index comparable to the STOL-120 scenario 3A (Table 4).

Conclusion

I have tried to be brief and in so doing have passed over such questions as the cost and performance of jet-STOL aircraft and several other matters I would like to have discussed. The study on which this paper is based considered airport noise and congestion which are obviously important but which have not been discussed here. For example, it might have been mentioned earlier that the apparent disadvantage of conventional major airport service in competition with new service derives mainly from assumed congestion delays. In calculations that are not included here congestion delays are also assumed in the new services and diversion of traffic from the major airports is assumed to reduce congestion delays in conventional services. Let me point out that it is important to consider congestion delays. Delays on some routes are so common that a substantial allowance is made in the schedules. And
with regard to STOL I would like to suggest that a Manhattan STOL-port would very likely become the most congested airport in the world.

It has not been my intention to make strong claims for the models described here. They are convenient and plausible, but better models could certainly be proposed. What I do want to stress is the power of the approach. It has seemed to me that airlines tend to compete in advertising and "cosmetic" features of service rather than in more fundamental aspects, and that instead of looking for new ways to stimulate air travel they concentrate on obtaining their share of the existing market. This they do even to the extent of having the same departure times as their competitors on some flights serving the same route. The demand sensitivity to schedule delay indicates that more trips would be made if the departure times were different. Furthermore, scheduling several departures for the same time is a cause of congestion delays which have a negative effect on demand. My guess is that the approach described here -- the use of relatively simple, but general models -- can be applied to analyzing important questions and will give more useful results than an elaborate simulation model taking twice as long to develop and costing four times as much.
THIRD LEVEL AIR CARRIER SERVICE

Two weeks ago I became an Associate Professor of Economics at George Washington University and so I can't claim to speak for the Justice Department any more. However some of the comments I will make on Monte Lazerus' presentation reflect work that was done while I was at the Justice Department. Another thing I should tell you is that about two years before I went to the Justice Department, I began a study of the Federal program of subsidizing the local service airlines. The study was essentially finished before I went to Justice and is being published by the Brookings Institution. This study was done completely independently of the Bureau of Operating Rights study that Monte has just talked about. Amazingly enough both BOR and I identified the same problems with the current local series subsidy program. We arrived at the same set of policy options facing the government, and we reached the same general conclusions as to which cities should be served and what it should cost to serve them. It is the first case that I know of private study and a government study undertaken completely independently coming to such parallel conclusions. In fact I was a bit shocked when I heard that BOR was going to beat my publication date.

I think that the most logical follow-on to Monte Lazarus' talk might be to comment on the CAB draft bill, S3460. In general OMB, Justice and DOT appear to support the bill strongly. They all thought
it very innovative. I was particularly happy to see the limitation of $2 million a year on the proposed program because if you look back at the original local service experiment one of the real problems was it started out as a limited experiment and quickly got completely out of hand. The $2 million a year limitation is essential I believe. However, I am afraid that it may be raised as certain Senators see they can use this bill as a vehicle to expand local air service. I view the bill (and I think the CAB does also) in large measure as a way of providing existing or somewhat better quality of air service to cities now being served at substantially lower costs.

We talked about the Allegheny commuter experiment quite a bit this morning. Let me try to contrast the Allegheny experiment with some of the attempts at route replacement that have been attempted in North Dakota. In the Allegheny system you are dealing with a densely populated area here in the East. In most cases you have good forms of alternative transportation. The local service carriers are in points in this region primarily for historical reasons, not because air transportation of the sort they provide has ever been a major advantage to the public. You find that when you replace a one or two flight per day, inconveniently timed pattern with a multiple flight per day pattern you generate a good deal of additional traffic, winning it away from the roads and, in some cases, the railroads. You can make this into a profitable situation for a low-cost air taxi operator. Therefore you can find independent contractors who are willing to enter
into an Allegheny type commuter operation and Allegheny can conduct it at virtually no cost. The example I am most familiar with is the service from Trenton down to Washington via Philadelphia. Allegheny was operating in this market providing two flights per day at very inconvenient times. By 1969 they were down to somewhat below 6000 originating passengers per year even though Trenton has a population of over 100,000. There is a lot traffic between Trenton and Washington but Trenton is also on the main line of the Penn Central Railroad and is one of the few places that really has good rail service. Furthermore you have interstate highways all over the place.

Ransome Airways began operations between Trenton, North Philadelphia, Philadelphia, and Washington not long after the CAB liberalized its air taxi regulations in the mid-1960's to allow these carriers to compete with certificated carriers. After a brief period of growth mania of the sort that recently led to Executive Airlines' downfall, Ransome decided to concentrate on serving these four cities, the ones it knew best. When I started teaching at Princeton in the fall of 1970 it already had worked out a deal with Allegheny to handle its reservations and its ticketing at Trenton, though it was not then an official Allegheny commuter. Allegheny began to cut back even more service until it was offering the minimum possible schedules at the worst possible times -- flights were timed for the convenience of the carrier rather than for the convenience of the passengers. Finally, Ransome and Allegheny negotiated an official Allegheny commuter contract.
Ransome has been quite successful. In fact, it recently sold some of its 15 passenger Volpor Turboliners (Buck 18 conversions) and acquired some of Allegheny's mothballed Nord 262's.

In this case providing frequent air service timed to suit the needs of the local community has has a major stimulative effect on traffic, and this has permitted turning an unprofitable operation into a profitable one. An essential factor has been the use of smaller aircraft and the cutting out of all frills in the service.

In the region in which Frontier Airlines tried its air taxi replacement (I am referring specifically to the North Dakota experiment with Apache), additional frequencies would stimulate little additional traffic. These are small communities and will never generate much traffic. The use of air taxi-type aircraft only serves to lower cost — and subsidy requirements.

The contrast between these two cases also reveals why the Allegheny commuter replacements generally got community support while the Frontier replacement was fought. In the former case, flight frequency increases as the timing of flights improves. The community will put up with smaller aircraft in exchange for this. In the Frontier case, you traded low frequency Convair 580 service for low frequency air taxi service. There is little wonder the communities howled. People being heavily subsidized will always prefer a better service to a poorer service. The people in North Dakota would like jets — provided they didn't have to pay for them.

In the east where good transportation alternative generally exist,
short-haul, low-density air service can (and should) be provided without a subsidy. Where it cannot pay its own way, there is no case for subsidizing it. But in some areas of the far west, and especially in Alaska, a strong economic case can be made for government support for some level of air service. It is just a question of how much service you want to subsidize.

Question: "What is your objective to the Congress' motive to try to bring the air transportation where it is not today? You said you were afraid that they would use it to expand..."

A: Look at where air transportation is today. It is pretty much every place that can use it and probably beyond that point. However, the decision to subsidize is pretty much a political decision and if Congress feels that 500 additional cities "need" air service, and I will put the word "need" in quotes, then Congress can do that. Just appropriate the necessary money. Back in 1944 when the Board was talking about setting up the local service carriers, one proposal was to provide scheduled air service to every community in this country with over 5000 population. I don't care where you draw this line -- Congress can appropriate as much money as it wants -- but the key point is wherever you draw the line, the cheapest way to provide service is by use of a bid system of the sort that the CAB is proposing. Congress apparently does not like the use of small planes. I have talked to some of the people on the Senate Aviation Subcommittee and that is one of their big sticking points. O.K., if you don't want the small planes, if you
don't want a Twin Otter, move the minimum aircraft size limit in the bill all the way up to a DC-9. I don't believe that's right but if that's the way Congress want it, let them do it that way. But still use a bid system. Again, a bid system is the system that provides the maximum incentive to efficient operation.

Senator Cotton, for example, believes there should be, there "ought" to be, air service into Waterville Valley. And he says that Waterville Valley is an isolated place even though it is only 2½ hours from Boston over excellent roads. Unless you put in a minimum of 5 flights a day almost everyone is going to drive up except those people who happen to arrive at Logan Airport just the time the plane is leaving. Furthermore the traffic peak here, and that's during the winter, could probably support its own service without subsidy. But Senator Cotton says that Waterville Valley "ought" to have air service, and Senator Cotton is on the committee that votes the subsidy. So I would predict that one of the areas the CAB is going to have to "experiment" with will be New England, though I hope not. (From the floor: There is a reason why -- VOLPE(?) -- specific to the New England case). This is the way the subsidy gets votes and, in fact, as Monte pointed out, if you read the history of the debates on the subject -- Congress never says "let's cut it," they say "why aren't you asking for more?" Because subsidy is a very small item in the Federal budget. The fact that the subsidy is running to $40 a passenger or more at some of these points doesn't seem to bother Congress.
So to get back to your question, the answer is Congress who votes the subsidy decides what type of air service the country ought to have. (From the floor: No that wasn't my question. My question was as an economist don't you find it appalling to move air service in where it doesn't make sense economically?)

A: I look where air service is and I look at the cities where they are talking about putting it in and I can't see the benefits. But if the local community wants to subsidize it, fine. That's a thing which I think we should push more on. If a regional area or a local area wants to have air service they should be allowed to subsidize it. But from the viewpoint of the nation as a whole I can't see the benefit.

(From floor: Is there a community in the states now that is contracting for this type of service?)

A: I had a phone call from the Southeast Regional Council and apparently they have been putting some funds into a commuter carrier somewhere in Georgia. (Discussion) If you go back to 1944 when local service carriers were first established (again I have this tabulated in the book) and you see the cities that had air service and the cities that didn't have air service, you see that even then we had a pretty good system of air service. And then we added the locals on top of that and then we expanded the locals during the '40's and the 50's and finally we have had a huge expansion of the highway system. Add to this the fact that if you operate at any decent frequency of air service at all you are going to generate a large number of seats, even if you use smaller aircraft, and you quickly conclude that
expanding air service to more cities just doesn't make much economic sense. But if Congress wants to do it there is no way to stop them. We can show them the cheapest way of doing it and that's really it.

(From floor: That's really the most important objective -- the cheapest?)

A: Well if you have two alternatives -- A and B -- and they will give you the identical service, and if A costs half of what B does, then I think Congress would want A. They can get any level of service they want with a bid system. They can specify 50 flights a day and they can specify that they be flown with 747's. Still, the cheapest way is the bid system.

(From floor: Aren't you in fact saying that transportation should always follow instead of being the leader?)

A: No, I am saying that the way air transportation has been used in this country, it has not made much difference in the rate of regional development (except, perhaps in Alaska), and I don't believe a significant expansion of the program would improve the record any.

(From the floor: But that doesn't necessarily make it right. The highway program has just changed. They got a $100 M program appropriation out of Congress and they are accelerating highway development for the express purpose of developing economic areas that are rural in Vermont. Now there is a change in the use of transportation -- rather than putting a road in there for people to move someplace -- if that's possible.)
A: Let's put it this way. We have had a system of air transportation and we have put out approximately a billion dollars in subsidy over the last 25 years for the purpose of encouraging rural development. We've had a pretty good level of air service in a lot of these communities until the last couple of years. And it hasn't worked. The population has still continued to shift. Now if you believe that West Podunk, N.D. would grow into a great metropolis if it has air service you could put it there. Economics will not support you on that.

(From floor: You are saying that air service alone won't do it -- it needs tax incentives from the state, etc.)

A: If you give people enough money you can establish a city in the midst of the Sahara Desert. It's questionable whether that is economically viable, but you can do it.

Why don't we move on to some specific objections to the formulation of the current bill? (S3410) As I say, I generally support the bill but I do not support, and I don't think the Department of Justice will support, the provision of the bill allowing the CAB to specify the limitation on minimum aircraft capacity. If it is felt that for safety reasons a twin-engine aircraft with two pilots is needed, then put that in the bill. But if the twin-engine aircraft with two pilots has only two seats for the passengers, then I think that you achieve your safety objectives and still allow your operator this flexibility.

In certain of these regions, a four-seater plane with two pilots shuttling constantly between two airports might well be the best way
of providing service. If the operator believes that it is the cheapest way of providing safe, efficient air service, I think he should have that option. I don't think that will be the way that will work out in many markets but I hate to limit the freedom of the operator by requiring the use of fifteen passenger planes because what you are doing there is increasing the cost to the government with virtually no increase, if any, in safety. Hopefully the maximum rate provision will be ineffective. The rate that's set will be such that the carriers operating smaller aircraft will not hit the ceiling. But suppose that the operator figures out that the profit maximizing fare in a market is $18 and through some formula you have told him he can only charge $16. All you are really doing is saying that it is in the national interest to pay every passenger who flies that route an additional $2. And again I find that to be somewhat objectionable as an economist but I can see the political reasons why these things are necessary in the bill.

Additionally, I object strongly on page 6, section 7B, to the exception of section 401, subsection k from the CAB ability to exempt section 401 k of the Civil Aeronautics Act writes into the Civil Aeronautics Act what was called Decision 83 which set up the current pay system for airline pilots. And the denial of the exception to exempt this section essentially writes an ALPA pay scale into this bill. If contract operators find it necessary to unionize and to pay ALPA wages I have no objection. But I don't think they should be forced to pay ALPA wages, although I do recognize again that this provision was
put in for political reasons and I do not want to take any chance of sinking the Bill just over this objection. I think it should be recognized, though, that the effect is going to be a substantial increase in cost and it is going to also pave the way for unionization of the air taxis.

(From floor: It seems to me that the bill is asking bidders to make some pretty in-depth economic analysis and very probably you are going to get some bids in with less analysis than was necessary.)

A: Well that is the purpose of the bonding system -- to assure that bidders are able to perform as required by the contract -- though it does raise the cost of entry. However we are taking some risk here. One reason that this bill proposes a limited experiment is to learn if these operators can make the calculations required. We are not going, and I would not want to go, completely over to this system without such a trial although in my experience in talking with some of these people I find that they are quite sophisticated businessmen. They know how much it costs to run their operation and they know roughly how many people are going to fly. They may not have computers and may not know about advanced technology, but they know how their operation runs. I am more optimistic than you may be on this point.

(From the floor:)

A: I do not think we will lack for bidders and I think a lot of the bidders will present some very good bids. Some of the people I have talked to are fairly sophisticated.
(Discussion)

My understanding that the rate limit is probably going to be at what the local service air carrier is charging now on a given route which probably puts the limit at a point beyond what the air taxi is going to charge anyway. I think the limit will be, in effect, a moot point that is put in to maintain some semblance of regulatory control. I am referring to the maximum rate -- clearly they should not put a floor under rates.

I would like to talk briefly now about the presentation Bill Swan made this morning and, in particular, follow up on his division of air taxi operators into three classes -- professional commuter carriers, growth oriented airlines who consider the Port 298 exemption as a step toward becoming a certificated carrier, and "mom and pop" air taxi operators. I think this classification is very instructive as an aid to understanding the different viewpoints concerning some of the proposals to change air taxi safety and economic regulation.

I want to concentrate on the first group -- the professional commuter carriers -- since they are the ones who are carrying the bulk of the traffic. As Bill said, 80 to 90 percent.

Earlier a question was raised concerning profitability. I have here a survey recently made by the Commuter Air Carrier Conference covering 44 of its members--most of which I presume are members of the first class of carrier. In 1971 about half of these people reported that they were making money. Now it's not to their advantage to report
that they're making money -- a lot of these are subsidiaries of other corporations and there are lots of tax considerations here. Furthermore, the last thing you want to do if you're in a situation with no route protection is tell how much money you're making. It is interesting that if half these carriers did make money, they did considerably better than the trunk lines did in 1971. I don't know how that's going to go in the future, however.

I found Bill's second class of air taxis, "growth oriented companies," to be a good characterization of the local service carriers. These carriers never were and never will be commuter specialists -- companies such as the first group only using larger aircraft. They have always been seeking to become track-type operators. Their neglect of smaller communities is not a new thing -- it has occurred since the first.

What explains this? In large degree, it can be traced to the type of route system and operating restrictions originally established for them by the CAB. Most routes originally were laid out between two hubs that already possessed air service. A number of intermediate points were added and the local service carriers were set up to serve these points. Obviously the Board could not give the new carriers freedom to operate as they chose because they would have concentrated on providing service between the hubs -- that was where most of the traffic was and still is. So the Board required that all flights start and end at designated terminal points and stop at every point in between. That didn't last very long for it soon became obvious
that the locals were flying practically empty over many of their route segments. Therefore the Board began to relax the restrictions it had imposed and it did so in a way that encouraged the local carriers to concentrate their attention on winning traffic away from the trunks rather than developing into short-haul specialists such as Bill's group 1 carries. My data show that even as early as 1952, less than half of all local service passengers connected with another air carrier on part of their journey, whereas, as Bill reported, about 80 percent of commuter carrier traffic is connecting traffic.

So I believe that the reason that most of the local carriers are interested in maintaining the weight limit exemption is that they don't want the current group of air taxis to emulate their example. My view of the weight limit exemption is that it is desirable to move up the limit. I would like the air taxis to have the option of using larger aircraft. And it might be nice for them to be able to carry greater fuel reserves. I see no problem in allowing them to carry stewardesses, to put in washrooms, galleys, or anything else they want. The only time I would worry about raising the exemption would be if there were some form of route protection. If there were, I would be very worried about this increase in the weight limit because what you would have happening is what happened with the local carriers -- namely, moving into uneconomic aircraft and being protected from the consequences. As long as the air taxi operators are not protected from the consequences of bad management decisions, I am willing to give
them as much freedom as they want, recognizing that the 30 passenger, 7500-lb. limit is still designed to protect the local carriers. (You cannot read the examiner's ruling without seeing that all the way through it.) The local carriers won't use this size of aircraft any more so we can go up to 30 seats without hurting them much. And the way things are going I would predict in a very few years they may be able to take it up to 50 or 60 seats. I don't mind raising the ceiling but I would predict that most of the commuter carriers would still find it most economical to use the aircraft with roughly 20 seats.

One thing an increase in the ceiling does do is raise the potential range of operations within which carriers not subject to economic regulation can operate. With a 12,500 lb. limit, you have an effective flight radius of about 200 miles that you can fly with a passenger load of 15 or 20 and keep within that weight limit. Raising the limit as proposed moves that radius out further.

So I see no problem in that. But I see where the local carriers would consider it to be a potential problem because it moves these carriers more into competition with them. I would see where the ALPA would like it because the ALPA does not like the fact that many air taxis use nonunion pilots. And raising the limit is a subtle form of de-regulation. If you gradually lift this limit up to infinity you would be de-regulating the airlines. Again I am not against that at all.
(Have you considered eliminating the weight and size limit and basing it on the route length, say 100 miles, to give free reign on what type of airline could fly 100 miles?)

A: With the limit of under 100 miles you are going to get the air taxis back to the very small airplane, because if you are going to by air travel within 100 miles you must offer very high frequency. And if you offer very high frequency you either generate lots of seats which requires a very high density market, or you have to use smaller aircraft.

(Some of the third level carriers say they need a bigger airplane even than the 30 passenger limit. They could use a 40-50 passenger airplane during peak hours.)

A: I don't find any problem with that as long as there is no route protection. If you say a commuter carrier could use a 747 that's fine with me and they may be right. But I don't want to have a grant of monopoly which is what route certificate is, and then allow them to use the 747. A certificate provides an implicit commitment to maintain the carrier in operation. Once the carrier gets a certificate the government is very reluctant to let it go broke.

(I don't know that 100 miles is the right breakoff point; I am just curious whether you have considered the route length, rather?)

A: Any constraint you put on an operator has certain advantages and disadvantages. I don't see what particular advantages the 100 mile thing has except for maybe the carrier you mention (Houston Metro(?)) and I'm not really sure they need more than a 30 passenger aircraft.
I don't know their operation that well.

(The possible advantage would be that the regional carriers and the trunks don't want to operate in that area?)

A: But if you set the limit up to 200 miles, you can get some pretty good routes -- NY/Wash. -- some of the California routes.

(The only thing you are really protecting is the local service carriers.)

A: I am not interested in protecting the local service carriers at all. But I would prefer to have the weight limit raised the way is being done and provide the local carriers with some degree of protection this way than to "protect" them the way they want to be protected. They want to be able to veto any competitive service established within fifty miles of a point they (or any other established carrier) serve. That is their concept of "route protection."

(Aren't all these discussions concerned with aspects of the bill that would provide route protection?)

A: The bill (S3460), the subsidy experiment proposal, is not aimed specifically at providing route protection for anyone. It is aimed at providing equal or better service to smaller communities at lower cost to the government. The weight limit hearing now before the CAB is a separate thing entirely. It is aimed at changing the restrictions to allow air taxis to operate larger aircraft. Right now they can't operate any aircraft over 12,500 lbs. maximum gross takeoff weight without a special exemption.
(But the weight limit restriction is there to protect the local carriers.)

A: I know, but it is not the same as route protection. Route protection includes the grant of a monopoly franchise which neither S3460 nor the weight limit increase does, though the latter is aimed at retaining some protection for the local service carriers.

As I just said, what the local service carriers view as route protection would exist if the existing carrier had the right to say that a new entrant could not begin service on any route where there is already a carrier operating (including a commuter carrier, a local service carrier, or a trunk line) unless the existing carrier approves. And not only this, but they are asking for the existing carriers to have a veto power over the establishment of any new service 50 miles in any direction. This is like the current restriction on baseball franchises. If Washington can attract a new baseball club it could not move that club into Washington unless the owner of the Baltimore Orioles allowed them to move in. The reason is to protect the monopoly rights of the Baltimore Orioles.

(This suggestion about limitation based upon distance has one advantage from your point of view of supporting the hub and spoke approach which you happen to favor.)

A: I don't happen to favor it. I don't favor any particular system of routes. Some people have said in fact that the reason we have a good air system in this country is that we don't have hub and spoke. I don't know but I think it is rather interesting to see the differences
in the route structure that has developed under a regulated and an unregulated system, and for some reason the fact that a basic hub and spoke has developed under an unregulated system suggests that the market is trying to tell us something. In fact the CAB examiners back in 1944 said that if somebody wants to get from a small town to a hub city, if you require him to stop 3 times on route to protect the local service carrier, he is going to drive. One of the original proposals made as an alternative to the every-stop, every-flight restriction that eventually was adopted was a limit on how far a local carrier could fly without stopping. Another proposal would have required a minimum number of stops but would have allowed the carrier the choice of how to fulfill the requirement you want to. But the Board didn't give the local carrier any flexibility. It was not until the early 1950's that the local carriers were even allowed to skip a stop on a particular flight if there was no reason to stop -- no passenger, cargo, or mail to be boarded or deplaned.

If you had an unlimited restriction on the kind of aircraft they could use I wouldn't expect everybody to set up a hub and spoke system. But a hub and spoke system is a very good one if you are operating basically a short-haul commuter system because that gets people to where they want to go quicker. You obviously would have certain linear routes if you had an unregulated system; we have had these in California.

(That kind where you have to make a stop regulation which is basically negative, basically trying to protect some end. You can
visualize some regulations which would encourage new kinds of service if the limitation or regulations was, say, on field length. Then the carrier could use any kind of airplane of that field length which would serve its purposes and maybe develop new markets.)

A: Certainly, but if you look at the whole history of regulation in every industry in which it has been tried you will see that the major purpose of regulation has been to protect someone. My view of the CAB proposal (S3460) is that it is a rare attempt at positive regulation. The Board admits that it's for political reasons we have decided to have a subsidy. Congress wants it so the question is how are we going to do it in the best way? And it is not designed for protection. It explicitly avoids protection. That's why I support it to the extent I do. The only type of route protection I would be in favor of is a one-time, limited, non-renewable certificate. In the book I suggested a duration of five years. When someone sets up a route, give him a certificate that gives him an exclusive franchise for only five years. If he can't defend that route on the basis of five years he isn't doing a good job. I have now changed my mind and would reduce the five year duration to two or three years. That is enough. Such protection would be almost like a patent grant and would provide an incentive for an operator to make the capital investment necessary to develop a route. But I oppose any form of permanent protection. One of the most powerful spurs to efficiency is the threat that if you get sloppy, someone will come in and take over your clientele. This has
happened in some cases -- I understand this is what happened in Executive's case. And I would be reluctant to abandon that spur to efficiency. It is one thing to provide someone with an incentive to take a chance at establishing a business. It is something far different to give him a permanent claim to that business, regardless of how he performs.

Suppose Joe Smith sets up a grocery store in a small town where there is a limited business and where there has not been a store previously. Assume that to encourage him to set up, the townspeople have agreed not to patronize for a period of five years any other grocer who happens to set up in the town. That would seem O.K. to me. I don't think that the townspeople would ever agree -- nor should they agree -- to a perpetual monopoly just to protect Joe Smith from competition. If he can't defend his market after five years of protection, then he isn't doing a good job. (If Sam Jones can successfully drive out Joe Smith after the five years is up due to lower prices and better services, he should not get a monopoly franchise -- the purpose of the monopoly is to allow the existance of the market to be tested, and that already has occurred. Furthermore, if in the competitive struggle between Jones and Smith both go bankrupt, the community should not be expected to offer a new monopoly to Adams, a third grocer, if he were to set up in the town. Smith's successful existence over five years has shown that a market does exist and the struggle between Jones and Smith has shown that the market is a natural monopoly. While Adams will have some monopoly power due to this fact, the community should
not give him absolute legal protection from entry as this destroys his incentive to limit his advantage to that confined by the natural monopoly).

The same reasoning applies to an air taxi operator seeking to set up a route in a community that does not now have air service. The grant of limited, temporary monopoly might be reasonable, but not so a permanent one.

(What do you think of protection against a financial concern moving in and undercutting?)

A: Well, we are talking about markets that in most cases will generate fewer than 7500 passengers per day, so the financial incentive for some big firm to move in and take over would be pretty small.

*(Tape ran out here -- I think the question was something like the following)*

(What about some big firm like ITT setting up a nationwide network of air taxis?)

A: The only thing that would worry me is if ITT could do this and get some form of permanent route protection. If ITT is unprotected and they set up a nationwide service -- ITT Internal Commuter Air Service -- and they succeed because of their ability to schedule aircraft more efficiently and have computerized reservations, then I see no problems. Let me say, I don't believe they would be able to do it. We have already heard about the problems PSA has competing with United. I have a feeling that a local operator concentrating on the needs of the local community could generally beat them out -- unless they were protected.
The ability of large firms to be successful at being "predatory" where entry remains easy is open to serious question. Standard Oil was long felt to have been a successful "predator" and indeed, it did buy up lots of firms. What would happen is that somebody would set up a refinery next to John D. Rockefeller's refinery and John D. would buy them out. They would take their cash, go away, somebody else would come in and John D. would buy them out. John D. was constantly funnelling money to small operators. And if you look at what actually happened he was not successful in predatory practices. As long as we have an opportunity for free entry I am not worried.

(We had an example down in Miami - Bahamas area. Joe Mackey sold his whole operation to Eastern and 5 years later he's got a big going operation down in the same area.)

The final thing I want to talk about is on this connection between regulation and safety. You can see the argument that we need economic regulation, somehow, in order to make air carriers safer. It reminds me of an argument that somehow Cadillac drivers should be more safety conscious than people who drive VW's. Sort of a "trickle down" theory in the extreme. Make people rich, then they'll spend enough money on safety. Also if you believe that you would expect that during periods when the trunk airlines make less than the normal rate of return, as they have in the past several years, the accident rate should go up. We don't observe that. Airlines are safe because if they're not safe they go out of business. And they're not out of business because the government puts them out of business but because nobody flies on them,
Bill Jordan's study of the California case supports that very nicely. PSA has been very safety conscious, because it had to be. I do not accept the "regulation equals safety" argument. It could well be that the air taxis do need to be safer. I understand that the National Transportation Safety Board is now in the last stages of an investigation to change the rules under which air taxis operate and it is felt that somehow stronger rules are needed. Fine. Let, for example, anyone convicted of a violation be subject to a criminal penalty. Right now he pays a fine -- he's not subject to criminal penalties. Let's hire some more inspectors. Let's watch out, though, for the sort of thing like the rule that any plane with more than 19 seats has to have a stewardess. I cannot see what having a stewardess on a Twin Otter has to do with safety. If it's to keep the passengers seatbelts buckled, I am sure that they can put on the Twin Otter the sort of thing that's put on the car I rented to come up here -- If the seat belt's not buckled, a light flashes on the dashboard. If an airline wants to put a stewardess on, they should be allowed to, but to say that they have to carry around 120 lbs. of dead weight all the time is confusing economics and safety.

(Back to your comparison of the Cadillac and Ford. The guy in the Cadillac is a little safer in some respects because he has good tires or can afford them. Whereas maybe the guy, not in a VW but a 1968 Chevy or something, maybe has slicker tires. Maybe the little guys need a certain amount of safety equipment in terms of avionics and navigation which in some cases can exceed the cost of the aircraft.)
O.K., require that. If that is the price of having safe air service, if somehow the public decides this, then we will raise the price of entry.

(But unfortunately the cost of the avionics isn't in proportion to the size of the airplane and so the other operators perhaps cannot afford.)

What you're saying is that in certain markets, economics will not permit air service. You're not saying somehow give these people monopoly rights and somehow make them wealthy enough and they will be safe. What you're saying is that in certain places, air service is not viable. And I'll accept that.

(I think to a large extent air safety regulates itself independent of economics for an airline because of publicity that an accident gets. If you get down into the automobiles and smaller aircrafts.)

Your little commuter aircraft would get a lot of publicity for the area that's relevant to them, namely, where they serve. If a commuter air carrier crashes out in Kansas it gets a lot of publicity out in Kansas. It doesn't get publicity in Washington, D.C., but that isn't where the passengers come from. If it loses its passengers out of its home community the fact that it can't pick up some businessman who hasn't heard of its record doesn't matter much; it's out of business, it's really questionable that we want commuter carriers to have the same level of safety as the larger carriers. This could be one thing that people have to make a decision on. All you're saying, again, is that air service is not viable.
(No, I'm not. I'm saying they can only establish a certain level of safety. It has nothing to do with whether it's viable. It has to do with the number of people that will accept that level.)

O.K. If you require all air taxis to have automatic landing systems and make each plane cost several million dollars, the fare you'd have to charge is very high. All that says is that people are going to drive rather than fly.

(I think the question is somewhat different. I think the question is how much safety is enough safety. Because safety has a cost.)

Right. I would hope that the National Transportation Safety Board would just recognize that safety has a cost and that certain safety features may not be worth the cost.

(First, commuter carriers have a higher accident level than trunk carriers. This could imply they are less safe; it could also imply they fly in less safe areas. All commuter airports are less than International or Boston. It's a system safety. It's the same analogy that Nawal was referring to where ICAO airlines have a much worse accident record.)

The relevant question is would two carriers operating identical systems, one regulated and the other unregulated, have different safety records? I would say there would be virtually no difference.

(What are the prospects for the idea that route limitation have some kind of a time limit on it?)

I've seen it bandied in a new DOT staff report. I think it's mainly because I've talked to some people over there. I'm really
not that keen on any form of route protection. This would be the maximum I would be willing to go and I think DOT feels something of the same. The problem is, of course, that maybe what will happen is that enough commuter carriers will get together and generate political pressure for permanent route protection. That's the way things get done. But I would hope there would be some realization about the effect of route protection and that's the reason I published the book.

(The three year business reminds me of the TV license -- three year renewable.......all of a sudden you're in FCC operation.)

I recognize that -- all I was saying is that it would be the outside limit.

(You said 5 years -- then you said you would prefer 2 - 3 years. It's interesting that Air Midwest has told us that 2 - 3 years is all that's necessary to establish their new airline in a new city. It takes them that long to get up to the point where they can operate.

That's why I went to 2 - 3 years in my discussion with commuter air carriers. That's about how long it takes to be established. It takes someone else 2 - 3 years to build up their identity.

(....certain level of increased business...much higher rate of increase.)

I put very strict limits on this because the cost of giving someone a monopoly is his inefficiency. I have documented quite well in the case of local service carriers, the cost to the economy of having given the local carriers effective route protection. We have put a
billion dollars of subsidy into these carriers and we have not got an efficient short-haul service -- we've gotten eight new trunk lines which we could have gotten free for handing out eight pieces of paper.
THE RIGHT TO REGULATE

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Abstract

An introduction to the historical and constitutional framework of industry regulation by local and federal governments. Problems of the confiscation of private property without due process, government control and the rights and duties of the regulated industry will be discussed.
THE ROLE OF GOVERNMENT

Government regulation of industry takes many forms. At the most indirect level, government creates a stable setting for social development. Once a society is secure, it will evolve a code of morality and ethics to guide the actions of its members. This social code is a type of regulation since it outlines how individuals are expected to act toward one another, and how businesses are to conduct themselves toward individuals and the community.

Government also indirectly regulates industry by providing a legal structure for the resolution of private disputes. The rules developed by the courts to determine who breached a contract and how much they should pay are forms of regulation.

Through the passage of criminal laws and administrative orders, a government takes a more active role in regulating business conduct. To protect the social order certain activities are forbidden. For example, price fixing or monopolistic practices are made illegal to protect the public from the evils of reduced competition. Finally, the government may compel businesses to do certain things that they might otherwise choose not to do. This is the most direct type of government regulation and is used to develop social policy in an active way.
Requiring a certificate of public convenience and necessity before a company can offer interstate air service between two points; or setting the price that can be changed for particular goods or services are examples of positive government control.

**HISTORY OF REGULATION**

The regulation of business has gone through several stages of historical development. Although there is evidence of a highly sophisticated system of government regulation of business and transportation in China as early as 300 B.C., the concept of positive control of private business practices emerged slowly in the western world.

During the Roman era, business activities were governed by the "fair price" doctrine. The price was any price on which the parties freely agreed without fraud, coercion or the like. Transactions were bargained for with what we now call supply and demand playing the major role in setting the final price.

This concept was modified during the early Christian era, and eventually replaced by the "just price" doctrine. Since the true reward of the Christian occurred in the next world and not this one, he was not supposed to be concerned about money. Rather, the Christian businessman was to treat all men fairly, charging only what was necessary to cover the basic needs of the merchant and his family and not what would maximize his profit. This rationale applied at all times no matter what
the supply and demand situation was. Even in times of great scarcity the merchant could only charge the "just price."

During the same period, the Guild System evolved. Guilds were craft-unions with limited entry. Each profession had its own guild and one could not practice or even learn a profession outside the guild. In return for the job security that the guild system provided, members were required to offer their services to all customers who were willing to pay, a concept retained in the later English law of the "Common Callings."

The next major development in the regulation of business was the evolution of the royal charter. The King or Parliament would create a monopolist corporation to carry out some specific project or task. Charters were very detailed about how the companies could operate, what they were to do and what the duties of the corporations were toward the public.

The last major inputs that helped shape our present regulatory system were the concepts developed by the English Common Law, the antecedent of our own legal system. Some of the basic ideas predate the Norman Conquest in 1066. These were developed on a case by case basis by the courts into a rather complete system of court enforced business regulation.

Four major areas of control developed. The first three were the definition and prohibition of certain practices: restraint of trade, illegal monopoly, and unfair competition.
The fourth area of regulation was the classification of certain trades as "Common Callings" and the detailed specification of what people who followed these professions could and could not do.

Common Callings were professions essential to the public such as bakers, brewers, millers, cab drivers, ferry men, innkeepers, smiths, surgeons, tailors, and warfingers. Since these professions tended to have at least limited monopolies in time or space, and since they were essential to the general welfare, the public required protection from exploitation. Therefore, those following a common calling were required to offer their services at a just and reasonable rate to anyone who wished to employ them.

An additional burden was placed on the innkeeper and those engaged in transportation. Since their customers were often far from home and the opportunity for collusion between the innkeeper or cab driver and local bandits was high, the courts imposed an absolute liability on these trades to protect their clients from harm.

During the Colonial period of the United States, the common law doctrines became the basis of the American legal system. But further regulatory measures were not developed for many years. In general, both federal and local governments adopted a laissez-faire policy until the end of the 19th century.
Rapid industrial expansion was desired and government inter-
vention in business activity was minimized to allow maximum
development.

The laissez-faire policy was slowly eroded under the
political pressures of the Grange movement. The period
from 1850 to 1870 had seen a rapid expansion of the railroads
both in number and area served. This led to intensive competi-
tion between major centers of shipping and commerce with freight
rates in these markets often falling below out of pocket costs.
These deficits were covered by charging high rates on sections
of the system that were monopolistic—generally lower density
farm markets. Often the cost of transporting farm products a
relatively short distance were greater than those charged for
industrial shipments of many hundreds of miles over competitive
routes.

Since the majority of the nation's population was still
rural at that time, the protests of the farmers directly and
through their Grange association was a potent political force.
One by one, the states adopted measures to regulate railroad
rates and practices.

Finally, in 1887, the Act to Regulate Commerce was passed
creating the Interstate Commerce Commission, the first of the
federal regulatory bodies. In its initial form, the commission
had little real power. And what power it thought it had was gradually eroded by court decisions. However, Congress passed additional legislation in 1906 and 1920 that gave the ICC the powers it needed to rule on the validity of rates and actually set them where required. Since that time, there have been few serious challenges to the federal government's role in transportation regulations.

**SOURCES OF POWER**

At the state level the powers to regulate business activities are based on state constitutional requirements that government protect the health and welfare of the citizens. Through ratification of the state constitutions the people agreed that government could perform these functions for the overall good.

Federal powers must also be based on Constitutional standards. However, in the federal constitution there is no broad delegation of power to act in the public good. Only very specific powers which each independent colony was willing to yield to the national government are enumerated. And powers not specifically delegated are retained by the states. Therefore, all federal legislation must be based on one of the powers enumerated in the federal constitution.

There are cases where both the state and federal government can theoretically regulate an activity. In these cases,
it is often difficult to decide if both can regulate or whether one must yield to the other. The nature of the activity and its national impact must be considered to decide this issue.

If the activity to be regulated is so national in scope that local regulation would only cause confusion, then the federal power is said to be exclusive and state action is barred. The courts have made this distinction even when the federal government fails to regulate. No regulation is thought better than varied local controls. Air traffic control is an example of an exclusive federal power.

Federal power is said to be "paramount" if state action is allowed as long as Congress has not acted. There is presently a great deal of legal debate whether the control of airport noise is an area of exclusive or paramount federal power. If the former, then all present and proposed state laws regulating airport noise are unconstitutional. If the power is the latter, then state legislation will stand until Congress decides to create a national plan.

At this point it is worth noting that the Courts decide what kind of federal power exists, and not Congress. Thus, if the United States Supreme Court holds that the regulation of airport noise is exclusively in the federal sphere, the Congressional statements that local control is permissible under Public Law 90-411 is invalid. Congress cannot delegate
a power to the state which is exclusively federal.

Powers are "concurrent" when both state and federal governments can regulate at the same time. An example of this is the power to tax which both possess.

Finally, there are areas where the states alone can act. For example, the federal government cannot pass a statute making homicide a federal crime unless it is done on federal land or perhaps involves a federal official. Otherwise, the power to pass such laws is exclusive to the states under their duty to protect the welfare of their citizens.

THE POWER TO REGULATE COMMERCE

Under the federal constitution, Congress is given the express power to regulate commerce among the states. In the exercise of this power, two questions must be considered: What is "commerce among the states?", and is the regulation so severe as to amount to a deprivation of property without due process under the fifth amendment?

WHAT IS COMMERCE?

The definition of commerce among the states is ever evolving through court decision. One of the earliest cases was Gibbons v. Ogden (9 Wheat. 1, 1824). The legislature of New York had given an exclusive charter for the operation of steam boats on waters of the state. Ogden, who had been
assigned this charter sued to stop Gibbons from operating a steamboat between New Jersey and New York City. The U.S. Supreme Court held the exclusive grant of the New York legislature to be unconstitutional. Since the boat passed over the state line, it was in interstate commerce during its entire trip. In attempting to prohibit the ship from using New York waters while on an interstate voyage, the state had attempted to use a power granted to the federal government.

In the 1870 case of The Daniel Ball (10 Wall. 557). The steamer was used to transport goods on the Grand River, entirely within the state of Michigan. However, some of the goods the Daniel Ball carried were destined for other states or had come from other states. Based on this, the Court declared the Daniel Ball was operating in interstate commerce and was, therefore, subject to federal regulation.

The finding of the court in The Daniel Ball is one of the reasons Pacific Southwest Airlines (PSA) does not accept interline tickets or baggage. Their passengers must make a distinct termination of interstate service, buy new tickets, and start an intrastate trip. Thus, PSA is not subject to the economic regulations imposed on interstate carriers.

The extremes to which the Court will go to find interference with interstate commerce and therefore federal
jurisdiction are quite interesting. An example is the 1942 case of Wickard v. Filburn (317 U.S. 11). Mr. Filburn grew corn in excess of his quota imposed by Wickard, the Secretary of Agriculture. Although all the excess corn was consumed on his farm, Filburn's acts were held to affect interstate commerce. If he had not planted so much, he would have had to buy corn on the market. The test was not so much the effects of an individual act, but the cumulative effects of many farmers acting the same way.

Perhaps an even more extreme case is the case of Katzenback v. McClung (379 U.S. 294, 1964). McClung operated a diner in Alabama. Under the Civil Rights Act of 1964 (42 U.S.C.A. 2000 et seq.), Congress outlawed segregation in any place of public accommodation. A restaurant was a place of public accommodation under the Act, if it serves or offers to serve interstate travelers, or a substantial portion of the food it serves has moved in interstate commerce.

The trial court found that McClung did not treat whites and blacks equally. It also found that 46% of the meat served in the restaurant had been purchased from a local supplier who had in turn purchased it in interstate commerce. But the trial court held that the act was unconstitutional since there was no demonstrable connection between food purchased in interstate commerce and sold in a restaurant and the conclusion of
Congress that discrimination in the restaurant would affect that commerce.

The Supreme Court upheld the constitutionality of the act. On the strength of Wickard v. Filburn (above), they held that Congress could regulate intrastate matters if there was an overall impact on interstate commerce and that there was evidence in the Congressional hearings that segregation in local restaurants serving interstate food could have an interstate impact. The Supreme Court then said:

"But where we find that the legislators, in light of the facts and testimony before them, have a rational basis for finding a chosen regulatory scheme necessary to the protection" of commerce, our investigation is at an end. (p.303) "...The Civil Rights Act of 1964, as here applied, we find to be plainly appropriate in the resolution of what Congress found to be a national commercial problem of the first magnitude. We find it in no violation of any express limitations of the constitution and we therefore declare it valid." (p.305)

In summary, the courts have defined what affects interstate commerce very broadly, and Congress by basing its action on the Commerce clause has been able to pass a great deal of legislation concerning the general welfare of the nation's population.

HAS THERE BEEN A VIOLATION OF THE FIFTH AMENDMENT?

Under the fifth amendment to the United States constitution, "No person shall be. . .deprived of life, liberty or property, without due process of law; nor shall
private property be taken for public use without just compensation." (Emphasis added.) The 14th Amendment extends this theory to the actions of state governments. When the government regulates a business, it interferes with the use of private property. The questions are whether the interference amounts to such a deprivation that due process has been violated or that compensation was required but not paid.

One of the earliest cases to raise these issues was Munn v. Illinois (94 U.S. 113, 1877). The state legislature had passed a law regulating grain elevator operators in the city of Chicago. Munn was one of 14 such operators through whose plants most of the midwest's grain had to pass. Munn failed to comply and defended his action on the basis that his business was his private property on which the government was imposing a burden.

The U.S. Supreme Court found that government interference with property rights was justified under certain instances and did not violate constitutional standards.

"When . . . one devotes his property to a use in which the public has an interest, he, in effect, grants to the public an interest in that use, and must submit to be controlled by the public for the common good, to the extent of the interest he has created. He may withdraw his grant by discontinuing the use; but, so long as he maintains the use, he must submit to the control." (p. 125-26)
The basis of holding grain storage facilities to be "affected with the public interest" seemed to be the virtual monopoly position they held in the Chicago market. This established the economic condition of monopoly as the basis of broad regulation.

In 1894, the Supreme Court again addressed these issues in Brass v. North Dakota ex rel. Stoeser (153 U.S. 391). Again, the state passed a law regulating grain storage operators. But now there were 600 elevators controlled by 125 operators. There was no actual or virtual monopoly on these facts. The court, however, felt that the principle of regulation by state legislature should be upheld, even though the facts were different.

"When it is once admitted, as it is admitted here, that it is competent for the legislative power to control the business of elevating and storing grain, . . . in cities of one size and in some circumstances, it follows that such power may be legally inserted over the same business when carried on in smaller cities and in other circumstances." (p.403)

The test does not seem to be monopoly, but the very nature and public need for the services.

In German Alliance Insurance Co. v. Lewis (233 U.S. 389, 1914), the Court allowed regulation of fire insurance, since it was "practically a necessity." Thus neither monopoly or public need were mandatory to grant regulatory policy.

The last attempt of the Supreme Court to define when an industry is so affected with a public interest as to permit
regulation was Nebbia v. New York (291 U.S. 502, 1934). The case concerned the regulation of the competitive milk industry. After agreeing that there was no monopoly, the court went on to say:

"So far as the requirement of due process is concerned, and in the absence of other constitutional restriction, a state is free to adopt whatever economic policy may reasonably be deemed to promote public welfare, and to enforce that policy by legislation adapted to its purpose." (p.536)

and further,

"If the laws passed are seen to have a reasonable relation to a proper legislative purpose, and are neither arbitrary nor discriminatory, the requirements of due process are satisfied. . . ." (p.537)

Note the similarity in thought and language to the Court's definition of powers under the commerce clause in the Katzenbach case. In summary, the state and federal governments both have broad regulatory authority from the public welfare and commerce clauses of their respective constitutions, with little review by the courts. What then holds these powers in check?

Since most regulatory statutes set up administrative agencies to administer them, state and federal Administrative Procedure Acts impose procedural safeguards on the operation of the agency. People to be regulated must be told of pending
regulations, given an opportunity to present their side of the case, and finally have rights of court appeal from arbitrary action. The courts often use violations of these procedural requirements to block policy decisions.

Secondly, the people through the elective process have some control over legislative action. In the last analysis, this is the only adequate check on over-regulation and excess government control of activities.

WHEN IS REGULATION IMPOSED?

The basic impetus to regulation is the political process. Thus, the first step in regulation occurs when some public or special interest group demands regulation and has enough political power to exert pressure on its representatives.

The second step occurs when the legislature agrees that regulation is needed and in the best interest of the people. It will then enact the needed legislation.

After legislation is passed, it is likely to be challenged in the courts on any number of points. Therefore, the regulation is not final until the courts recognize the need and approve of the legislative approach.

THE RIGHTS OF A REGULATED INDUSTRY

Even though regulation is imposed on an industry, it is not deprived of all its rights. The regulated industry has a right to earn a reasonable return on its investment so that
it can continue to grow and attract investors. However, the right to a reasonable return is not a guarantee. If management is inefficient, the government is not bound to grant rates high enough to affect inefficiency.

The industry is also able to impose reasonable rules and regulations on the service it supplies. Although it is affected with a public interest, it is not obliged to respond to every whim of the public it serves.

Finally, in many cases the industry is given protection from competition through government control of entry into markets. Since the industry must provide certain services to the public under all conditions, it is protected from competitive forces that might restrict its ability to perform.

THE OBLIGATIONS

Like the Guilds and the Common Callings, a regulated business must serve any customer willing and able to pay. They must also offer safe and adequate services and charge a "just and reasonable" price. (What is "just and reasonable" is the topic of the paper on Basic Rate Making.)

Finally, the regulated industry must avoid unjust or unreasonable discrimination.

There are several types of discrimination, not all of which are unjust or unreasonable. They can be classified as:
1. Personal - The charging of different rates to different persons (or companies) for the same service. For example, a non-standby youth fare.

2. Commodity - The charging of different rates for different commodities not proportional to the different cost. An example would be higher charges for manufactured goods than for bulk commodities of the same weight.

3. Place - The charging of different rates for the transportation of the same commodity and level of service over different distances not justified by costs alone. The treatment of farmers on monopoly segments by the railroads before the Grange movement was place discrimination.

4. Temporal - The charging of different rates for the same service at different times, e.g., peak-hour premiums or off-hour discounts.

It must be noted that not all of these are illegal even though each is a form of discrimination.

**SUMMATION**

Both federal and state government have great powers to impose rules and regulations on the conduct of businesses. The sources of these powers are historical and embodied in constitutional provisions at both national and state levels.
Certain duties can be imposed on regulated businesses that are not imposed on free enterprise in general. However, the regulated industries are granted special privileges in return. These duties and privileges result from a balancing of the interests of the general public and the entrepreneur who engages in a business "affected with the public interest."
BASIC RATE MAKING

BY J. F. Vittek
Deputy Director
Flight Transportation Lab
M. I. T.

July 19, 1972

Abstract

A description of how rates are set. Topics include the determination of a fair rate of return, the rate base, allowable expenses, load factors, and seating configurations.
It is conceded that the government has broad powers to control the economic policies of certain industries, including the power to fix maximum, minimum and exact rates and fares. The Civil Aeronautics Board has rarely actively used this power, preferring to rule on the reasonableness of rates filed by the carriers on a case by case basis. However, the General Passenger Fare Investigation of 1960 and the present Domestic Passenger fare investigation, indicate that the Board will probably take a stronger position on rate regulation in the near future.

The Rule of Ratemaking

In the 1960 G. P. F. I., the C. A. B. decided to adopt the traditional ratemaking process used to regulate railroads and public utilities. The present D. P. F. I. is settling issues of how the traditional approach should be applied to the air industry. The "Rule of Ratemaking" sets out those factors that the Board must consider in establishing its regulatory policy. The factors are:

1. The inherent advantages of air transportation
2. The potential effect of the rate on the movement of traffic
3. The quality of service to be offered at the rate to be established
4. The public need for efficient and adequate air transportation at the lowest reasonable cost
5. The carrier need for sufficient revenue to operate the service under efficient, honest and economical management

Revenue Requirements

Under the utility theory of rate making, total revenue requirements are computed as follows:

\[ R = OC + (V-D)r \]

Where:

- \( R \) = Revenue Requirement
- \( OC \) = Operating Costs
- \( V \) = Gross Value of Investment Property
- \( D \) = Accumulated Depreciation
- \( r \) = Rate of Return

The total revenue should cover the operating costs and yield a sufficient return on the value of the investment to attract and hold new sources of finance. The term \((V-D)\) is often referred to as the "Rate Base" which represents the value of the present investment. Hence, this approach is known as the "Rate Base Method" of rate determination.

Operating Costs

The operating costs category can be broken down into three subcategories.
1. Out of pocket operational expenses
2. Depreciation of property
3. Local and Federal taxes

Problems are often encountered in determining what items should be included in each subcategory, especially 1 and 2. Usually, the rate making authority will allow business expenses that result from arm’s length bargaining between the firm and its suppliers in the exercise of managerial judgement. Management is not held to a standard of perfection, but costs arising from inefficiency, improvidence or extravagance will not be allowed into the revenue calculation.

What costs will be allowed vary from one industry to another. The monopolistic utility industries probably have the tightest cost restrictions. Although the costs imposed by the regulatory process are usually allowed, many areas are disputed. For example, funds expended for dues to trade associations, advertising and promotional costs and public relations expenditures are closely watched. So are the salaries and benefits of executives, and charitable contributions and donations.

Depreciation

From a bookkeeping standpoint, there are several acceptable ways of accounting for depreciation of assets. Likewise, there
is some freedom in assigning a useful life to an asset, and its residual value at the end of the depreciation period. Thus there are many combinations of techniques that could be applied.

To avoid confusion and promote uniformity, the regulatory body will determine what technique shall be used for rate making purposes. This does not mean that the industry is compelled to use the specified depreciation scheme for all purposes. On the contrary, the company may use one technique for regulatory matters, another for its internal use and perhaps a third for tax purposes. But all companies filing with the regulatory commission will use the same technique, life time and residual value for similar types of property.

Depreciation actually enters the revenue equation twice. In addition to being an allowable cost, it is used to decrease the value of the rate base. As the asset is used up, the company's allowable return is lessened.

The Rate Base

The determination of what assets are to be included in the rate base has been a fruitful area for lawyers and economists because of the great deal of litigation it creates. In general, the rate base can include any assets used and useful in the operation of the business. These may include all kinds of current, fixed or intangible assets. However, not all assets of all types are allowed.
Duplicate and unnecessary property is excluded. Property that is obsolete and abandoned must be dropped from the rate base. If the property is held for non-transportation purposes its value cannot be included. Finally, rented or leased property is not includeable in the rate base. Rather, the rental fees paid would be deducted as an operating expense.

Valuation

Once the decision is made as to what can be allowed in the rate base, the agency must decide how it should be evaluated. Many approaches have been tried. For example:

1. **Original Cost** - what was originally paid for the item
2. **Reproduction Cost** - what it would cost to replace the asset at the present time
3. **Prudent Investment** - That portion of the original cost that was not frivolous or unnecessary
4. **Market Value** - what the asset would bring if sold

Since the mid-1930's, the courts have allowed the agencies to impose any reasonable rule on the industry. This is the "End Result Test" stated in Federal Power Commission v. Hope Natural Gas Co. (320 U.S. 591, 1943).

"It is not theory but the impact of the rate order which counts. If the total effect of the rate order cannot be said to be unjust and unreasonable, judicial inquiry under the Act is at an end. The fact that the method employed to reach that result may contain infirmities is not then important." (P 602)
Rate of Return

The change in the allowed rate of return from 4% to 5% would have the same effect on the revenue equation as 20% upward evaluation of the rate base. But although there has been a great deal of discussion and litigation over a few percent difference in rate base computations, there is curiously little debate over the rate of return.

In general, the rate cannot be confiscatory. That is, it should not be so low as to seriously deprive the investor of the revenues from his property. Yet it is not a guarantee. The rate of return is an industry standard which some firms may surpass and some never reach. And since industry conditions change, the allowable rate of return must be adjusted over time.

In general, the agency must balance the needs of the consumers against those of the investors. It must also consider the relative interests of the debt investors and the equity investors.

In evaluating the rate of return needed to attract debt investments, the agency uses the "cost of capital" standard. That is, the regulated industry must be able to attract capital on terms that will:

1. Maintain its credit standing
2. Protect the financial soundness of the firm
3. Maintain the integrity of presently outstanding debt investment
Equity owners, on the other hand, are interested in the "comparability of earnings". Their return should be commensurate with those from firms with similar risks.

When the commission determines the returns needed to attract debt and equity credit, it must look at the rate of debt/equity financing to determine the overall return needed. Table 1 shows how the overall cost of capital fluctuates with the change in the debt/equity percentages.

Price Structure

Once the factors in the revenue equation have been selected, the overall financial need of the industry is computed. The regulatory body must then examine the price structure to see if it yields the proper amount of revenue. If not, the agency can establish various price guidelines.

Minimum Prices

The establishment of minimum prices that can be changed for given goods or services has several economic results. First, it protects the industry from competitive price cutting. It may also provide protection from exploitation if the buyer is a superior economic force. (Minimum wage standards are an example of protective minimums).
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<th>% CAPITAL STRUCTURE</th>
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Minimum price standards also affect the supply and demand of the quantity. As Figure 1 shows, in a free market, supply and demand would be in equilibrium at price $P$ and quantity $Q$. When the price is raised to $P_{\text{min}}$ by the regulatory agency, demand is reduced to $Q_1$. If supply is controlled, this could be used as a way to conserve scarce resources. However, if supply (or capacity) is not controlled, the producer will increase his output to $Q_2$ creating excess supply. This effect can be observed in the farm subsidy program where farmers attempt to get maximum output from their assigned acreage.

**Maximum Prices**

The major reason to set price maximums is to protect the consumer from exploitation. However, there are several important economic effects that must also be considered. In Figure 2, supply and demand would dictate a market for $Q$ of a good at price $P$. The suppression of the price to $P_{\text{max}}$ will induce producers to
supply less \((Q_1)\), while increasing demand to \(Q_2\). Since price no longer controls the market, some rationing scheme must be devised.

This could be used as a technique to limit production of a product using scarce commodities, or as a way of diverting production resources to other areas since the supplier will look for new products as his market decreases.

**Exact Rates**

Finally, the agency could specify the exact rate to be charged for particular goods or services. In this case, the regulator substitutes its decision for the market.

Any such decision must be based on the average industry cost structure. This results in excess profits for the low cost efficient producer, while the inefficient producer may be forced out of the market. In a competitive market, the loss of the inefficient producers would diminish supply. As a result, price would go up, the efficient producer would produce more, and price would come back down until equilibrium is attained.

However, since the price is fixed, the efficient producer may not be induced to increase his output when the inefficient suppliers leave the market. This could result in the same situation as the setting of maximum prices.
Pricing Problems

The cost structure of any industry can be divided into the direct costs of producing a product or service, and the indirect costs of supporting the general administrative aspects of the firm. Any allocation of the indirect costs to the price charged for the product must be arbitrary since they are really not directly related. The scheme itself may not treat products arbitrarily, but the selection of the scheme is. For example, indirect costs could be proportioned on the basis of percent sales, or percent direct cost, or according to a number of other reasonable formulae. But management is free to select whatever basis of allocation they feel best suited to their firm.

Therefore, when an agency regulates an industry with more than one product, it must somehow allocate the indirect costs to those products when it sets a price. Several techniques are used.

Cost of Service Pricing

In this method, the agency tries to allocate the indirect cost as part of the price according to some plans. The price would also include the direct cost component. Such an approach is best suited for setting minimum rates since at least direct costs must be covered for each product.
Value of Service Pricing

This technique is based on the theory that market demand may place a premium on some services in excess of actual cost. Thus, by putting more indirect costs into the price of these products, the agency lets demand allocate the distribution of the indirect cost component. Since no one will use the service if the rate exceeds what the market will bear, this method essentially establishes a maximum price.

There is a variation of the value of service method called value of commodity pricing which is sometimes discussed. Thus, a high value product pays a high rate. Since the only possible economic justification for this is the additional risk the carrier incurs from potential damage, the method has fallen into disuse.

Public Policy

Finally, an agency may set rates on the basis of public policy rather than cost, feeling that the public interest outweighs economic efficiency. An example is reduced fares for the elderly on public transit.

Such a policy places the extra cost on the transportation company and ultimately on the other users.
Summary

Classic rate making is easily describeable, even though its implementation is often difficult and fraught with judgemental problems. How the CAB will resolve these issues will be seen at the completion of the Domestic Passenger Fare Investigation. Dr. Miller's paper will address the specifics of that investigation and what has been decided to date.
A CRITIQUE OF CAB REGULATORY POLICY*

by

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I was asked to do a critique of CAB regulatory policy, and since I am a critic of the CAB, this might seem like a very easy task. However, when an economist broadcasts a critical evaluation of a government agency, there are several problems of communication and persuasion. First, not everyone has in mind the same criteria for judgement. The CAB is alleged to have several objectives: economic efficiency, equity, and other national goals. In my presentation on the 13th, I tried to show that economic efficiency, if not an all-encompassing objective, should be an overriding one in most cases. Secondly, whenever anyone proposes an institutional change, there is not much experience to go on. For example, I read Paul Cherington's review of Bill Jordan's book. While I agree with Paul on some points, I think to criticize

*Presented at a Summer Workshop on "Air Transportation Systems Analysis and Economics," conducted by the Flight Transportation Laboratory of the Massachusetts Institute of Technology, and sponsored by the Office of Aeronautics and Space Technology, National Aeronautics and Space Administration (July 21, 1972). Portions of this presentation are excerpted from a study on airline regulation the author and George W. Douglas are preparing for the Brookings Institution. The standard disclaimer applies.

1The scope of this paper is limited to economic regulation of domestic air transport by the U.S. Civil Aeronautics Board.


Bill for drawing implications about CAB policy from the PSA experience is merely to reveal that there are precious few cases of alternative institutional patterns in commercial aviation.

Moreover, economists who speculate about institutional changes often do not seem very helpful. I am reminded of a story Milton Friedman told during his AEA Presidential address. A physicist, a chemist, and an economist were marooned together on an island. They were starving to death when a case of spinach floated up on shore. The chemist claimed that if they put the can into the fire, he could predict the exact moment when the top would explode. The physicist claimed he could, at that moment, plunge his hand into the fire and point the can at the precise angle such that the spinach would describe a parabolic arc, terminating on the banana leaves spread on the ground near-by. The economist's contribution was "Let's assume we had a can opener." A lawyer would have asked, "To whom does the can opener belong?"

I. CAB Control over Rates

The Federal Aviation Act of 1958 gives the Civil Aeronautics Board control over airline rates and entry. After several aborted attempts, the Board held a General Passenger Fare Investigation over the period of 1956 to 1960. All they could really conclude from this effort was that the carriers were entitled to a 10.5 percent return on investment. They could not even determine the reasonable level of fares.

---

The Board initiated the Domestic Passage Fare Investigation (DPFI) in 1970. Some work on this is still going on. The Investigation was divided into nine phases, as indicated in Table 1. The first three were rule-making proceedings, the rest were public hearings.

Table 1: Phases of the Domestic Passenger Fare Investigation

(CAB Docket 21866-1 through 9)

<table>
<thead>
<tr>
<th>Phase</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Aircraft Depreciation</td>
</tr>
<tr>
<td>2</td>
<td>Leased Aircraft</td>
</tr>
<tr>
<td>3</td>
<td>Deferred Federal Income Taxes</td>
</tr>
<tr>
<td>4</td>
<td>Joint Fares</td>
</tr>
<tr>
<td>5</td>
<td>Discount Fares</td>
</tr>
<tr>
<td>6</td>
<td>Load Factor and Seating Configurations</td>
</tr>
<tr>
<td>7</td>
<td>Fare Level</td>
</tr>
<tr>
<td>8</td>
<td>Rate of Return</td>
</tr>
<tr>
<td>9</td>
<td>Fare Structure</td>
</tr>
</tbody>
</table>

Rate Level Issues

Cases involving rates are, by convention, broken down into issues involving rate level (or average yield) and rate structure (or the relationship one rate has to another). First, the rate level. The rate level issues in the DPFI are 1, 2, 3, 6, 7, and 8. Skipping 1, 2, and 3, we move onto 6, 7, and 8.

Essentially, the Board had to determine the connection between load factor and fare level. Should the Board control carrier load factors?
Can the Board control load factors? If they can control them, what is the optimal load factor? The presentation made by the Department of Transportation in the Investigation is consistent with what I presented on the 13th. That analysis is summarized in Figure 1.

As shown in the figure, there is a break-even load factor for each fare over a broad range of fare levels. Carriers can break even at a high fare and low load factor, or they can break even at a low fare and a very high load factor. The dynamics are that carriers, by competing with each other, tend to eliminate excess profits by reducing load factors toward the break-even load. On the other hand, if load factors are below break-even, carriers will tend to constrict capacity and drive load factors upward.

In decisions on phases 6, 7, and 8 of the Investigation, the Board went along with the controversial view we had advocated at DOT:

"In the Board's view, a policy of basing fares on actual load factors can only lead to increasing overcapacity, with the traveling public being asked to pay higher fares to compensate the carriers for the cost of operating an increasing number of empty seats. This result is virtually inevitable because schedules constitute the major competitive device of carriers in their efforts to preserve and enhance their participation in the traffic markets which they serve. In any given market, the carrier with the greatest number of schedules will normally carry the largest number of passengers. Thus, the desire to maximize market participation creates powerful incentives to add capacity. The contravailing incentive is supplied only by the imperative of economics: Schedules cannot be added indefinitely if the load factors achieved are insufficient, at the prevailing fare levels, to permit the carriers to cover costs and return a profit. But this economic incentive loses its force if the carriers are able to raise their fares to cover declining load factors. In that event, the pressure of competition to add schedules will become virtually irresistible and will inevitably lead to a long-term decline in load factor, rising fares to support higher levels of unused capacity, and, because of regulatory lag, a chronically depressed profit level for the industry as a whole."

1CAB Order 71-4-54, April 9, 1971, p. 5.
Average Yield (Fare Level)

I have nothing but commendations for the Board in that decision. Eventually fares are to be established commensurate with a 55 percent load factor.

Let us now look at the question of return on investment. Table 2 summarizes the Board's position, the carriers' advocacy position, the Examiner's initial decision, and the Board's final decision. The Board came out with a 12 percent rate of return for trunk carriers, 12.35 percent for local service carriers, and based both on an "optimum" debt-equity ratio. Over the past years, especially the local service carriers have been increasingly financing their investment with debt rather than equity. Since debt is less costly than equity, this reduces the cost of capital. The decision was to ask the question, "What would be the carriers' cost of capital if the debt-equity ratio were commensurate with "sound financial management?" The effect of choosing the "optimum" rather than the actual debt-equity ratio is to give the carriers a higher allowable rate of return.

DOT made the argument that the Board really cannot fix carrier rate of return very well. If one believes the carrier competition dynamic, it stands to reason that excess profits will be eliminated --where "excess" is defined as a rate of return above that which the carriers themselves require. Essentially, by attempting to regulate rate of return the Board finds itself in the uncomfortable position depicted in Figure 2.

Suppose that in the figure $R_1$ is the load factor-average yield trade-off curve consistent with the carriers' perception of rate of return. Suppose $R_0$ connotes the Board's "entitled" rate of return. The Board now finds
Table 2

Proposed and Decided Rates of Return (and Cost Bases) in Rate of Return Phase of the DPFI

<table>
<thead>
<tr>
<th>Position/Decision</th>
<th>Cost of Debt (in percent)</th>
<th>Cost of Equity (in percent)</th>
<th>Debt-Equity Ratio</th>
<th>Return on Investment (in percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trunk Carriers' Position</td>
<td>6.63-7.60</td>
<td>16.00-18-00</td>
<td>40/60-45/55&lt;sup&gt;1/&lt;/sup&gt; (optimum)</td>
<td>12.25-13.50</td>
</tr>
<tr>
<td>Local Service Carriers' Position</td>
<td>9.50</td>
<td>20.00-21.00</td>
<td>55/45 (optimum)</td>
<td>14.225-14.675</td>
</tr>
<tr>
<td>Bureau of Economics' Position</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trunk Carriers</td>
<td>5.70</td>
<td>16.00</td>
<td>58.9/41.1 (actual)</td>
<td>10.50</td>
</tr>
<tr>
<td>Local Service Carriers</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>11.50&lt;sup&gt;2/&lt;/sup&gt;</td>
</tr>
<tr>
<td>Examiner's Initial Decision</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trunk Carriers</td>
<td>7.00</td>
<td>17.00</td>
<td>60/40 (actual)</td>
<td>11.00</td>
</tr>
<tr>
<td>Local Service Carriers</td>
<td>8.50</td>
<td>~30.00</td>
<td>88/12 (actual)</td>
<td>11.00</td>
</tr>
<tr>
<td>Board's Final Decision</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trunk Carriers</td>
<td>6.20</td>
<td>16.75</td>
<td>45/55 (optimum)</td>
<td>12.00</td>
</tr>
<tr>
<td>Local Service Carriers</td>
<td>7.25</td>
<td>20.00</td>
<td>60/40 (optimum)</td>
<td>12.35</td>
</tr>
</tbody>
</table>

<sup>1/</sup> Counts convertible debentures as equity.

<sup>2/</sup> Based on the Bureau's judgment that local service carriers are entitled to one percentage point in excess of the return for trunk carriers.
the appropriate fare level. The carriers are earning excessive
profits at $F_0$, so they invariably add capacity. Average load factor
falls. The Board then entertains arguments that the per-passenger cost
exceeds that predicted (because load factors are now lower than antici-
pated), and a fare increase is in order. This iterative process will
continue. In sum, if the Board tries to "enforce" a rate of return
either above or below the carriers' necessary rate of return, fares
will either soar or plummet respectively.

The point is, you cannot regulate both load factor and rate of
return by regulating fares. In fact, fares really regulate only load
factor; the carriers through non-price competition, set their own rate
of return. The decision reads:

"The rates of return specified herein will be used in
standards for measuring the reasonableness of the general
domestic passenger fare level. They are not in any sense to be
regarded as guarantees that any air carrier will earn the standard
return in any given year or period of years, or that the industry
as a whole will achieve the specified rates in particular
periods."$^1$ . . . The fact that earnings in a particular year are
either above or below the standard rate of return would not be
an occasion for fare adjustments unless the fares are signifi-
cantly out of line with those required to produce reasonable
earnings at the standard load factor. The Board believes that
a firm adherence to this policy will enable the industry,
during representative periods, to cover its cost of capital
and provide investors with reasonable compensation for the
risks taken and permit the carriers to attract needed additional
capital." (footnotes omitted).$^2$

$^1$ CAB Order 71-4-58, April 9, 1972, p. 3.

$^2$ CAB Order 71-4-59, 71-4-60, April 9, 1972, pp. 73-4.
Again, I think that is a very enlightened decision.

**Rate Structure Issues**

So much for the fare level questions. Now let us move on to issues concerning fare structure. Briefly, economic efficiency requires that the fare in any given market be equal to the average and marginal costs of providing that service. We have a lot of evidence that this condition does not presently hold. The Board in its Phase 4, joint-fare decision found that in every single market where inter-line service is available the consumer should be offered a fare that is no higher than the sum of the "local" fares minus a $4.00 cost saving. Although this surely is a meat-axe approach, essentially I would agree with the policy conclusion, namely that fares should reflect the level of (average and marginal) cost.

In the discount-fare phase of the Investigation, we have only the Hearing Examiner's report. It was a conservative decision; he concluded that the discount seems to be too large in some cases. He also said discounts should be available only during certain parts of the week. My position is that discounts per se are instances of (third degree) price discrimination. Whenever you have "eligibility requirements," there are economic efficiency losses. Furthermore, I would conjecture that carriers do themselves harm in many cases by having discounts.

In the fare structure phase of the Investigation, the principle issue was what form the "fare curve" should take. Since 1969, the carriers have computed the basic coach fare from a formula approximately as follows: \( \text{Fare} = \text{Fixed Charge} + (\text{Charge per mile} \times \text{Distance}) \). Obviously
a carrier with a preponderance of long-distance flights would not like to see the "taper" (i.e., slope of the fare-per-mile curve) increased. On the other hand, a carrier with a preponderance of short-haul flights might like to see an increase in taper.\textsuperscript{1} Of course, the resulting fare taper arguably had to give the industry as a whole revenues sufficient to cover costs. The question boiled down to who would have an easier time of it—which carrier's proposal (if any) would be adopted. This was the great debate.

The second issue was what relationship different classes of fares would have with each other. Would first class fares be 133 percent of coach fares, 150 percent, or 110 percent? What about night coach and economy fares?

A third issue was the "zone of reasonableness" proposal that got a lot of play because of the Justice Department and DOT pushed it. What we (DOT) suggested was that in order to inject price competition into the airlines—that is, instead of deciding on a fare formula to which all carriers would in effect be required to adhere—go ahead and establish a fare formula and allow some deviation up and down. Within this "band" (DOT recommended \(\pm 15\) percent), fares would be lawful on grounds of reasonableness. Fares could still be declared unlawful on grounds of preference and prejudice. The essence of the proposal is described in Figure 3.

Some carriers, those most afraid of price competition, opposed the zone of reasonableness proposal with great vehemence. Interestingly enough, American Airlines, who is traditionally the price leader in

\textsuperscript{1}Several of the local service carriers did not want short-haul fares raised very much, claiming that they were as "high as travellers could afford" already.
Figure 3

Source: CAB Docket 21866-9, DOT-T-4, p. 5.
the industry, came in with exactly the same proposal. Most carriers were aghast at this show of initiative.

According to the Examiner's rendered opinion in phase 9, this concept, be it $\pm 15$ percent or even $\pm 5$ percent (as the Board's Bureau of Economics had recommended) should be squashed. The Board, however, could reverse the decision. If it does, I hope that the zone is made quite wide, since one so narrow as $\pm 5$ percent would not make enough difference to generate much price competition.

DPFI Summary

Table 3 summarizes the results of the DPFI as of this date.

II. Entry, Exit, Merger, and Collusion

Entry of New Firm, and Choices of Carriers

Let us move now to the second type of control the Board exercises, namely determining which carriers which serve markets. Section 401(a) of the Federal Aviation Act requires that any carrier serving a market must obtain a certificate of public convenience and necessity from the Board. Has the CAB ever authorized a new full-fledged trunk carrier? The answer is, "no". The Board has never certified a new trunk carrier, although it has certified other groups of carriers. As indicated in Table 4, the trunks were certificated in 1938 when the Board came into existence. The local service carriers were given temporary authority in the 1940's and finally given permanent authority in 1955. Supplementals were certificated on an interim basis in 1962.

Table 5 compares the average size of an original trunk carrier with the average sizes of trunks and "other" carriers today. In 1938, the average
<table>
<thead>
<tr>
<th>Policy Issue (Phase of DPFI)</th>
<th>GPFI (1960)</th>
<th>Policies Developed Subsequently</th>
<th>DPFI (1971)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Flight Equipment Investment</td>
<td>Straight-line writeoff</td>
<td></td>
<td>Affirmed</td>
</tr>
<tr>
<td>2. Leased Aircraft</td>
<td>-</td>
<td>Not included in rate base</td>
<td>Affirmed</td>
</tr>
<tr>
<td>3. Deferred Federal Income Taxes</td>
<td>Included as current expense</td>
<td></td>
<td>Affirmed</td>
</tr>
<tr>
<td>5. Discount Fares</td>
<td>-</td>
<td>b. Division based on local rates</td>
<td>b. Division based relative carrier costs.</td>
</tr>
<tr>
<td>6A. Seating Configuration Standards</td>
<td>-</td>
<td>Discriminatory discounts encouraged</td>
<td>Discriminatory discounts permitted. 1/</td>
</tr>
<tr>
<td>6B. Load Factor Standards</td>
<td>Rejected</td>
<td>-</td>
<td>Standards adopted, regulation implicit.</td>
</tr>
</tbody>
</table>
Table 3: (continued)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>7. Fare Level</td>
<td>Unable to determine reasonable fares from record</td>
<td>Fares based on carrier revenue need</td>
<td>Fares based on average cost of providing reasonable quality of service</td>
</tr>
<tr>
<td>8. Rate of Return</td>
<td>a. 10.5 percent overall return based on cost of capital</td>
<td>b. Implication of guaranteed return</td>
<td>a. 12 percent overall return, based on cost of capital</td>
</tr>
<tr>
<td></td>
<td>b. 'Guarantee' explicitly rejected; actual return left to market forces</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. Fare Structure</td>
<td>-</td>
<td>Gradual increase in fare taper; promulgation of industry-wide fare formula</td>
<td>Further increase in fare taper; rates to be cost-related, but not cost-based, using industry-wide formula; fare flexibility rejected</td>
</tr>
</tbody>
</table>

17 Hearing Examiner's initial decision.
Table 4: Certificated Carrier Groups and Dates First Authorized by the Civil Aeronautics Board.

<table>
<thead>
<tr>
<th>Carrier Group</th>
<th>Date First Authorized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trunks</td>
<td>August 22, 1938</td>
</tr>
<tr>
<td>Local Service</td>
<td>November 5, 1943 (experimental); March 11, 1966 (permanent)</td>
</tr>
<tr>
<td>Supplementals</td>
<td>October 9, 1962 (interim); March 11, 1966 (permanent)</td>
</tr>
<tr>
<td>All-Cargo</td>
<td>July 29, 1949</td>
</tr>
<tr>
<td>Commuters</td>
<td>February 20, 1952</td>
</tr>
</tbody>
</table>

TABLE 5  
1971 Revenue Ton Miles Per Carrier Compared with 1938 
Trunk Revenue Ton Miles Per Carrier, by Carrier Group.

<table>
<thead>
<tr>
<th>Group</th>
<th>Total Revenue Ton-Miles (x 1,000,000)</th>
<th>Number of Carriers</th>
<th>Revenue Ton-Miles Per Carrier (x 1,000,000)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trunk (1938)</td>
<td>55.3</td>
<td>16</td>
<td>3.5</td>
</tr>
<tr>
<td>Trunk (1971)</td>
<td>12,288.7</td>
<td>11</td>
<td>1,117.2</td>
</tr>
<tr>
<td>Local Service</td>
<td>850.5</td>
<td>9</td>
<td>94.5</td>
</tr>
<tr>
<td>Supplemental</td>
<td>205.5</td>
<td>14</td>
<td>20.4</td>
</tr>
<tr>
<td>All-Cargo</td>
<td>301.5</td>
<td>2</td>
<td>150.8</td>
</tr>
<tr>
<td>Commuter</td>
<td>47.1</td>
<td>179</td>
<td>.3</td>
</tr>
</tbody>
</table>

trunk carrier accounted for 3.5 million revenue ton miles. The trunks of today grossly exceed that number. The average local service carrier is 20 to 30 times as large as the trunk carrier of 1938. Even an average commuter airline today carries almost one-tenth of an original trunk's traffic.

The point I wish to emphasize is that the effect of CAB regulation of entry of new firms has been to protect the original trunks. The Board has never certificated direct competition on an equal footing with trunk carriers. It introduced local service carriers as feeders to trunk carrier terminals. That helped the trunks because it got them more traffic than they would have had otherwise. But note that it took a public law in 1955 to get the local service carriers permanent certificates. The big fight over the supplementals was the same way. The trunks were afraid of encroachment into their markets. It took a public law to get the supplementals certificated.

For the commuter airlines, "Part 298" was set up in 1952. Part 298 said that if you wanted to run an airline with aircraft that weighted less than 12,500 lbs. gross take-off weight, that would be OK with the Board. Of course, everyone knew that service with such a vehicle just could not be viable. Technology, however, has changed all that, and today there are many carriers providing very good service with light-weight equipment. Recently, the local service carriers proposed that the Board start regulating the commuter carriers because they were giving the locals too much competition. The fact that commuter carriers exist in many local service markets and even compete in some trunk carrier markets—despite immense handicaps—should suggest something about the effects of (de)regulation
or the efficiency of air carrier operations.

Entry into City-Pair Markets

What about entry into city pair markets? One thing to note immediately is that the percentage of "monopoly markets" had been decreasing over time. As late as 1955 almost half the trunk carriers' traffic was in non-competitive markets. As shown in Table 6, today less than a quarter is in monopoly markets.

Entry has taken place in a number of ways. The difficulty is that there is no good aggregated measure of this entry. Table 7 shows that route miles operated by the trunk carriers has increased over time, especially between 1966 and 1968. Another measure is the number of points served. As shown in Table 8, this also has been increasing over time.

Whenever entry into a city-pair market is proposed, the Board traditionally looks to several criteria in interpreting its statutory mandate. First, the Board must decide whether a carrier is fit, willing and able to serve. More importantly, the Board must also determine that there is a need, in the public interest, for the service. An incumbent carrier is going to object to having additional competition. What you inevitably get into are proceedings where the incumbent carrier says, "no, we are providing great service," and the petitioning carrier says, "no, they are not providing good service, we are going to provide better service." It usually comes down to who has the best argument. And weights of legal arguments do not necessarily coincide with economic forces.

Another consideration is that procedure discourages entry. Why bother to get into a new market if you have to go through a morass of expensive litigation? This obviously is a constraint.

<table>
<thead>
<tr>
<th>Carrier/Group</th>
<th>1955</th>
<th>1960</th>
<th>1970</th>
</tr>
</thead>
<tbody>
<tr>
<td>American</td>
<td>58.6</td>
<td>77.2</td>
<td>83.0</td>
</tr>
<tr>
<td>Eastern</td>
<td>46.3</td>
<td>73.7</td>
<td>76.6</td>
</tr>
<tr>
<td>TWA</td>
<td>62.9</td>
<td>78.8</td>
<td>91.1</td>
</tr>
<tr>
<td>United</td>
<td>61.3</td>
<td>71.0</td>
<td>67.5</td>
</tr>
<tr>
<td>Big Four</td>
<td>b/</td>
<td>b/</td>
<td>79.8</td>
</tr>
<tr>
<td>Braniff</td>
<td>32.4</td>
<td>50.2</td>
<td>66.0</td>
</tr>
<tr>
<td>Continental</td>
<td>12.5</td>
<td>65.2</td>
<td>79.4</td>
</tr>
<tr>
<td>Delta</td>
<td>37.9</td>
<td>58.9</td>
<td>67.9</td>
</tr>
<tr>
<td>National</td>
<td>80.2</td>
<td>88.0</td>
<td>89.1</td>
</tr>
<tr>
<td>Northeast</td>
<td>8.7</td>
<td>79.9</td>
<td>88.9</td>
</tr>
<tr>
<td>Northwest</td>
<td>59.3</td>
<td>73.9</td>
<td>63.5</td>
</tr>
<tr>
<td>Western</td>
<td>54.4</td>
<td>53.4</td>
<td>73.4</td>
</tr>
<tr>
<td>Other Trunks</td>
<td>b/</td>
<td>b/</td>
<td>73.7</td>
</tr>
<tr>
<td>All Trunks</td>
<td>55.6</td>
<td>72.2</td>
<td>76.5</td>
</tr>
</tbody>
</table>

\(a/\) A market is considered competitive if no one carrier has over 90 percent of the traffic in that market.

\(b/\) Not available.

\(c/\) Weighted average; includes data for Capital (which merged with United in 1961), not shown in table (49.2 in 1955, and 70.5 in 1960).

### TABLE 7


<table>
<thead>
<tr>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
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<tbody>
<tr>
<td>American</td>
<td>6.8</td>
<td>7.0</td>
<td>6.7</td>
<td>6.7</td>
<td>6.7</td>
<td>6.3</td>
<td>8.5</td>
<td></td>
</tr>
<tr>
<td>Eastern</td>
<td>5.3</td>
<td>7.6</td>
<td>7.6</td>
<td>7.5</td>
<td>9.3</td>
<td>10.1</td>
<td>10.4</td>
<td>11.4</td>
</tr>
<tr>
<td>TWA</td>
<td>5.7</td>
<td>7.1</td>
<td>6.9</td>
<td>6.6</td>
<td>6.5</td>
<td>6.5</td>
<td>7.6</td>
<td>9.1</td>
</tr>
<tr>
<td>United</td>
<td>5.3</td>
<td>6.4</td>
<td>9.8</td>
<td>9.7</td>
<td>9.9</td>
<td>10.1</td>
<td>10.1</td>
<td>12.6</td>
</tr>
<tr>
<td>Braniff</td>
<td>2.5</td>
<td>5.3</td>
<td>5.4</td>
<td>5.4</td>
<td>6.4</td>
<td>7.0</td>
<td>9.0</td>
<td>12.5</td>
</tr>
<tr>
<td>Continental</td>
<td>0.6</td>
<td>4.5</td>
<td>3.7</td>
<td>3.7</td>
<td>4.7</td>
<td>5.7</td>
<td>6.6</td>
<td>8.8</td>
</tr>
<tr>
<td>Delta</td>
<td>1.1</td>
<td>5.7</td>
<td>8.5</td>
<td>8.5</td>
<td>8.5</td>
<td>8.5</td>
<td>8.8</td>
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<td>b/</td>
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<td>69.2</td>
<td>72.7</td>
<td>80.4</td>
<td>111.5</td>
</tr>
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</table>

---

a/ Capital merged with United on June 1, 1961. At that time, Capital operated 4,300 route miles.

b/ Not available.

### TABLE 8


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</tr>
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<td>34</td>
<td>34</td>
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On the other hand, the Board, rather than constraining entry, will sometimes "force" carriers into markets. In their sub-part M proceedings, the Board put the local service carriers on notice that it would attempt to reduce subsidy requirements by giving the locals longer-haul, higher-density markets in competition with trunk carriers. From these markets the locals would earn profits which would then be used to offset losses in less-dense, shorter-haul markets. But given that locals often have an equipment disadvantage, how can they be expected to make profits in markets which the trunks themselves have trouble covering costs? As could have been predicted, this effort has failed.

Bill Fruhan has talked about another type of "forced entry." He depicted the entry game as a prisoner's dilemma. A carrier gets into a route prematurely because, though he knows he will lose money if he gets in, he will lose more money if he fails to take advantage of the opportunity. Of course, if there were no controls on future entry, carriers would move into a market only as it became economic to do so.

Exit from Service

The next question of CAB control over carrier economic activity concerns market exit. No trunk carrier has ever gone bankrupt. "Failing firms" have always been absorbed through merger.

On the city-pair market level, exit has been fairly easy, at least for the trunk carriers. The local service carriers have found it at times hard and at times easy to abandon markets depending on their subsidy needs and the Board's willingness to grant subsidy. Right now, many local service carriers are turning over their least dense markets to commuter

---

carriers under contractural arrangement.

Mergers

What about mergers? Table 9 summarizes the mergers that have taken place among trunk carriers. Briefly, in historical review, the Board has vacillated in its attitude toward mergers. During the period from 1938 to the late 1940's, the Board was fairly pro-competitive, turning down a host of merger proposals. From the late 1940's to about 1956, it actively encouraged mergers. From 1956 until very recently, the Board has been pro-competitive again. Recently, it has become rather permissive. It approved the Northwest-Northeast proposal (which fell through), Allegheny-Mohawk (which has been consummated), and Delta-Northeast. Still pending are American-Western and Northwest-National.

The work I have done and the work of many other economists has concluded that the airline industry is characterized by reasonably constant returns to scale. Size per se does not seem to have a significant influence on average cost. That being the case, mergers are not likely to have a significant effect on average cost. If there are no such cost savings, then why do companies merge? First, one carrier might simply buy up the physical assets of another company which is going out of business at a good price. But usually the most important thing the surviving carrier acquires from the failing firm is that carrier's routes. The price paid to most carriers going out of business is not for the equipment, but for the routes.

When one carrier buys out another for the purpose of expanding routes, the merger is usually fairly innocuous. The type of merger that you have
### TABLE 9

Successful and Unsuccessful Mergers Involving Trunk Carriers, 1938-1972

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<thead>
<tr>
<th>Year</th>
<th>Trunk Carriers</th>
<th>Comments</th>
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<tbody>
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<tr>
<td>1939</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>1940</td>
<td>16</td>
<td>United*-Western merger denied</td>
</tr>
<tr>
<td>1941</td>
<td>16</td>
<td>TWA* absorbed Marquette</td>
</tr>
<tr>
<td>1942</td>
<td>16</td>
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</tr>
<tr>
<td>1943</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>1944</td>
<td>16</td>
<td>Western* absorbed Inland</td>
</tr>
<tr>
<td>1945</td>
<td>16</td>
<td>Northeast* absorbed Mayflower; American* absorbed American Export</td>
</tr>
<tr>
<td>1946</td>
<td>16</td>
<td>Braniff*-Frontier merger denied; American*-MidContinent* merger denied</td>
</tr>
<tr>
<td>1947</td>
<td>16</td>
<td>Capital*-Northeast* merger denied</td>
</tr>
<tr>
<td>1948</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>1949</td>
<td>16</td>
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<td>1950</td>
<td>16</td>
<td>Mid Continent-Parks merger denied</td>
</tr>
<tr>
<td>1951</td>
<td>16</td>
<td>Continental*-Midwest merger withdrawn</td>
</tr>
<tr>
<td>1952</td>
<td>16</td>
<td>Northwest*-Capital* merger dismissed; Braniff* absorbed Mid-Continent*</td>
</tr>
<tr>
<td>1953</td>
<td>14</td>
<td>Delta* absorbed Chicago and Southern*</td>
</tr>
<tr>
<td>1954</td>
<td>13</td>
<td>Eastern*-Colonial*-National* merger denied</td>
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<tr>
<td>1955</td>
<td>13</td>
<td>Continental* absorbed Pioneer; Delta*-Northeast* merger withdrawn</td>
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<td>1956</td>
<td>13</td>
<td>Eastern* absorbed Colonial*</td>
</tr>
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<td>1957</td>
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<td></td>
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<tr>
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<td>1960</td>
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<td>United* absorbed Capital*</td>
</tr>
<tr>
<td>1962</td>
<td>11</td>
<td>Continental*-National* merger withdrawn</td>
</tr>
<tr>
<td>1963</td>
<td>11</td>
<td>Pan-Am-TWA* merger withdrawn; American*-Eastern* merger disapproved</td>
</tr>
<tr>
<td>1964</td>
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</tr>
<tr>
<td>1965</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>1966</td>
<td>11</td>
<td>Braniff* absorbed Panagra</td>
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<tr>
<td>1967</td>
<td>11</td>
<td>Eastern* absorbed Mackey; Braniff absorbed Pan American-Grace; Western* absorbed Pacific Northern</td>
</tr>
<tr>
<td>1968</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>1969</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>1970</td>
<td>11</td>
<td>American* absorbed TCA; Northeast*-Northwest* merger approved, subsequently terminated by Northwest</td>
</tr>
<tr>
<td>1971</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>1972</td>
<td>11</td>
<td>Delta* absorbed Northeast* American*-Western* merger denied</td>
</tr>
</tbody>
</table>

* Indicates trunk carrier.

to look out for is one which results in increasing monopoly power. For example, a study done by the CAB's Bureau of Operating Rights noted in the United-Capital merger that in markets where competition was eliminated, service deteriorated.

Collusion

What about collusion? The Board must approve any formal agreements among carriers. It has approved the capacity restriction scheme in the transcontinental markets. It has approved congestion agreements. The Board has approved mutual aid pacts and an agreement limiting competition on travel agents' commissions. All these things are very anti-competitive, and open to a lot of criticism.

There is also the specter of extra-legal collusion. There is no hard evidence of this, however. What usually happens is that there is a down-turn in the industry's financial prospects. The carriers start blaming the Board for being a spoil-sport, and they go around making speeches and handing out press releases. Finally, one carrier, usually American, petitions for a fare increase and most of the other carriers join in. That gives the appearance of collusion, but you cannot prove it. Chris Barnekov did some studies which found that in some markets tacit collusion on service appears to work and in some markets it does not. But this too is difficult to prove.

1Economists have looked upon congestion agreements as a poor second best. A better method would be to allocate airway and landing space according to passengers' values as reflected in the prices they would be willing to pay.
III. Regulation vs. Deregulation

What are the costs of regulation? References to the California intra-state markets suggest that without regulation fares would drop about 20 percent. I am dubious of simply ascribing a "20 percent efficiency loss" due to regulation from this experience since the quality of service in these markets, measured by average load factor, is commensurately lower. Without regulation, technical efficiency probably would increase no more than 5-10 percent. One might note also that the Board could reduce fares 20 percent simply by setting higher load factor standards. My feeling is that the greater costs of regulation arise from not having the optimal quality of service. You have too high a price and too high a quality of service. Consumers in the aggregate would prefer a lower quality of service and a lower price.

On a disaggregated basis there are social welfare losses arising from allocative inefficiencies. Because prices do not equal costs in some markets, there are modal split problems. Carriers say they cannot raise prices very high in short-haul markets because passengers will desert to their automobiles. That is exactly what they should do. The fact that they don't because prices are kept artificially low indicates a misallocation of resources.

You may also find "wrong" carriers in "wrong" markets. I once compared the carriers' actual costs per ton mile with those estimated from a regression equation. The results are summarized in Table 10. These numbers are in the form of "(in)efficiency indices," where the lower the number, the more efficient the carrier. For example, American in 1970,
Actual Unit Cost as Percent of Estimated Unit Cost, for the Years 1962-1970, U.S. Trunk Carriers; Also, Percent of Revenue Passenger Miles in Competitive Markets, 1970.

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<tr>
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</table>
had actual cost per available ton mile equal to 95 percent of the "estimated" amount. The equation from which Table 10 is derived is shown as regression #1 in Table 11. I emphasize most strongly, however, that these comparative results are preliminary and are subject to considerable error.

In closing, let me just mention briefly deregulation. Under a completely deregulated regime, retaining only the safety restraints of the Federal Aviation Administration, the industry would have a great deal more price competition. Exit and entry into particular markets would be governed by conditions of cost and demand. There would be much more service differentiation, some carriers offering high-density, low-quality and low-cost service; other carriers offering low-density, high-quality and high-cost service.

What about the structure of the industry? For one thing, there likely would be a greater number of carriers in the market, since there are no detectable scale economies above small-sized firms. There probably would be more oligopolistic practices (price as well as service quality), which is a problem. But as long as entry were free, this would be policed pretty well.

To be candid, the prospects for total deregulation are close to nil. (Those who would benefit from deregulation fail to perceive the opportunity and in any event are poorly organized and not very powerful; those who would be hurt by deregulation know well the situation, are highly organized and very influential.) What part-way measures are worth considering? First, adoption of the zone of reasonableness proposal would bring about some price competition and a gradual elimination of price discrimination.
TABLE 11

Average Cost Regression Equations for Domestic Trunk Carriers

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</tr>
<tr>
<td>2</td>
<td>86</td>
</tr>
<tr>
<td>3</td>
<td>86</td>
</tr>
</tbody>
</table>
Second, why not make the certificate of public convenience and necessity contingent merely on being *consistent* with the public interest, rather than being *required* by it? This would force the Board to make a finding that entry would be adverse to the public interest in order for such entry to be denied. Also, such a provision, properly drawn, would constrain the Board from denying entry on grounds that it would impair an incumbent carrier. Third, redefine the "public interest" in Section 1002 of the FA Act to mean the attainment of economic efficiency. At present the language is so broad that almost any decision and policy direction can be "justified." Finally, facilitate exit through a contractual scheme such as proposed by George Eads,¹ similar to one presently being advanced by the Board itself.

This obviously is only a partial list of alternative courses of action. Some such reforms would require Congressional action; some could be put into effect by the Board under the existing statute (e.g., the zone of reasonableness). Fortunately for the airlines, they have been in a rapidly growing industry, where the mistakes of regulation are soon forgotten, and where inefficiency costs to the public are not so obvious. Although industry and government officials often speak of "crises" in commercial aviation, the truth is that nothing on the horizon is likely to jolt the public and its Congressional representatives to question seriously the regulatory institution. In such a circumstance it will take gutsy policy-makers and articulate advocates to bring about desirable change.

The performance of an industry is greatly influenced by the institutional environment within which it operates. In the case of the certificated interstate airlines, the regulatory environment shaped by the Civil Aeronautics Board's procedures, policies, and decisions has had an important effect on airline costs. Unfortunately, the intertwining of CAB regulation and airline operations makes it impossible to use operating and financial data from the regulated airlines to determine the extent to which regulation affects costs. It happens, however, that the essentially nonregulated, but otherwise, similar, intrastate airlines operating wholly within California (and thus beyond the CAB's jurisdiction) provide a benchmark with which to compare the performance of regulated airlines and thus measure the effects of CAB regulation. This comparison, which serves as the basis for the lecture, shows that the nonregulated environment within California has been a much sternier disciplinarian of airline operations than the regulated environment of interstate air transportation. Issues of survival, profits, efficiency, fares, and the impacts of CAB regulation on costs are examined.
This paper was reconstructed by the Editor with the permission of Professor Jordon and his publisher, The Johns Hopkins Press, from the tape recording of Professor Jordan's talk, this outline notes and his book, *Airline Regulation in America, Effects and Imperfections*, 1970. Specific references and sources of data are in Professor Jordan's book, but have been deleted from this paper in the interest of space. All tables labeled 10- or 11- have been taken directly from the book. Other tables have been numbered sequentially.

Because of time considerations, Professor Jordan has not been able to review this reconstruction, and therefore any errors, misstatements or the like are the Editor's and not his.
The growth of the CAB-regulated airlines has been, and continues to be, outstanding. But even though this expansion occurred while the certificated carriers operated under CAB regulation, it does not necessarily follow that the CAB had any measurable impact on the development of these airlines. Many other industries, regulated and non-regulated, enjoyed substantial growth during this same period. It is possible that the airline industry could have expanded even more rapidly without CAB regulation.

It is possible to study the extent of CAB influence on the certificated carriers by comparing their development with that of similar airlines not regulated by the CAB. Starting in 1946, a number of airlines quite similar to the CAB-regulated interstate airlines operated substantial scheduled service wholly within the state of California and thus beyond CAB jurisdiction. A comparison of their development with that of the certificated carriers provides a basis for measuring the economic effects of CAB regulation.

The Scope of Regulation

Since the beginning of the CAB in 1938, it has had regulatory power over the certificated carriers in the areas of entry, exit, service, and price. The California intrastate carriers have also been subject to some direct economic regulation, though not by the CAB. Since the airlines first began operations, certain
Provisions of Article XII of the California State Constitution (pertaining to transportation in general) had been given. Before September 17, 1965, the California Public Utilities Commission (PUC) had jurisdiction over only the prices charged for scheduled air service within the state. However, on that date the California legislature gave the PUC authority over the entry, exit, and service of the intrastate carriers, in addition to its existing power over prices. Because of this increase in the regulation of intrastate carriers, this study is confined to the period from 1946, when the first intrastate carrier inaugurated service, to 1965. Table 1 compares the economic regulatory powers of the CAB and the PUC for this 20-year period.

**TABLE I**

Differences in Economic Regulatory Powers

<table>
<thead>
<tr>
<th>Area of Direct Regulation</th>
<th>CAB (to 9/17/65)</th>
<th>PUC (to 9/17/65)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Entry and Exit</td>
<td>Complete</td>
<td>None</td>
</tr>
<tr>
<td>Service</td>
<td>Limited, but could exert great indirect pressures</td>
<td>None</td>
</tr>
<tr>
<td>Price</td>
<td>Complete</td>
<td>Complete, but by policy decision, only regulated increases</td>
</tr>
</tbody>
</table>
Because regulatory commissions have considerable discretion, the degree of actual regulation may be less than the maximum allowed and may change over time. For example, even though it had the power to regulate both price increases and decreases, in practice the PUC only controlled increases where CAB controlled decreases as well. Overall, a detailed examination of the actual practices of the CAB and the PUC has shown that the California intrastate carriers operated under relatively limited regulation by the PUC, whereas the certificated carriers were extensively regulated by the CAB. Thus, if these two groups of carriers operated under fairly comparable technological, economic, and operational conditions, major differences in performance between them can be attributed to the differences in economic regulation.

Similarities Between the Carrier Groups

In 1965 the California intrastate carriers accounted for 1.1 percent of total common-carrier, scheduled revenue passenger-miles flown in large aircraft (ranging from DC-3's to four-engine jets) within the contiguous 48 states, and 2.2 percent of the total scheduled domestic passenger originations. The three largest California markets were extremely important markets in the overall domestic airline route structure, ranking first,
ninth, and twenty-third in passenger volume among all domestic 
U.S. city-pair markets. The ability of certain intrastate 
carriers to survive and even dominate such markets makes it 
clear that, within their limited geographic area, they were large-
scale operators and that their service during the period studied 
was significant.

Technological conditions were essentially the same for all 
U.S. airlines from 1946 through 1965. Airports, air traffic 
control, and airways have generally been provided by federal or 
local governments and have been used jointly by all types of 
carriers. Suitable personnel, maintenance facilities, communica-
tions, marketing services, etc., have been widely available 
within the United States to any who care to utilize them at 
existing prices. Most important, substantial numbers of large 
commercial aircraft were available from aircraft manufactu- 
ers (located mainly in Southern California), and many commercial 
aircraft could be bought second-hand from the federal government, 
airlines, and other owners throughout the postwar years. During 
a substantial part of the period studied, identical aircraft 
types were operated by both the certificated and the intrastate 
carriers.

Differences did exist between the general economic and 
demographic conditions in California and in other parts of the
country. Above average increases in population and economic development have occurred in California since World War II. The differences in these growth rates, however, do not appear to be large enough to affect significantly a comparison of California intrastate airlines with the certificated airlines. Indeed, the large growth rate of air transportation in all parts of the country probably is sufficient to "swamp" any effect of differences in economic growth.

The greatest differences between these carrier groups are to be found in operational factors - for example, in distance. The fact is that the cities comprising the longest nonstop market within California (San Diego and San Francisco) are only 449 statute miles apart. In contrast, the domestic nonstop markets of the certificated carriers range up to 2,700 miles. Nevertheless, the average distances for the certificated trunk carriers' on-line passenger trips and flight stage lengths differed much less from those of the California intrastate carriers than the distance differences existing between their longest nonstop markets. Furthermore, the local service carriers' average on-line passenger trip and stage length distances were less than those of the intrastate carriers; therefore, by comparing the intrastate carriers with both classes of certificated carriers, differences due to distance may be partially accounted for.
Although the certificated and California intrastate carriers did not operate under identical conditions, the similarities were substantial and the carrier groups were sufficiently comparable to permit the conclusion that differences between them were due to differences in regulation. This is especially true when the relationship between carrier performance and regulation proves to be quite direct and when differences between carrier groups are very large - so large, in fact, that they really cannot be explained away simply by pointing to certain differences in technological, economic, or operational conditions.

The following sections compare the CAB-regulated airlines with the California intrastate carriers. In particular, three questions will be examined in detail:

1. Is regulation necessary for reliable service or will "cut throat" competition drive fares down below survival levels?
2. If carriers do survive, what is their profit experience?
3. What factors affect the cost structure allowing survival with low fares?

SURVIVAL
Certificated Carrier Entry and Exit

A total of 16 certificated trunk carriers operated during all or part of the period from 1946 through 1965. During this period,
five of the carriers were acquired by or merged with another trunk carrier, so that by June 1, 1961, only 11 trunk carriers remained in operation. All of the 16 trunk carriers received their certificates of public convenience and necessity from the CAB in 1939 and no other airline has since received such a certificate authorizing it to provide comparable trunk-type service. Apparently the necessary and sufficient condition for an airline to have obtained a certificate for the performance of interstate trunk carrier operations was for it to have been in operation between May 14 and August 22, 1938 - the "grandfather" period specified in the 1938 Act.

In contrast to the trunk carriers, the local service carriers were initially certificated by the CAB without benefit of a "grandfather" clause. Beginning with Pioneer Air Lines (then named Essair, Inc.) on November 5, 1943, and ending with Ozark Air Lines on September 26, 1950, the CAB authorized 21 carriers to provide subsidized, experimental, "local feeder" service connecting smaller communities with larger cities, which, in turn, were generally connected by the trunk carriers. Except for a few isolated instances, the local service carriers were not permitted to provide nonstop, terminal-to-terminal service or to operate in direct competition with the trunk carriers during the period covered by this study.
Of the 21 local service carriers receiving certificates from the Board, 13 were still in existence at the end of 1965. Of the 8 that ceased operations, 4 terminated service when the CAB canceled their certificates or denied their requests to extend or renew temporary certificates, and 4 merged with another certificated carrier. These terminations and mergers all occurred before the enactment of Public Law 38 on May 19, 1955, which required the CAB to issue permanent certificates to the surviving local service carriers. There was no further exit from the ranks of the local service carriers throughout the remainder of the period covered by this study.

Overall, it is clear that entry into the ranks of the certificated carriers has been limited to a single time period for each class of carriers, and so long as a departing carrier possessed a CAB operating certificate, exit had been via merger with or acquisition by some other certificated carrier.

Intrastate Carrier Entry and Exit

Between 1946 and 1965, a total of 16 California intrastate carriers provided scheduled, common-carrier service with DC-3's or larger aircraft. Two important facts emerge from comparing the intrastate carriers with the certificated carriers. First, even though the California intrastate market was much smaller than the national market available to the certificated carriers,
the number of intrastate carriers equals the number of trunk
 carriers in existence during these years and is not much smaller
 than the number of local service carriers certificated by the
 CAB. Second, rather than entering during a single period, the
 intrastate carriers entered at various times from 1946 through
 1964, with most entry occurring during 1949 and early 1950,
 and between May 1962 and September 1964.

The Evidence of Survival

Eight of the 16 carriers that operated large aircraft within
California between 1946 and 1965 did so for only one to six
months because of their short periods of service they are not
considered viable attempts to become established in the California
markets. The remaining eight carriers (the so-called major
carriers) survived for nine months or more. One of these, PSA,
has managed to survive since May 1949, even though, with the
exception of a few years in the early 1960's, it charged the
lowest fares per mile available within California. Its per-
formance alone shows that low fares were not a sufficient
condition for failure in these markets, a conclusion buttressed
by the successful operation of Mercer Enterprises since early
1964.

Of the six major intrastate carriers that terminated service
at least two of them clearly did so for noneconomic reasons.
Paradise Airlines terminated operations because the Federal Aviation Agency suspended its commercial operator certificate following the crash of its Constellation on March 1, 1964. The transcript of the Civil Aeronautics Board hearing in which Paradise unsuccessfully appealed the FAA's action shows that the owner of Paradise was eager to resume operations. He was convinced that Paradise's service under its existing fares was viable and was prepared to test that conviction.

Similarly, Western Air Lines of California (WALC) also discontinued service for noneconomic reasons. Western Air Lines (the trunk carrier) finally obtained permission from the CAB to introduce day-coach service at fare equal to those offered by WALC and the other intrastate carriers. Given this permission, Western canceled its extensive leasing arrangements with WALC (thereby causing WALC's demise) and introduced an identical service under its own name.

While Western believed low-fare service was viable, it did not believe such service maximized the profits available from this market. Clearly, the certificated carriers would have preferred the continuance of the situation existing prior to 1949 when they alone offered service under first-class fares that were more than twice the initial coach fares of the intrastate carriers. Given, however, the introduction of low-fare service by the
intrastate carriers and the resulting "diversion" of traffic from first-class to coach service, Western and United chose to match these low fares and service rather than limit themselves to carrying only first-class passengers. They would not have done so had such low-fare service been unprofitable, nor would WALC have been sustained by Western had its service incurred significant losses.

Two of the eight major intrastate carriers terminated service through bankruptcy proceedings. Bankruptcy may be a clear indication of uneconomic operations, but it does not tell whether fares were too low or costs too high. Indeed, one of these two carriers, Pacific Air Lines, adopted the certificated carriers' relatively high, first-class fares for its service. For the Burbank-San Francisco market, Pacific's fare in 1946-47 was more than 50 percent higher than the coach fare introduced in 1949 ($15.15 vs. $9.95). Thus, for whatever reasons Pacific went bankrupt, it did not do so because it charged low fares.

California Central Airlines (CCA) was the second of the major carriers to go bankrupt. Of course, it did charge low fares so that they could have been a factor in its service termination. Four factors, however, seem to be relevant in evaluating this possibility. In the first place, during 1952 CCA led the other carriers in increasing the Los Angeles/Burbank-
San Francisco/Oakland fare from $11.70 to $13.50 (together with the $1.80 increase in the associated San Diego-San Francisco/Oakland fare), and this action was followed by a sharp reduction in its 1953 and 1954 traffic. Second, the analysis of CCA's financial statements shows that its costs increased substantially during 1953 even though its traffic volume decreased. Third, the owners of CCA reinstituted service with California Coastal Airlines shortly after CCA's assets had been sold in bankruptcy, and they did so at fares equal to or lower than those in effect prior to the bankruptcy proceedings. This does not indicate that they thought low fares were the crucial factor in CCA's bankruptcy. Finally, it should be remembered that CCA managed to survive for over six years prior to its bankruptcy. Thus, at the very least, its low fares did appear to cover average costs for a significant part of this period.

The evidence from the remaining two major carriers is not as clear. California Coastal Airlines operated for over two years, during which time it lowered rather than increased its fares. Thus, it appears that higher fares were not considered viable by its management. The fact remains, however, that California Coastal did gradually reduce its service and eventually transferred its equipment to the nonscheduled operations of its associated company, Airline Transport Carriers, indicating that
more profitable opportunities existed in the services provided by that latter company.

Trans California Airlines (TCA) did not lower its fares during the more than two years it operated from 1962 to 1964. On the other hand, neither did it increase its fares, even though it could easily have done so. The former president of TCA attributed its failure not to its low fares but to the loss of traffic that resulted when Western inaugurated Thriftair service between Los Angeles and Oakland in June 1964.

In summary, two of the eight major intrastate carriers did manage to survive while charging low fares, whereas, of the six carriers that terminated service, two clearly did so because of noneconomic factors. Thus, at most, the attrition due to economic considerations was no more than 50 percent. Of the four carriers whose service terminations appear to have been due to economic factors, one charged high first-class fares, so that low fares cannot be blamed for its failure. The actions of the other three major carriers indicate that at least their managements thought low fares were not the critical factor in their failure to survive. In their cases it appears that either rival service by other carriers prevented their achieving viable levels of output or that their modes of operation were such that average costs exceeded those attainable under alternative operating procedures.
In the evaluation of the viability of economic activities in an open market, it is the fact of survival that is crucially important. Other measures of performance are secondary. This section has shown that some of the intrastate carriers did survive, and this provides hard evidence about the economic viability of low-fare service wherever conditions exist similar to those existing within California during the period studied.

PROFITS

The Evidence from Financial Statements

The earliest available financial information regarding the intrastate carriers is that presented by the PUC's staff in the 1949-50 investigation of the "reasonableness" of the intrastate carrier's low fares. The conclusion of this study was that the operations of the intrastate carriers as a group during the first ten months of 1949 were profitable, and that CCA and WALC earned rates of return after taxes in excess of 10 percent.

Abbreviated income statements are available for California Central for almost all of its six years of operations. Starting with February 1, 1949 (one month after it inaugurated service), and extending through December 31, 1953, CCA's operating revenues totaled $7,172,000, and operating expenses (including depreciation) totaled $7,292,000. This resulted in an overall operating loss of $120,000 and an operating ratio (total operating expenses divided by total operating revenues) of 101.7 percent - hardly an
outstanding performance, and one that appears to forecast the approaching bankruptcy of CCA. An inspection of the data for the various time periods, however, shows that CCA had operating profits for the two months ended March 31, 1949, and for the years ended March 31, 1951 and 1952. Indeed, the really major loss (of $126,000) occurred during the nine months ended December 31, 1953, a period in which CCA experienced a 37-day strike of its maintenance employees that curbed operations during July 1953 (a peak traffic month). The fiscal year in which CCA had its greatest profit ended on March 31, 1951. This was the last full year of DC-3 operation, and for eleven of the twelve months, the low $9.99 fare was in effect between Los Angeles and San Francisco. CCA's profit performance with the Martin 202 (introduced on August 31, 1951) and with the $11.70 and $13.50 Los Angeles-San Francisco fares was poorer than under its earlier combination of aircraft and fares.

The income statement for the period from January 28 to December 31, 1954, covers the first eleven months that CCA operated under the general direction of the court-appointed bankruptcy referee, although its owners actually controlled operations as debtors in possession. It shows that the large rate of loss experienced during the last nine months of 1953
had been reduced and an operating loss of only $25,000 was incurred during these eleven months. The operating ratio was 101.4 percent, or just under the average for the previous five years. Net nonoperating expenses increased the loss for this period to about $39,000, but noncash depreciation charges of $110,000 resulted in a positive operating cash flow. This indicates that CCA was on the road to regaining a viable operation, but apparently it was too late to overcome the losses of 1953.

It is beyond the scope of this study to delve more deeply into the reasons for CCA's bankruptcy. The effects of the strike were certainly harmful; the one-year lease of an L-049 aircraft from July 1952 through June 1953 (at a fee of $330,000) proved to be extremely detrimental to both Airline Transport Carriers and CCA; the unilateral fare increase of June 15, 1952, resulted in a sharp reduction in traffic, etc. The important point for this study, however, is that through 1952, CCA's operations were marginally profitable under the relatively low fares then in effect.

Western Air Lines of California's income statement for the period from August 19, 1949, through January 31, 1950, shows a loss of $22,800 after taxes on total revenues of $596,500. The monthly breakdown for this 5½ month period shows, however, that most of this loss was incurred in January 1950. Only small
losses were experienced in August and November 1949, with profits being earned in the other months. During this period, WALC paid Western Air Lines a total of $556,466 in charter fees. This should be compared with Western's estimate of $570,628 for direct aircraft operating expenses, including depreciation, for a similar, if not identical, schedule pattern covering the entire year ending June 30, 1951. This implies that any profits made by WALC's operation were captured by Western through its leasing fees. Of course, this is consistent with the effective control exercised by Western over WALC throughout its lifetime.

From April 6 to December 31, 1962, Paradise Airlines made a small operating profit, but nonoperating expenses resulted in a loss of $332. The record for all of 1963, indicates operating losses of over $25,000 and total losses of $37,000. But total revenues in 1963 were $616,000 compared with just over $150,000 for the eight to nine months of service in 1962. This large increase in revenues combined with the extraordinary operating expenses, due to the introduction of L-049 service in April 1963, may have been the reason why the owner of Paradise was so eager to continue service after the fatal accident on March 1, 1964.

The very limited data for Trans California indicate that it enjoyed a net profit before taxes of $22,000 during the eleven months ended March 31, 1964. This figure may be misleading,
since no aircraft leasing charges are shown. During this eleven month period, TCA operated 3,120 flight hours with its L-749 aircraft, leased from California Airmotive at a rate of $100 per flight hour to cover aircraft leasing and overhaul charges, plus $50 per hour for maintenance. But only about $65,000 are shown in this income statement for aircraft maintenance (rather than $156,000); and the entire $312,000 leasing/overhaul charge is missing. It seems clear that the income statement significantly understated TCA's true expenses and that the company did suffer a serious loss during this period. Whether TCA's loss for these eleven months should be attributed to low fares or to other factors cannot be deduced from these data. It is relevant however, that during more than two years of operations, TCA failed to achieve a 50 percent load factor; therefore, it seems proper to conclude that important factors other than low fares contributed to its losses.

Mercer Enterprises was one of the two surviving intrastate carriers as of December 31, 1965. Mercer's income statements for 1964 and 1965 show total operating revenues of $128,000 and $177,000, respectively, with common carrier revenues being essentially constant at $69,000 and $66,000. An operating profit of almost $41,000 was earned in 1964, with net income before taxes of $38,000. Nineteen sixty-five shows an operating loss of $2,349 with a net income before taxes of just over
$12,000, due largely to capital gains. Income taxes are not shown since Mercer Enterprises was a sole proprietorship during those years and it is not possible to calculate income taxes without information regarding the owner's personal tax status. Also, the expenses for these two years do not include the manager's (owner's) salary.

One reason for the 1965 loss is that Mercer incurred substantial expenses in inaugurating a contract service with the U.S. Military Air Transport Service. In the first six months of 1966, military contract revenues were $250,000 out of a total of $339,000 with a net income before taxes of $62,750. Obviously, Mercer's common-carrier service is only one part of its total operation, but the fact that it has retained this very short-haul, weekend scheduled service implies that is economically viable, even though offered under low fares.

Table 10-1 summarizes the financial information for PSA. This table shows that in every year for which information is available PSA made an operating profit and also earned a profit after taxes. True, the profit for 1960 was nearly zero, but this was the first full year of PSA's Electra operations and the year the FAA ordered this aircraft operated at reduced speeds pending the modification of its wing and engine support structure. During this period many passengers shunned the Electra (regardless
of the airline operating it). The abnormal situation of that year is emphasized by the large profits PSA earned in the preceding and subsequent years.

The operating ratios given in Table 10-1 appear to have been related to the type of aircraft operated by PSA. Those for both 1950 and 1955 were around 96 percent. During those two years PSA operated DC-3 aircraft (DC-4's were introduced on November 10, 1955), its fare level was virtually the same (its Burbank-San Francisco/Oakland fare was $9.95 in 1950 and $9.99 in 1955), and it operated over about the same route structure. Thus, it appears that the effects of inflation were balanced by economies resulting from increases in the volume of output and from greater experience in operating DC-4's, and that 96 percent was about as low a ratio as could be attained with DC-3's under such low fares. The operating ratios for DC-4 service started at 94.7 percent in 1956 and fell each year until reaching 81.0 percent in 1959; however, this reduction was helped by the April 14, 1958, fare increase. The introduction of Electras on November 20, 1959, ushered in a new era in PSA's operating ratios. Starting at 99.7 percent in 1960, by 1964, the last full year of all-Electra service, the ratio had declined to 71.4 percent, due in part to the fare increase of December 12, 1960, which raised the Los Angeles-San Francisco fare from $11.81 to $13.50. The mixed
### Table 10-1

**Selected Financial Data, Operating Ratio, and Return on Stockholder Equity**

**Pacific Southwest Airlines, Various Years 1950-1965**

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Operating Revenues</th>
<th>Total Operating Expenses</th>
<th>Profit after Taxes(^a)</th>
<th>Stockholder Equity(^b)</th>
<th>Operating Ratio(^c)</th>
<th>Return on Stockholder Equity(^d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>$505,988</td>
<td>$489,939</td>
<td>n.a.</td>
<td>n.a.</td>
<td>96.8%</td>
<td>n.a.</td>
</tr>
<tr>
<td>1955</td>
<td>1,587,697</td>
<td>1,523,385</td>
<td>$243,997(^c)</td>
<td>n.a.</td>
<td>95.9</td>
<td>n.a.</td>
</tr>
<tr>
<td>1956</td>
<td>2,264,850</td>
<td>2,144,385</td>
<td>58,588</td>
<td>n.a.</td>
<td>94.7</td>
<td>n.a.</td>
</tr>
<tr>
<td>1957</td>
<td>3,126,254</td>
<td>2,727,079</td>
<td>196,606</td>
<td>$86,550</td>
<td>87.2</td>
<td>227.2%</td>
</tr>
<tr>
<td>1958</td>
<td>3,929,921</td>
<td>3,267,309</td>
<td>322,031</td>
<td>n.a.</td>
<td>83.1</td>
<td>n.a.</td>
</tr>
<tr>
<td>1959</td>
<td>4,775,993</td>
<td>3,867,215</td>
<td>908,788</td>
<td>1,057,609</td>
<td>81.0</td>
<td>43.1</td>
</tr>
<tr>
<td>1960</td>
<td>8,130,483</td>
<td>8,109,688</td>
<td>499</td>
<td>n.a.</td>
<td>99.7</td>
<td>0.0</td>
</tr>
<tr>
<td>1961</td>
<td>10,300,293</td>
<td>9,173,116</td>
<td>310,483</td>
<td>n.a.</td>
<td>89.1</td>
<td>n.a.</td>
</tr>
<tr>
<td>1962</td>
<td>14,204,915</td>
<td>10,803,179(^f)</td>
<td>1,368,770</td>
<td>3,007,734</td>
<td>76.1</td>
<td>45.5</td>
</tr>
<tr>
<td>1963</td>
<td>17,852,448</td>
<td>12,900,409(^f)</td>
<td>2,951,719</td>
<td>7,429,810</td>
<td>72.3</td>
<td>30.5</td>
</tr>
<tr>
<td>1964</td>
<td>20,773,372</td>
<td>2,827,415</td>
<td>2,034,932(^g)</td>
<td>10,075,046</td>
<td>71.4</td>
<td>29.2%</td>
</tr>
<tr>
<td>1965</td>
<td>24,015,261</td>
<td>19,605,184</td>
<td>11,504,770</td>
<td>n.a.</td>
<td>81.6</td>
<td>17.7%</td>
</tr>
</tbody>
</table>

n.a.—not available.

\(^a\)Profit after taxes and special items.

\(^b\)As of December 31, of each year.

\(^c\)Total operating expenses divided by total operating revenues.

\(^d\)Profit after taxes and special items divided by stockholder equity.

\(^e\)Includes gain of $206,150 on sale of DC-3 aircraft. Excluding this gain yields profit after taxes for 1955 of $37,847.

\(^f\)Reported total operating expenses reduced by $100,000 (1962) and $55,000 (1963) by deletion of investment tax credit that was added to provision for obsolescence and depreciation during those years.

\(^g\)Includes provisions for investment tax credit.
operation of Electras and B-727-100's in 1965 raised the operating ratio to 81.6 percent, and its reduction to 76.8 percent in 1966 seemed to maintain the old pattern. The ratio increased, however, to 83.8 and 86.1 percent in 1967 and 1968, when the Electras were retired and PSA's fleet was expanded to include DC-9-30's, B-737-200's, and B-727-200's. Thus, the decreasing trend found with DC-4's and Electras has yet to be established with PSA's all-jet operation.

The very limited information regarding return on stockholder equity suggests an outstanding performance for the years since 1957 (again with the exception of 1960). The 227 percent return of 1957 was due as much to the very low level of stockholder equity for that year (about $87,000) as to the level of profits. But the 43.1 percent return in 1959 was with stockholder equity of over $1 million, and the 45.5 percent return in 1962, was on an equity base of $3 million. These rates of return were too high to sustain, especially in a market with open entry. In fact, these high returns are consistent with the new entry that occurred in 1962 after a seven-year hiatus, and with Western's introduction of Thriftair service in that same year. However, the 30 percent return of 1963 and 1964, and even the 17.7 percent return of 1965, are still outstanding.
PSA Compared with the Certificated Carriers

The certificated trunk and local service carriers' operating ratios and returns on stockholder equity provide yardsticks with which to evaluate PSA's performance. The operating ratios for total trunk and total local service carriers are presented in Table 10-2, together with those for Western Air Lines, Pacific Air Lines (the local service carrier), and PSA. The data for Western and Pacific are presented because they, of all the trunk and local service carriers, had the greatest portions of their operations within California and, so, are more likely than other certificated carriers to be affected by the regional factors (if any) affecting PSA.

A comparison of the median and range for each of these series of operating ratios shows that the trunk carriers generally had lower ratios than did the local service carriers, despite the relatively large direct subsidy payments received by the local service carriers. Within the trunk carrier group, Western usually enjoyed below average (superior) operating ratios (a median value of 88.7 percent for Western vs. 92.0 percent for all trunk carriers). Similarly, during these 17 years, Pacific's median ratio was 95.0 percent, compared with 98.3 percent for all local service carriers. Until late 1955, PSA, operated the same type DC-3 aircraft that Pacific and the other local service
carriers operated during those same years. Thus, it is not surprising to find that PSA's operating ratios were similar to those of Pacific and of all local service carriers during this period, despite the large subsidies received by the local service carriers. The impact of four-engine aircraft can be seen in PSA's ratios for 1957 (the second full year of its DC-4 service) and operating ratios of the trunk carriers and Western, even though PSA's fares per mile were significantly lower than those of these larger carriers, and it did not receive any air mail revenue. Overall, to the extent that operating ratios indicate efficiency, it appears that PSA was generally more efficient than the trunk or the local service carriers. Not only did it have the lowest median operating ratio (85.2 percent) but the interval of its range (28.3 percentage points) exceeded Western's interval (19.2 percentage points) as well as the interval for the total trunk carriers (16.6 percentage points).

The returns on stockholder equity for these same carriers and carrier groups are summarized in Table 10-3. These data show that, at least since 1957, PSA has generally achieved higher rates of return than those of the certificated carriers. Rates above 30 percent appear to have been common for it in contrast to the highs of 21.6 percent for total trunk carriers, 25.5 percent for
### Table 10-2
Operating Ratios for Total Trunk and Local Service Carriers
Western Air Lines, Pacific Air Lines, and Pacific Southwest Airlines
1949-1965

<table>
<thead>
<tr>
<th>Year</th>
<th>Trunk Carriers</th>
<th>Local Service Carriers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Western</td>
</tr>
<tr>
<td>1949</td>
<td>94.6%</td>
<td>92.2%</td>
</tr>
<tr>
<td>1950</td>
<td>88.1</td>
<td>88.7</td>
</tr>
<tr>
<td>1951</td>
<td>83.9</td>
<td>83.4</td>
</tr>
<tr>
<td>1952</td>
<td>87.6</td>
<td>83.8</td>
</tr>
<tr>
<td>1953</td>
<td>89.9</td>
<td>88.7</td>
</tr>
<tr>
<td>1954</td>
<td>89.8</td>
<td>92.3</td>
</tr>
<tr>
<td>1955</td>
<td>89.2</td>
<td>85.9</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Trunk Carriers</th>
<th>Local Service Carriers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Western</td>
</tr>
<tr>
<td>1957</td>
<td>92.0</td>
<td>90.8</td>
</tr>
<tr>
<td>1958</td>
<td>97.0</td>
<td>88.1</td>
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<tr>
<td>1959</td>
<td>93.7</td>
<td>95.9</td>
</tr>
<tr>
<td>1960</td>
<td>94.1</td>
<td>81.5</td>
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</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Trunk Carriers</th>
<th>Local Service Carriers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Western</td>
</tr>
<tr>
<td>1961</td>
<td>100.5</td>
<td>97.6</td>
</tr>
<tr>
<td>1962</td>
<td>96.7</td>
<td>90.6</td>
</tr>
<tr>
<td>1963</td>
<td>94.7</td>
<td>81.5</td>
</tr>
<tr>
<td>1964</td>
<td>89.4</td>
<td>78.4</td>
</tr>
<tr>
<td>1965</td>
<td>87.2</td>
<td>82.4</td>
</tr>
</tbody>
</table>

Median 92.0 88.7 98.3 95.0 85.2

Range 83.9-100.5 78.4-97.6 91.7-103.1 88.2-104.0 71.4-99.7*

n.a.—not available.
*Estimated.
aTotal operating expenses divided by total operating revenues.
bDomestic operations only.
cBased on data for 12 years rather than 17 years.

### Table 10-3
Return on Stockholder Equity for Total Trunk and Local Service Carriers
Western Air Lines, Pacific Air Lines, and Pacific Southwest Airlines
1951-1965

<table>
<thead>
<tr>
<th>Year</th>
<th>Trunk Carriers</th>
<th>Local Service Carriers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Western</td>
</tr>
<tr>
<td>1951</td>
<td>17.9%</td>
<td>17.5%</td>
</tr>
<tr>
<td>1952</td>
<td>18.5%</td>
<td>15.0%</td>
</tr>
<tr>
<td>1953</td>
<td>14.0%</td>
<td>8.3%</td>
</tr>
<tr>
<td>1954</td>
<td>13.9%</td>
<td>14.4%</td>
</tr>
<tr>
<td>1955</td>
<td>14.8%</td>
<td>17.0%</td>
</tr>
<tr>
<td>1956</td>
<td>11.9%</td>
<td>22.5%</td>
</tr>
<tr>
<td>1957</td>
<td>4.8%</td>
<td>15.5%</td>
</tr>
<tr>
<td>1958</td>
<td>7.7%</td>
<td>9.2%</td>
</tr>
<tr>
<td>1959</td>
<td>9.6%</td>
<td>24.8%</td>
</tr>
<tr>
<td>1960</td>
<td>0.0%</td>
<td>8.5%</td>
</tr>
<tr>
<td>1961</td>
<td>-5.2%</td>
<td>2.2%</td>
</tr>
<tr>
<td>1962c</td>
<td>1.2%</td>
<td>11.7%</td>
</tr>
<tr>
<td>1963c</td>
<td>1.9%</td>
<td>21.6%</td>
</tr>
<tr>
<td>1964c</td>
<td>17.1%</td>
<td>25.5%</td>
</tr>
<tr>
<td>1965c</td>
<td>21.6%</td>
<td>19.6%</td>
</tr>
</tbody>
</table>

Median 11.9 15.5 13.0 6.6 n.a.

Range (-)5.2-21.6 2.2-25.5 (-)11.4-21.2 (-)10.9-26.4 0.0*-227.2*

n.a.—not available.
*Estimated.

aProfit after taxes and special items divided by stockholder equity. The certificated carriers' return is based on the arithmetic mean of stockholder equity at the end of the 12-month period a year ago and at the end of each quarter of the current 12-month period. PSA's return is based on stockholder equity as of December 31, of each year.
bDomestic operations only.
cIncludes provisions for investment tax credit.
Western, and in comparison with the 18 percent cost of equity specified by the CAB as being fair and reasonable for the smaller trunk carriers. The negligible return of 1960 was due to the Electra problem and was not repeated in subsequent years; 1965 seems to be the only other year during the period studied when PSA's rate of return was below those of the two total carrier groups and Western. The 1965 results are not surprising, however, considering greatly increased service and price rivalry given PSA by United and Western and the addition of five B-727-100's to PSA's fleet between April and August 1965, thereby more than doubling its capacity and incurring the costs of introducing a new aircraft type.

Conclusion

This section shows that it has been possible for some airlines to survive and operate profitably within California under relatively low fares. Indeed, the fact of survival is persuasive evidence of the viability of such fares. PSA was consistently the intrastate carrier with the lowest fares and it survived and prospered throughout the period studied; California Central did well for several years before succumbing to the effects of such actions as an independent fare increase, a costly aircraft lease, and a strike; Mercer was successful in providing a very limited service at low fares; and several
carriers operated until having to terminate service because of noneconomic factors. In addition, the actions of United and Western in the early 1950's and, again, in 1962-65 show that they preferred to offer low-fare service rather than accept a declining traffic share in the major markets. Overall, four or more carriers have consistently operated in the Los Angeles-San Francisco and Los Angeles-San Diego markets, whereas three or four carriers have operated between San Diego and San Francisco. Clearly, fares per mile substantially below those resulting from the CAB's across-the-board fare increases have proved to be high enough to attract and support extensive airline service in the major California markets ever since 1949.

Table 2 indicates what the fare structure was in the major California markets. Similar low-fares existed in the minor markets as well. The 1949 data compares the first class fares charged by the certificated carriers with the coach fares of the intrastate carriers. The 1965 data compares the intrastate fares with hypothetical coach fares of the certified carriers computed on the same basis as their intrastate fare structure. In reality, the interstate carriers were forced to meet the lower fares of the intrastate carriers because of competitive pressures.
### TABLE 2

**Fares Differences in Major California Markets**

<table>
<thead>
<tr>
<th>Market</th>
<th>Aircraft Type</th>
<th>1949</th>
<th>1965</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Cert. FC</td>
<td>Calif. C</td>
<td>% Lower</td>
</tr>
<tr>
<td>LAX-SFO</td>
<td>Prop.</td>
<td>$21.05</td>
<td>$9.99</td>
<td>52.5</td>
</tr>
<tr>
<td></td>
<td>Jet</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>LAX-SAN</td>
<td>Prop.</td>
<td>6.75</td>
<td>5.55</td>
<td>17.8</td>
</tr>
<tr>
<td></td>
<td>Jet</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>SAN-SFO</td>
<td>Prop.</td>
<td>27.80</td>
<td>15.54</td>
<td>44.1</td>
</tr>
<tr>
<td></td>
<td>Jet</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Range</td>
<td></td>
<td>17.8 - 52.5%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
INTRODUCTION

How was it possible for Pacific Southwest Airlines (PSA), Mercer Enterprises, and some of the other intrastate carriers to achieve profits with low fares per mile when the certificated carriers required much higher fares per mile to earn profits from their interstate operations? There appears to be no one simple answer to this question, and it seems likely that many large and small differences in operating practices combined to enable the surviving intrastate carriers to operate at lower costs than the certificated carriers. Indeed, one would expect that the ability of an airline to achieve low average costs would have a particularly high survival characteristic in the California markets where fares were low and where entry and exit were unimpeded by government regulation.

On the other hand, it may be that operating conditions in the major California markets (and in similar high-density interstate markets) naturally yield average costs that are lower than those attainable in smaller markets, so that the certificated and intrastate carriers' costs were about the same in these markets while being substantially different on a system-wide basis. If this is correct, it follows that the almost universal
application of the Civil Aeronautics Board's fare policies and increases to all markets, regardless of their cost characteristics, results in large profit potentials in California-type interstate markets, even greater profit potentials in high-density, long-haul markets, and, of course, only low profits or even losses in short-haul, low-density markets.

Actually, low-cost carrier operations and low-cost markets are not mutually exclusive, and both could have existed within California during the period under study. That is to say, the intrastate carriers may have been lower cost operators than the certificated carriers, and the major California markets may have been served by all carriers at costs that were lower than those required to serve smaller markets. Information is not available with which to investigate the direct effects of market characteristics on airline costs.

Implications Regarding Economies of Scale

The financial data and the experience of the California intrastate carriers indicate that most economies of scale attainable in airline operations can be achieved by small airlines operating a few aircraft over small (in terms of the number of cities served) route structures. If large operations are required to achieve major economies of scale, then the operating ratios of
PSA should have been higher than those of Western (which has always been much bigger than PSA) and even higher than those of Pacific during the 1950's (when Pacific was bigger than PSA). This was not the case, however. PSA's operating ratios were generally equal to Pacific's during the years they both operated DC-3's (despite Pacific's larger size, higher fares, and subsidy receipts), and they were consistently lower than Western's once PSA adopted four-engine aircraft.

It might be argued that PSA's lower operating ratios for 1957-59 compared with 1950 and 1955, and its even lower operating ratios for 1961-64, provide evidence of increasing economies of scale. As discussed above, however, these lower operating ratios appear to be associated with the type of aircraft operated (DC-3, DC-4, or Electra rather than with the size of operations. Note that throughout these years PSA's fleet never exceeded six aircraft. In fact, PSA never operated more than four DC-3's at one time (from August 1952 to November 1955), and four was the maximum number of DC-4's in its fleet (from June 1957 to December 1959). Would anyone arguing that domestic airlines experience significant economies of scale be content to set the top limit of such economies during this period at the output of six aircraft?

The survival over significant time periods of Mercer Enterprises and California Central Airlines (with total revenues of $128,000 and $177,000 for Mercer in 1964 and 1965, and from $1 to $2 million for CCA during 1950-54) provides additional
evidence that important economies of scale can be achieved by small carriers. The fleets of these and other intrastate carriers were miniscule in comparison with those of the trunk carriers during the same time periods. Yet, it was possible for some of these small intrastate carriers to be profitable with fares per mile much lower than those of the certificated carriers.

Overall, the evidence provided by the intrastate carriers relative to the certificated carriers seems to be consistent with decreasing rather than increasing economies of scale. In any case, it is certainly inconsistent with the hypothesis that there were significant economies of scale in U.S. domestic airline operations through the mid-1960's over those attainable with, say, five aircraft of a given type.

If this is indeed true, it becomes obvious that the CAB's control of entry has been very important to the existing certificated carriers. Without such entry control the experience of the California intrastate carriers implies that many more carriers would now be operating within the U.S. and that many other carriers would have operated at various times over a large number of small, simple route structures. This, of course, would have increased the rivalry that the "grandfather" carriers would have otherwise experienced after 1938. There is little question that nonregulated airlines would not have evolved into a natural monopoly because of economies of scale. Quite the
contrary, a prediction of fragmentation seems to be more reasonable than one of concentration.

If only very large airlines had been able to survive while providing low-fare service, this would provide evidence that economies of scale exist in the airline industry. The fact is, however, that the smallest of airlines introduced low-fare service and that at least one of these managed to survive while achieving operating ratios and returns on stockholder equity comparable or superior to those of the much larger certificated carriers operating under substantially higher average fares per mile. This indicates that there are no significant economies of scale in domestic air transportation that cannot be achieved by a carrier operating four or five aircraft of a suitable type over a small route structure. It follows from this that without regulation the U.S. airline industry would probably consist of many small carriers rather than a few very large ones.

Resource Utilization

It is also possible to study differences in carrier operating practices to determine whether they were an important source of differences in operating costs. This section will be devoted first to examining differences in aircraft utilization, and then to examining differences in personnel productivity.
Together, these two types of resources - aircraft (capital) and personnel (labor) - provide the major inputs purchased by airlines; therefore, they probably account for a substantial part of the cost differences attributable to carrier operating practices.

Aircraft Utilization

The following three measures indicate the overall intensity with which aircraft are utilized by airlines:

1. The average number of revenue hours per day that each aircraft is operated (a measure of airframe utilization).
2. The number of seats installed in each aircraft type for a given class of service (which indicates the extent to which the aircrafts's interior is used).
3. The average passenger load factor (which measures the degree to which the installed seats are utilized).

If a carrier flies its aircraft more hours each day, installs more seats in a given aircraft type for some class of service, and sells a higher percentage of those seats on each flight than other carriers, then it clearly utilizes its aircraft resources more intensively than the other carriers. In the following three subsections, the certificated and the intrastate carriers will be compared with respect to these three measures.
Revenue Hours per Aircraft per Day

Table 11-1 presents much of the fragmentary information that is available regarding the average number of revenue hours per day that the intrastate carriers operated their aircraft. In addition, comparable data for the certificated trunk and local service carriers are also presented. These data show that in 1964 three of the intrastate carriers had much lower daily aircraft utilizations than PSA, the trunk carriers, or the local service carriers. Of these three, California Time (with 1.8 hours per aircraft per day) was a short-lived carrier that obviously failed to find a significant demand for service between San Jose/Oakland, Burbank and Palm Springs. Since Mercer operated scheduled service only on weekends, its 0.8 hour per aircraft per day is not surprising. Daily service would have increased its aircraft utilization (but not necessarily its passenger load factor). Trans California's low utilization rate of 2.1 hours per day was due to its leasing arrangement with California Airmotive, whereby it agreed to keep four to five aircraft maintained and operable so that they would be immediately available for sale should such an opportunity present itself. Actually, two aircraft could have adequately covered its schedule pattern and would have brought its average aircraft utilization up to almost five hours per day.
Table 11-1

Average Number of Revenue Hours per Aircraft per Day
Certificated and California Intrastate Carriers
All Services, Selected Years 1952-1964

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Certificated</th>
<th>California Intrastate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Trunk</td>
<td>Local Service</td>
</tr>
<tr>
<td>1952</td>
<td>7.3</td>
<td>6.0b</td>
</tr>
<tr>
<td>1955</td>
<td>7.7c</td>
<td>6.0</td>
</tr>
<tr>
<td>1958</td>
<td>7.5</td>
<td>6.5</td>
</tr>
<tr>
<td>1961</td>
<td>5.9</td>
<td>5.4</td>
</tr>
<tr>
<td>1964</td>
<td>6.5</td>
<td>5.5</td>
</tr>
</tbody>
</table>

n.a.—not available.

aCalculated by dividing the number of aircraft days assigned to service into revenue aircraft hours flown.
bScheduled service only.
cExcludes a small number of hours flown by Eastern with aircraft not assigned to its fleet. Also, excludes National's helicopter operation.
dCalifornia Time Airlines operated from September 19, 1964, through February 1, 1965. This figure applies to this entire period.
eMercer Enterprises inaugurated scheduled service on or about April 18, 1964. This figure applies to its first full 12 months of operation from May 1964 through April 1965.
fTrans California Airlines terminated service on October 7, 1964. This figure applies to its operation from January 1 through October 7, 1964.
In contrast to these cases of very low aircraft utilization, the two largest intrastate carriers - California Central and PSA - appear to have been able to achieve utilizations generally equal to or above those of the local service carriers and quite comparable to the averages for the trunk carriers. While PSA had a higher average daily utilization than the trunk carriers in three out of the five years given in Table 11-1, its 6.6 to 8.7 hours per aircraft per day always fell within the annual range of daily aircraft utilization by the individual trunk carriers. Similarly, California Central's 5.4 hours per day in 1952 was close to the lowest individual trunk carrier's (TWA) daily utilization of 5.7 hours for that same year. Since the trunk carriers' routes have always been longer than those of the intrastate carriers, their average stage lengths have been greater, and longer flights tend to increase average daily utilization (by decreasing relative ground time). The intrastate carriers, therefore, may be penalized somewhat by a system-wide comparison with trunk carriers. At the same time, the intrastate carriers' average stage lengths have been greater than those of the local service carriers, thereby improving their showing relative to that group. Overall, it seems proper to conclude that, aside from identifiably unique situations, the intrastate carriers utilized their aircraft about as intensively as the trunk carriers, and did somewhat better in this respect than most local service carriers.
Number of Seats Installed per Aircraft

A different situation emerges with regard to the number of seats installed in each aircraft. First, the intrastate carriers operated very little of what might be classified as first-class service. Aside from Pacific Air Lines' (the intrastate carrier) service in 1946-47, all intrastate carrier aircraft were operated in essentially high-density configuration, whereas the certificated carriers operated a large number of aircraft in low-density, first-class configuration. This alone served to increase the average number of seats installed in the intrastate carriers' aircraft compared to the average number of seats in similar aircraft operated by the certificated carriers.

Putting aside the effects of class of service on the average number of seats per aircraft, a direct comparison between coach-configured aircraft shows that significant differences existed in the seating configurations of the carrier groups. As can be seen from the data in Table 11-2, with the exceptions of California Central's DC-4, PSA's initial DC-4 configuration, and the L-049's, the intrastate carriers consistently installed more seats in their aircraft than the certificated carriers did in their coach versions of the same aircraft.
The relatively short routes and flight stage lengths of the intrastate carriers may facilitate the installation of more seats in a given cabin area since passenger comfort and payload restrictions are less critical on such stage lengths than they are on the longer stage lengths over which the certificated carriers operate their aircraft outside of California. Both United and Western, however, assigned special aircraft to serve just the major California markets, and even these aircraft had seating configurations that were not as dense as those adopted by PSA. Western's DC-6B Thriftair aircraft contained 92 seats, compared to the 98 seats PSA installed in its DC-6B; and United's B-727-100 Jet Commuter aircraft had 113 seats, compared to the 122 in PSA's B-727-100's. These differences of 6.5 and 8 percent are not tremendously large, but they are similar to the other differences shown in Table 11-2, thereby indicating that the certificated carriers did not limit the number of coach seats because of their longer stage lengths.

Given the strict physical dimensions of the interior of any aircraft, and given the consistency with which the intrastate carriers installed more coach seats within each aircraft type, it is clear that these carriers did utilize the cabins of their coach-configured aircraft more intensively than did the certificated carriers. When the certificated carriers' first-class or mixed-class configured aircraft are included to provide
Table 11-2
Coach Seating Configurations for Aircraft Operated within California by Both the Certificated and the California Intrastate Carriers 1949-1965

<table>
<thead>
<tr>
<th>Aircraft Type</th>
<th>Certificated Carrier</th>
<th>No. of Seats</th>
<th>California Intrastate Carrier</th>
<th>No. of Seats</th>
<th>Intrastate % of Certificated</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC-3</td>
<td>United</td>
<td></td>
<td>CCA</td>
<td>28 &amp; 32</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Western</td>
<td>-a</td>
<td>PSA</td>
<td>28 &amp; 31</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pacific</td>
<td>-a</td>
<td>Others</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>M-202</td>
<td>Pacific</td>
<td>40</td>
<td>CCA</td>
<td>44</td>
<td>110%</td>
</tr>
<tr>
<td>DC-4</td>
<td>TWA</td>
<td>62</td>
<td>CCA</td>
<td>60</td>
<td>97-111</td>
</tr>
<tr>
<td></td>
<td>United</td>
<td>64 &amp; 66</td>
<td>PSA</td>
<td>62 &amp; 70</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Western</td>
<td>66</td>
<td>Others</td>
<td>73</td>
<td></td>
</tr>
<tr>
<td>L-049</td>
<td>TWA</td>
<td>80 &amp; 81</td>
<td>Futura</td>
<td>81</td>
<td>100-101</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Paradise</td>
<td>81</td>
<td></td>
</tr>
<tr>
<td>L-749</td>
<td>TWA</td>
<td>-b</td>
<td>TCA</td>
<td>98</td>
<td></td>
</tr>
<tr>
<td>DC-6B</td>
<td>United</td>
<td>79</td>
<td>PSA</td>
<td>98</td>
<td>103-124</td>
</tr>
<tr>
<td></td>
<td>Western</td>
<td>87, 92, 95</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electra</td>
<td>Western</td>
<td>94 &amp; 96</td>
<td>PSA</td>
<td>98</td>
<td>102-104</td>
</tr>
<tr>
<td>B-727</td>
<td>United</td>
<td>113</td>
<td>PSA</td>
<td>122</td>
<td>108</td>
</tr>
</tbody>
</table>

*a* The certificated carriers did not operate their DC-3's in coach configuration within California. United and Western installed 21 first-class seats in their DC-3's, while Pacific installed 28 such seats.

*b* TWA did not operate its L-749's in coach configuration within California. Its maximum first-class seating configuration for L-749's was 55 seats.

Table 11-3
Average Annual Passenger Load Factors for the Certificated and California Intrastate Carriers Scheduled Service, 1946-1965

<table>
<thead>
<tr>
<th>Year</th>
<th>First Class</th>
<th>Coach</th>
<th>Total Cert. Local Service</th>
<th>Total Intrastate</th>
</tr>
</thead>
<tbody>
<tr>
<td>1946</td>
<td>78.8%</td>
<td>-</td>
<td>37.9%</td>
<td>n.a.</td>
</tr>
<tr>
<td>1947</td>
<td>65.7%</td>
<td>-</td>
<td>29.8%</td>
<td>n.a.</td>
</tr>
<tr>
<td>1948</td>
<td>58.5%</td>
<td>72.9%</td>
<td>27.1%</td>
<td></td>
</tr>
<tr>
<td>1949</td>
<td>58.7%</td>
<td>70.2%</td>
<td>28.2%</td>
<td>66.9%</td>
</tr>
<tr>
<td>1950</td>
<td>61.2%</td>
<td>74.2%</td>
<td>31.5%</td>
<td>73.9%</td>
</tr>
<tr>
<td>1951</td>
<td>68.9%</td>
<td>74.5%</td>
<td>37.4%</td>
<td>69.0%</td>
</tr>
<tr>
<td>1952</td>
<td>65.3%</td>
<td>75.6%</td>
<td>37.5%</td>
<td>65.9%</td>
</tr>
<tr>
<td>1953</td>
<td>62.2%</td>
<td>72.8%</td>
<td>38.6%</td>
<td>67.1%</td>
</tr>
<tr>
<td>1954</td>
<td>61.2%</td>
<td>68.2%</td>
<td>42.2%</td>
<td>69.2%</td>
</tr>
<tr>
<td>1955</td>
<td>62.3%</td>
<td>67.6%</td>
<td>45.2%</td>
<td>72.2%</td>
</tr>
<tr>
<td>1956</td>
<td>62.4%</td>
<td>67.3%</td>
<td>45.8%</td>
<td>75.7%</td>
</tr>
<tr>
<td>1957</td>
<td>59.4%</td>
<td>65.1%</td>
<td>45.2%</td>
<td>80.6%</td>
</tr>
<tr>
<td>1958</td>
<td>58.9%</td>
<td>61.7%</td>
<td>45.7%</td>
<td>72.4%</td>
</tr>
<tr>
<td>1959</td>
<td>55.5%</td>
<td>64.1%</td>
<td>44.4%</td>
<td>71.1%</td>
</tr>
<tr>
<td>1960</td>
<td>56.1%</td>
<td>63.3%</td>
<td>41.9%</td>
<td>71.1%</td>
</tr>
<tr>
<td>1961</td>
<td>51.6%</td>
<td>60.2%</td>
<td>41.6%</td>
<td>72.1%</td>
</tr>
<tr>
<td>1962</td>
<td>46.6%</td>
<td>57.6%</td>
<td>42.3%</td>
<td>75.3%</td>
</tr>
<tr>
<td>1963</td>
<td>51.7%</td>
<td>54.9%</td>
<td>43.8%</td>
<td>72.8%</td>
</tr>
<tr>
<td>1964</td>
<td>49.9%</td>
<td>57.8%</td>
<td>46.4%</td>
<td>74.9%</td>
</tr>
<tr>
<td>1965</td>
<td>49.0%</td>
<td>57.7%</td>
<td>47.3%</td>
<td>63.3%</td>
</tr>
</tbody>
</table>

n.a.—not available.

*a* Some local service carriers operated small amounts of coach service in 1952-53 and from 1956 to early 1965. Their coach load factors were generally above their first-class load factors and, overall, equaled 51.3 percent. However, due to the limited quantity of coach service, the total local service load factor was no more than 0.3 percentage points above the first-class load factor in any one year.

*b* Partially estimated, includes all services.

*c* Coach service inaugurated November 4, 1948.
fleet-wide comparisons, the intrastate carriers' relative cabin utilization becomes even more intensive than that of the CAB-regulated airlines.

Passenger Load Factors

The final measure of aircraft utilization to be considered is average annual load factor - the percentage of total seats flown that were actually occupied by revenue passengers. Table 11-3 presents load-factor data for the three carrier groups from 1946 through 1965, and shows that the trunk carriers' first-class load factors ranged downward from 78.8 percent in 1946 and 68.9 percent in 1951, to a low of 46.6 percent in 1962. In comparison, their coach load factors ranged from 75.6 percent (1952) to 54.9 percent (1963) and were consistently 3 to 14 percentage points higher than those for their first-class service. Because the low average load factors for the local service carriers set them apart from the other two carrier groups, they will not be considered further in this section. It should be noted, however, that their low load factors are consistent with their large subsidy payments. If the local service carriers' subsidy payments were converted to passenger equivalents, their resulting passenger-plus-subsidy load factors would be much higher than their actual load factors.
The most significant comparison is between the trunk carriers' coach load factors and the total load factors for the California intrastate carriers. From 1949 through 1953 (the end of the Korean War), the trunk carriers' coach load factors were generally above those of the intrastate carriers. Overall, during those five years the trunk carriers managed to fill 73.9 percent of their available coach seat miles, compared to the 69.8 percent the intrastate carriers filled (disregarding the denser seating configurations of the California carriers' aircraft). In every year following 1953, however, the California intrastate carriers' average load factor exceeded that for the trunk carriers' coach service by amounts ranging from 1.0 percentage point in 1954 to 17.9 percentage points in 1963. From 1955 through 1964, the intrastate carriers' average annual load factor never fell below 70 percent and reached a high of 80.6 percent in 1957. Over the 12-year period from 1954 through 1965, their weighted mean load factor was 71.2 percent, compared to a 12-year average of only 59.1 percent for the trunk carriers' coach operations - a difference of 12.1 percentage points.

As was discussed above in relation to cost differences, it may be that these large load-factor differences were due primarily to the differing characteristics of the markets served by the two carrier groups, or they may have been due in large part to different operating procedures resulting from management decisions.
and policies that were quite independent of market characteristics. The best way to test which of these was the primary reason would be to compare the load factors of all turnaround flights operated by the certificated and intrastate carriers solely in the three major markets - that is, flights scheduled to serve mainly local traffic. Large differences in the load factors of such flights would imply that management decisions were primarily responsible for the carriers' performance, whereas inconsequential differences would indicate that market characteristics were the important factor. Unfortunately, such detailed information is not available. In fact, only system-wide load factor data are publicly available for the certificated carriers, and one of the intrastate carriers had a policy of not divulging information that would permit the direct calculation of even its system-wide load factors. It is therefore necessary to rely upon indirect analyses to investigate the reasons for differences in overall coach load factors.

Several factors serve to indicate that different market characteristics were not the primary reason for the trunk carriers' lower coach load factors. First, prior to the widespread adoption of dual-configured jet aircraft in the early 1960's, the trunk carriers confined coach service to their high-density markets and provided only first-class service in relatively low-density markets. From 1954 through 1959, coach traffic accounted for 33 to 44 percent of total trunk RPM, but even in this period the
trunk carriers' coach load factors ranged from 1.0 to 15.5 percentage points under those of the intrastate carriers.

Second, the intrastate carriers also served several minor markets within California. Although the three major California markets did generate most of the traffic carried by the intrastate carriers as a group, it appears that the overall range of traffic densities for markets having coach service was greater for the intrastate carriers than for the trunk carriers. During the period studied, trunk carriers did not operate coach service in markets as small as Burbank-Inyokern, Lake Tahoe-Oakland/San Jose, or Burbank-Brown Field, etc.

Finally, a comparison of system load factors for individual intrastate carriers shows that high average load factors were achieved in minor as well as in major markets. For example, Paradise achieved load factors of about 69 percent in its Lake Tahoe-Oakland/San Jose service during 1963 and early 1964, while Mercer Enterprises' load factor between Burbank and Brown Field was about 76 percent from April 1964 through 1965. In contrast, Trans California's average load factor was just 44 percent during its more than two years of service in 1962-64, even though it operated in the relatively major markets of Oakland-Burbank-Los Angeles-San Diego. These performances are inconsistent with the hypothesis that high load factors result from serving high-density markets.
In contrast to the above findings, it seems reasonable to conclude that management decisions do play an important role in determining load factors. In the first place, high load factors could "easily" be achieved by the certificated carriers if all of their managements "simply" adopted the policy that flights would not be scheduled if they did not consistently operate at, say, a 70 percent load factor. Given various marketing (demand-increasing) activities that could be implemented, varieties of aircraft that could be utilized, levels of service quality that could be offered, and the relatively high marginal revenue resulting from the certificated carriers' fare level and structure, such a policy would probably not yield maximum profits, but it would increase average load factors. Another way to do this would be to lower the fare level. As fares decreased, greater numbers of passengers would be required on each flight in order to equate marginal revenues with marginal costs (other things held constant), and airline managers would be motivated to schedule flights to achieve higher load factors in order to maximize profits under the new fares. (Conversely, increases in fare levels would promote lower load factors). Of course, the differences in fare levels for the certificated and intrastate carriers are consistent with the observed differences in load factors between these carrier groups. Still another
discretionary way to increase load factors would be to change the number of scheduled flights in accordance with daily, weekly, and seasonal (annual) fluctuations in traffic. Thus, fewer flights would be scheduled to depart at 3 A.M. than at 8 A.M. each day, fewer flights would be operated on Saturdays than on Fridays and fewer daily flights would be scheduled during February of any year than during the following August when traffic is at its seasonal peak.

It happens that some data are available regarding traffic and schedule fluctuations in the three major California markets that support the hypothesis that management decisions did play a significant role in the intrastate carriers' achievement of relatively high load factors. PSA reported that Friday and Sunday each accounted for something over 21 percent of its total weekly traffic, with the other five days each accounting for between 10.5 and 13.0 percent. Generally speaking, business travel predominates on Monday through Thursday, then on Friday and Sunday afternoons and evenings there is a large volume of weekend personal and pleasure travel which results in traffic peaks. Given such a predictable weekly traffic fluctuation, a concurrent fluctuation in schedules should yield a higher average load factor than if the same number of flights were distributed equally over the week so that 14.3 percent of total weekly flights were operated each day.
Table 11-4 gives the percentage of total weekly seats scheduled on Friday and Sunday (combined) in the three major California markets by the certificated and California intrastate carriers at various times from 1948 to 1965. This table shows that the certificated carriers' schedules were much less responsive to weekly traffic fluctuations than were those of the intrastate carriers. Indeed, it turns out that the median percentages of weekly seats operated by the certificated carriers on Friday and Sunday were 28.6 and 28.7 percent for both first-class and coach service in all three markets. This is the percentage that would be obtained if all flights were operated seven days a week - that is, \( \frac{2}{7} = 28.6 \) percent. In contrast, the intrastate carriers' Friday and Sunday median percentages were 35.8 percent for Los Angeles-San Francisco, 28.1 percent for Los Angeles-San Diego, and 31.2 percent for San Diego-San Francisco.

The intervals of the ranges for each series in Table 11-4 provide an even better idea of the relative scheduling flexibility of the two carrier groups. With two exceptions, the intervals for the certificated carriers are smaller than three percentage points, thereby indicating only small changes in scheduling practices over these years. In comparison, the intervals for the intrastate carriers were 14.4, 11.7, and 9.8 percentage points. Obviously, the intrastate carriers varied their weekly schedules much more than the certificated carriers did.
### Table 11-4

Percentage of Total Weekly Seats Scheduled on Friday and Sunday\(^a\) in the Three Major California Markets by the Certificated and the California Intrastate Carriers

Selected Dates 1948-1965

<table>
<thead>
<tr>
<th>Date</th>
<th>LAX/BUR-SFO/OAK(^b)</th>
<th>LAX/BUR/LGB/ONT-SAN</th>
<th>SAN-SFO/OAK/SJC</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Certificated</td>
<td>First</td>
<td>Coach</td>
</tr>
<tr>
<td>8/ 1/48</td>
<td>28.7%</td>
<td>28.6%</td>
<td></td>
</tr>
<tr>
<td>7/31/49</td>
<td>28.4%</td>
<td>30.3%</td>
<td>24.4%</td>
</tr>
<tr>
<td>3/ 1/51</td>
<td>28.7%</td>
<td>30.8%</td>
<td>35.8%</td>
</tr>
<tr>
<td>9/ 1/52</td>
<td>28.4%</td>
<td>28.6%</td>
<td>37.4%</td>
</tr>
<tr>
<td>9/ 1/53</td>
<td>28.7%</td>
<td>28.6%</td>
<td>39.2%</td>
</tr>
<tr>
<td>10/1/54</td>
<td>29.6%</td>
<td>28.6%</td>
<td>39.2%</td>
</tr>
<tr>
<td>8/ 1/55</td>
<td>29.1%</td>
<td>30.1%</td>
<td>35.2%</td>
</tr>
<tr>
<td>8/ 1/56</td>
<td>29.1%</td>
<td>30.0%</td>
<td>35.8%</td>
</tr>
<tr>
<td>8/ 1/57</td>
<td>28.3%</td>
<td>30.3%</td>
<td>42.4%</td>
</tr>
<tr>
<td>8/ 1/58</td>
<td>29.2%</td>
<td>28.5%</td>
<td>44.7%</td>
</tr>
<tr>
<td>8/ 1/59</td>
<td>29.1%</td>
<td>28.2%</td>
<td>31.1%</td>
</tr>
<tr>
<td>8/ 1/60</td>
<td>28.7%</td>
<td>28.2%</td>
<td>38.6%</td>
</tr>
<tr>
<td>8/ 1/61</td>
<td>28.9%</td>
<td>28.6%</td>
<td>38.3%</td>
</tr>
<tr>
<td>8/ 1/62</td>
<td>28.4%</td>
<td>28.5%</td>
<td>36.1%</td>
</tr>
<tr>
<td>8/ 1/63</td>
<td>28.0%</td>
<td>28.5%</td>
<td>35.0%</td>
</tr>
<tr>
<td>8/ 1/64</td>
<td>28.2%</td>
<td>28.6%</td>
<td>33.1%</td>
</tr>
<tr>
<td>10/1/64</td>
<td>28.5%</td>
<td>29.0%</td>
<td>33.1%</td>
</tr>
<tr>
<td>8/ 1/65</td>
<td>29.2%</td>
<td>29.6%</td>
<td>33.1%</td>
</tr>
<tr>
<td>Median</td>
<td>28.7%</td>
<td>28.6%</td>
<td>35.8%</td>
</tr>
<tr>
<td>Range</td>
<td>28.0%- 28.2%</td>
<td>30.3%- 30.8%</td>
<td>27.5%- 27.4%</td>
</tr>
</tbody>
</table>

\(^{a}\)Flights scheduled to depart up to 2:30 A.M. on Saturday or Monday were considered to have been Friday or Sunday flights.

\(^{b}\)LAX/BUR/LGB/ONT-SFO/OAK/SJC.
Unlike the intrastate carriers' schedules for the two long-haul markets, a number of their Friday and Sunday percentages for the short-haul Los Angeles-San Diego market fell well below 28.6 percent. The lowest share was 20.0 percent (for 8/1/56), and the percentages for seven out of the last eleven dates were less than 28.6 percent. The low percentages for this market in these more recent years could have been due to a number of factors. First, the traffic pattern may have changed, reducing Friday and Sunday traffic. Such a reduction could have resulted from substantial improvements in freeways which might have encouraged automobile travel between these adjacent metropolitan areas. Second, personal and pleasure air travel may be relatively less important in this market, yielding a traffic low rather than a traffic peak on Fridays and Sundays. Third, it may be that PSA (the sole intrastate carrier in this market from 1957 through 1962) found itself short of aircraft and/or crews during these weekly peak periods and discovered that it was more profitable to concentrate its resources in the longer-haul markets. This could be particularly true of the period represented by 8/1/56, when PSA's total fleet consisted of only two DC-4's and when its Friday and Sunday percentage in this market fell to 20.0 percent. Regardless of whether the Friday and Sunday seat percentages were above or below 28.6 percent, the important fact is that the
intrastate carriers did vary their schedules much more than the certificated carriers. This variability in the intrastate carriers' schedules implies a conscious effort by their managements to adjust output to correspond to the different demands existing during the week, and the system load factors given in Table 11-3 indicate that they were successful in this endeavor. In comparison, the certificated carriers tended to ignore weekly traffic fluctuations in the major California markets. To the extent their California practices represent their scheduling policies in interstate markets, their relatively low annual load factors are also consistent with their chosen operating procedures.

It can be argued that PSA's (and the other intrastate carriers') traffic fluctuations differed significantly from those of the certificated carriers. The better-known certificated carriers may have attracted relatively more business travelers, whereas - due to their consistently lower fares - the intrastate carriers may have attracted more personal and pleasure travelers. Thus, the certificated carriers' traffic may have been more stable than that of the intrastate carriers. This explanation might apply to differences found in the 1950's, but with the introduction of Electra aircraft by PSA and the increasing demand for coach service for business travel, it would certainly not apply to the 1960's. Also, while there is no published data available, this writer knows from professional experience that the certificated
carriers do experience weekly traffic peaks on Fridays and Sundays. Evidence of this can be found in their provisions for the "family plan" and "Discover America" promotional fares which generally suspend these promotional fares from Friday noon through Friday midnight or Saturday noon, and from Sunday noon through Monday noon - the same periods during which PSA experienced its traffic peaks.

Overall, the evidence is most consistent with the hypothesis that the intrastate carriers' relatively high load factors are primarily the result of conscious scheduling decisions by their managements, decisions that may well have been imposed by the requirements for survival under the low fares in effect since 1949. At the same time, the certificated carriers' less flexible scheduling practices and lower load factors may reflect the higher fares authorized by the CAB, and the emphasis on service quality by all such carriers in their attempts to obtain larger shares of total traffic when price rivalry is precluded by CAB regulation.

Summary

Taken together, the three parts of this section show that the intrastate carriers generally utilized their aircraft resources more intensively than the certificated carriers. This greater utilization appears not to have been the result of flying each
aircraft more hours per day during the year. Rather, it resulted from the intrastate carriers generally installing more seats in each of their aircraft than the certificated carriers and then usually achieving higher load factors - that is, selling more seats on each flight. In addition, the offering of low-density, first-class service by the certificated carriers also served to decrease their overall aircraft utilization relative to the intrastate carriers.

Still another measure of aircraft utilization is the total number of years each aircraft is operated. It was pointed out in chapter 3 that the trunk carriers repeatedly purchased new aircraft to replace their existing aircraft, whereas, with the exception of PSA's Electras and B-727's, the intrastate carriers bought or leased used, obsolescent aircraft, most of which had been discarded by the trunk carriers. Thus, the intrastate carriers served to extend the productive lives of these aircraft, thereby increasing their overall utilization. This is another example of greater efficiency (increasing the output of a given resource) by the intrastate carriers. This efficiency was reflected in the low prices they paid for their used piston-powered aircraft which, in turn, served to lower their expenses.

The differences between the trunk and intrastate carriers in aircraft utilization appear to have been due more to differences

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in operating practices determined by management decisions than to differences in market characteristics (especially when the comparison is limited to coach-type operations). Both seat installation and fluctuations in weekly schedule patterns are directly controlled by management. In addition, the observed load factor differences are also consistent with the relative fare levels of these two carrier groups - that is, lower fares require larger passenger loads to equate marginal revenues with marginal costs and thus maximize profits. In California, management decisions determined both fare levels and scheduling practices, and those who made the correct decisions were rewarded with the survival of their companies.

Relative Output per Employee

Several measures of employee productivity are used in the airline industry. For example, the CAB publishes the following "crude measures" of productivity:

1. Overall available ton-miles per employee.
2. Overall revenue ton-miles per employee.
3. Total operating revenues (excluding subsidy) per employee.

It is important to realize, however, that dividing some measure of total output by the total number of employees does not yield a measure of employee productivity. Rather, it indicates the
amount of output per employee resulting from the combined use of all inputs. These inputs include those purchased by the airlines (such as labor, aircraft, airport facilities, and fuel), as well as those whose costs are not borne directly by the carriers (for example, the airway, air traffic control, and weather services provided by the federal government). Even though output per employee does not indicate the absolute contribution of airline personnel to total output, it can be used to yield insights into relative employee productivity, providing comparisons are made between carriers or carrier groups whose proportions of labor to nonlabor inputs are roughly similar.

All airlines use the federal airways, lease airport facilities for their aircraft and traffic handling operations, and usually lease the land and buildings where they conduct their maintenance, sales, and administrative activities. These inputs, together with other supplies and services, are generally available to all carriers under equal or very similar terms, and the certificated and intrastate carriers appear to be comparable with regard to their use. This leaves aircraft as the most important nonlabor input by which the carrier groups might be differentiated. It turns out, however, that little difference seems to exist between the carrier groups in the use of this input relative to other capital inputs. For the years 1951 through 1965, the end-of-year book values of the
trunk carriers' flight equipment plus spare parts and assemblies (at cost and before depreciation) comprised between 81.2 and 89.1 percent of the undepreciated book values of their total operating property and equipment (the higher percentages apply to the 1960's). For the local service carriers, flight equipment plus spare parts and assemblies made up 78.3 to 89.4 percent of the total undepreciated book value of their operating property and equipment for these years. Comparable data are not available for any of the intrastate carriers except for PSA from 1962 to 1965. During these four years, PSA's flight equipment, etc., accounted for 89.4 to 93.9 percent of the undepreciated book value of its total operating property. Given a similarity in other nonlabor inputs, this apparent consistency in the dominance of aircraft over all real capital inputs means that if labor inputs are found to be roughly proportional to aircraft inputs it should be possible to use measures of output per employee to obtain fairly reliable estimates of relative labor productivity for these carrier groups.

An indication of the use of labor inputs relative to aircraft inputs may be obtained by dividing the total number of aircraft assigned to service for some period into the total number of employees for that period. The results of such a calculation for various years from 1949 through 1965 are presented in Table 11-5. The data in this table indicate that while California Central and PSA operated two-engine aircraft (through 1955), they utilized
around 30 employees per aircraft (this estimate excludes the 48 employees per aircraft for PSA in 1951, on the assumption that it was inflated by employees engaged in fuel sale and flying school activities). This figure is about 25 percent lower than that of the local service carriers through 1961, the period when those carriers were mainly operating similar two-engine aircraft. PSA's adoption of DC-4's increased its number of employees per aircraft from around 30 to about 48 - somewhat more than that of the local service carriers but just half the number for the trunk carriers for 1952-58, when those carriers produced about three-quarters of their total available seat-miles (ASM) in four-engine propeller aircraft that were mainly larger and faster than PSA's DC-4's. Following its adoption of Electras, PSA employed around 88 persons per aircraft, but this was still only about 90 percent of the number of employees per aircraft that the trunk carriers utilized during 1952-58, while operating aircraft that were slower than the Electra. The further increase in the trunk carriers' number of employees per aircraft in 1961, 1964, and 1965 shows that substantially larger numbers of employees were utilized to operate jet aircraft. Assuming the average speed and size of PSA's Electras in 1962-64 were roughly comparable to the average speed and size of the trunk carriers' diverse fleet during 1961 (when they produced 50 percent of their total ASM in
jet aircraft, and 14 percent in turboprop aircraft), it appears that PSA utilized about 20 percent fewer employees per aircraft than the trunk carriers, while operating a similar "class" of aircraft.

Overall, it is clear that the number of employees per aircraft is influenced by the size and speed of the aircraft operated. Given this, however, it seems that the intrastate carriers utilized around 25 percent fewer employees per aircraft than the certificated carriers for each class of aircraft. The law of diminishing returns, therefore, would lead one to predict somewhat greater average output per employee for the intrastate carriers. How much greater cannot be determined from these data, but if the differences in output per employee are much greater than the differences in number of employees per aircraft, it may still be reasonable to conclude that there are significant differences in relative labor productivity beyond the effects due to the use of different proportions of labor and nonlabor inputs. The following subsections show that this does seem to be the case.

ASM per Employee

The most general measures of physical output are available ton-miles and revenue ton-miles. Since it has not been possible to obtain such measures for the intrastate carriers, available
### Table 11-5

**Number of Employees per Aircraft Assigned to Service**

<table>
<thead>
<tr>
<th>Year</th>
<th>Trunk</th>
<th>Local Service</th>
<th>CCA</th>
<th>PSA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1949</td>
<td>77</td>
<td>39</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1950</td>
<td>-</td>
<td>-</td>
<td>25c</td>
<td>-</td>
</tr>
<tr>
<td>1951</td>
<td>-</td>
<td>-</td>
<td>48</td>
<td>-</td>
</tr>
<tr>
<td>1952</td>
<td>93</td>
<td>41</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1954</td>
<td>-</td>
<td>-</td>
<td>34</td>
<td>-</td>
</tr>
<tr>
<td>1955</td>
<td>96</td>
<td>40</td>
<td>-</td>
<td>29</td>
</tr>
<tr>
<td>1957</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>49</td>
</tr>
<tr>
<td>1958</td>
<td>98</td>
<td>44</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1959</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>48</td>
</tr>
<tr>
<td>1961</td>
<td>108</td>
<td>41</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1962</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>96</td>
</tr>
<tr>
<td>1963</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>85</td>
</tr>
<tr>
<td>1964</td>
<td>133</td>
<td>42</td>
<td>-</td>
<td>83</td>
</tr>
<tr>
<td>1965</td>
<td>143</td>
<td>46</td>
<td>-</td>
<td>82</td>
</tr>
</tbody>
</table>

*aCalculated by dividing average number of aircraft assigned to service into the total number of employees. Employee data are for a brief period of time in each year, while data for the average number of aircraft pertain to the entire year.

bDomestic operations only.

cCCA's average number of aircraft assigned to service during 1950 was partially estimated.

### Table 11-6

**Average Annual Available Seat-Miles per Employee**

<table>
<thead>
<tr>
<th>Year</th>
<th>Trunk</th>
<th>Local Service</th>
<th>California Intrastate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Western</td>
<td>Total</td>
</tr>
<tr>
<td>1950</td>
<td>216,000</td>
<td>298,000c</td>
<td>152,000</td>
</tr>
<tr>
<td>1951</td>
<td>218,000</td>
<td>270,000c</td>
<td>161,000</td>
</tr>
<tr>
<td>1954</td>
<td>329,000</td>
<td>385,000c</td>
<td>182,000</td>
</tr>
<tr>
<td>1955</td>
<td>341,000</td>
<td>408,000c</td>
<td>179,000</td>
</tr>
<tr>
<td>1957</td>
<td>368,000</td>
<td>410,000c</td>
<td>193,000</td>
</tr>
<tr>
<td>1959</td>
<td>389,000</td>
<td>503,000c</td>
<td>202,000</td>
</tr>
<tr>
<td>1962</td>
<td>499,000</td>
<td>726,000c</td>
<td>257,000</td>
</tr>
<tr>
<td>1963</td>
<td>544,000</td>
<td>781,000c</td>
<td>277,000</td>
</tr>
<tr>
<td>1964</td>
<td>567,000</td>
<td>774,000c</td>
<td>298,000</td>
</tr>
<tr>
<td>1965</td>
<td>603,000</td>
<td>769,000c</td>
<td>312,000</td>
</tr>
</tbody>
</table>

n.a.—not available.

*aCalculated by dividing total number of employees into annual average scheduled available seat-miles. Employee data are for a brief period of time in each year, while the ASM data pertain to the entire year.

bDomestic operations only.

cIncludes Inland Air Lines merged with Western on April 10, 1952.

dBased on data that are partially estimated.
seat-miles and revenue passenger-miles (RPM) are used here. Unfortunately, these more limited measures penalize the certificated carriers because a much larger portion of their total operations is involved in transporting cargo (freight, express, and mail). To compensate partially for this bias in favor of the intrastate carriers, an added output measure based on total operating revenues will also be used which, because of the differences in fare levels, is biased in favor of the certificated carriers.

It was possible to obtain employment information for only two years for CCA and for just eight years for PSA. CCA employed about 200 persons in both 1950 and 1954, while PSA's range from 1951 through 1965 was 115 to 740 employees. During the same period, the employment for Western (one of the smaller trunk carriers) ranged from 1,288 to 4,328 persons, while Pacific employed between 256 and 814 persons. At no time did PSA's employment equal Pacific's, even though by 1960 PSA's output was much larger than Pacific's.

Table 11-6 presents the average annual ASM per employee for the four carriers and the two certificated carrier groups for the 10 years from 1950 through 1965 for which CCA's or PSA's employment information is available. During these years, the total trunk carriers had much higher outputs per employee than the local service carriers as a group (increasing to almost twice the output
per employee by 1965), whereas Western's outputs per employee were consistently higher than those for total trunk carriers, and Pacific's were higher than those for total local service carriers. Over the 16-year period covered by the data, all of the certificated carriers' ASM per employee increased greatly, doubtless due in large part to the bigger and faster aircraft operated as the years progressed and, for the trunk carriers, to the increasing emphasis on high-density coach service.

The average annual ASM per employee for CCA in 1950 was almost equal to that for Pacific (both carriers operated DC-3's that year), although it was superior to that for total local service carriers. The data for PSA show that even when operating DC-3's in 1951 and 1955, its ASM per employee were far superior to the local service carrier group and to Pacific. In fact, they were even 24 or 46 percent higher than those for the total trunk carriers and either equal to or 22 percent greater than Western's ASM per employee. Then, when it operated four-engine aircraft, PSA's average annual ASM per employee ranged from 34 to 67 percent higher than Western's and from 68 to 128 percent higher than the average for total trunk carriers. Finally, in 1965 PSA still managed to produce 111 percent more ASM per employee than the trunk carriers (and 65 percent more than Western), despite the fact that, whereas 80.6 percent of total trunk ASM were produced
in jet aircraft, PSA did not introduce jets until April 1965 and produced only about a third of its ASM with such aircraft.

**RPM per Employee**

A similar, but even more striking, difference is found when these carriers are compared on the basis of average annual RPM per employee (see Table 11-7). This measure is influenced by the generally superior load factors attained by the intrastate carriers, and here there is no question about whether CCA was more like a local service carrier or a trunk carrier. In each of the two years for which employement data are available, CCA's average annual RPM per employee was much above that for the total local service carriers and even exceeded that for total trunk carriers by 4 percent. In fact, its figures for these two years were close to Western's relatively high outputs per employee.

PSA's achievements were even more impressive than CCA's. During every year for which information is available, its average annual RPM per employee exceeded that of the total trunk carriers and Western, not to mention the local service carriers and Pacific. In 1951 and 1955, while operating DC-3's (except for the last month and a half of 1955), PSA's outputs per employee were 19 and 60 percent higher, respectively, than Western's. During 1957 and 1959, while operating DC-4's, PSA's outputs per employee were 75 to 124 percent greater than that of both the total trunk
carriers and Western. Then, in 1962-1964, with an all-Electra fleet, PSA retained its 100 percent or more lead over Western while increasing its lead over the trunk carriers to 218 percent, despite the extensive operation of jet aircraft by these carriers. The large increase in PSA's personnel in 1965 (associated with the addition of five B-727-100's to its existing six Electras) resulted in a drop in its output per employee, but its figure was still 87 percent larger than that of Western and 141 percent larger than that of the total trunk carriers.

There is just no question about it. Somehow, some way, PSA managed to achieve impressive levels of RPM per employee. Differences in the order of magnitude of 20 to 30 percent might properly be attributed to inaccuracies or noncomparability in the measures, or to differences in proportions of labor to non-labor inputs. But consistent differences of from 75 to over 200 percent (since 1957) are just too large to be accounted for by these factors, especially when they were achieved while PSA operated DC-4's or Electras and the trunk carriers provided increasing amounts of jet service.

Revenues per Employee

Cargo has accounted for an increasing share of the certificated carriers' output since 1946. By 1965, 19.7 percent of the domestic trunk and 9.9 percent of the local service carriers'
total revenue ton-miles were obtained from cargo. Cargo ton-mile data are not available for the intrastate carriers, but they were prohibited from carrying mail or express, and it is known that they carried little freight during the period under study. It is obvious, therefore, that cargo accounted for a very much smaller share of their total output. It follows that the certificated carriers' total employee figures are relatively larger than those of the intrastate carriers because of the additional employees required to handle cargo traffic. Data are not available that would permit the elimination of cargo employees from the certificated carriers' totals and, even if this adjustment could be made, the jointness of passenger and cargo output would make it impossible to obtain accurate calculations of ASM and RPM per noncargo-related employee. One way to compensate for this bias against the certificated carriers is to calculate average annual total operating revenues (from passenger, cargo, and other operations) per employee as an output measure. Of course, this measure is biased against CCA and PSA because their much lower average fares yield less revenue per unit of physical output. But, taken with the two previous measures, average annual operating revenues per employee should provide some useful insights into comparative airline productivity.

Table 11-8 shows that the average annual operating revenues per employee for CCA and PSA during 1950, 1951, and 1954 were quite
similar to the total revenues (including subsidy) per employee for the total local service carriers. Thus, during those early years, the intrastate carriers were able to obtain roughly the same revenues per employee with their low-fare, high-density coach service as the local service carriers were able to achieve with their high-fare, low-density, first-class service plus subsidies.

By 1955, when it benefited from the termination of rival service by CCA, PSA managed to earn total operating revenues per employee high enough to exceed those for total trunk carriers, total local service carriers, and Pacific, and to approach those for Western. With the adoption of DC-4's, PSA's operating revenues per employee for 1957 and 1959 increased to about 40 percent above those for the total trunk carriers and from 9 to 23 percent above Western's operating revenues per employee. PSA's introduction of Electras in late 1959 was associated with a further relative increase in revenues per employee until they were 98 percent higher than the total trunk carriers' and 55 percent higher than Western's (in 1964). Even in 1965, with a large increase in its number of employees and with its late adoption of jet aircraft, PSA still had a 46 percent advantage over the total trunk carriers and a 25 percent advantage over Western.
Table 11-7

Average Annual Revenue Passenger-Miles per Employee\textsuperscript{a}

Total Trunk and Local Service Carriers, California Central Airlines, Western Air Lines, Pacific Air Lines, and Pacific Southwest Airlines

Selected Years 1950-1965

<table>
<thead>
<tr>
<th>Year</th>
<th>Average Annual Revenue Passenger-Miles per Employee\textsuperscript{a}</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Western</td>
<td>Local Service</td>
<td>CCA</td>
<td>PSA</td>
</tr>
<tr>
<td>1950</td>
<td>136,000</td>
<td>163,000\textsuperscript{c}</td>
<td>48,000</td>
<td>87,000</td>
<td>142,000</td>
</tr>
<tr>
<td>1951</td>
<td>152,000</td>
<td>175,000\textsuperscript{c}</td>
<td>60,000</td>
<td>86,000</td>
<td>n.a.</td>
</tr>
<tr>
<td>1954</td>
<td>209,000</td>
<td>214,000</td>
<td>77,000</td>
<td>119,000</td>
<td>218,000\textsuperscript{d}</td>
</tr>
<tr>
<td>1955</td>
<td>218,000</td>
<td>241,000</td>
<td>81,000</td>
<td>122,000</td>
<td>—</td>
</tr>
<tr>
<td>1957</td>
<td>226,000</td>
<td>246,000</td>
<td>87,000</td>
<td>147,000</td>
<td>—</td>
</tr>
<tr>
<td>1959</td>
<td>239,000</td>
<td>303,000</td>
<td>90,000</td>
<td>136,000</td>
<td>—</td>
</tr>
<tr>
<td>1962</td>
<td>266,000</td>
<td>384,000</td>
<td>109,000</td>
<td>153,000</td>
<td>—</td>
</tr>
<tr>
<td>1963</td>
<td>293,000</td>
<td>422,000</td>
<td>121,000</td>
<td>167,000</td>
<td>—</td>
</tr>
<tr>
<td>1964</td>
<td>314,000</td>
<td>446,000</td>
<td>138,000</td>
<td>169,000</td>
<td>—</td>
</tr>
<tr>
<td>1965</td>
<td>333,000</td>
<td>431,000</td>
<td>147,000</td>
<td>170,000</td>
<td>—</td>
</tr>
</tbody>
</table>

n.a.—not available.
\textsuperscript{a}Calculated by dividing total number of employees into annual average scheduled revenue passenger-miles. The employee data are for a brief period of time in each year, while the RPM data pertain to the entire year.
\textsuperscript{b}Domestic operations only.
\textsuperscript{c}Includes Inland Air Lines merged with Western on April 10, 1952.
\textsuperscript{d}Based on data that are partially estimated.

Table 11-8

Average Annual Operating Revenues per Employee\textsuperscript{a}

Total Trunk and Local Service Carriers, California Central Airlines, Western Air Lines, Pacific Air Lines, and Pacific Southwest Airlines

Selected Years 1950-1965

<table>
<thead>
<tr>
<th>Year</th>
<th>Average Annual Operating Revenues per Employee\textsuperscript{a}</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Western</td>
<td>Local Service</td>
<td>California Intrastate</td>
<td></td>
</tr>
<tr>
<td>1950</td>
<td>$ 9,100</td>
<td>$11,000\textsuperscript{c}</td>
<td>$ 7,000</td>
<td>$ 8,600</td>
<td>$ 6,100\textsuperscript{d}</td>
</tr>
<tr>
<td>1951</td>
<td>9,800</td>
<td>10,700\textsuperscript{c}</td>
<td>7,600</td>
<td>7,800</td>
<td>n.a.</td>
</tr>
<tr>
<td>1954</td>
<td>12,600</td>
<td>13,000</td>
<td>9,300</td>
<td>11,800</td>
<td>8,900\textsuperscript{f}</td>
</tr>
<tr>
<td>1955</td>
<td>12,900</td>
<td>14,600</td>
<td>8,800</td>
<td>11,000</td>
<td>—</td>
</tr>
<tr>
<td>1957</td>
<td>13,100</td>
<td>14,800</td>
<td>9,600</td>
<td>12,600</td>
<td>—</td>
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<tr>
<td>1959</td>
<td>15,300</td>
<td>19,900</td>
<td>10,700</td>
<td>13,400</td>
<td>—</td>
</tr>
<tr>
<td>1962</td>
<td>18,500</td>
<td>25,700</td>
<td>14,000</td>
<td>16,400</td>
<td>—</td>
</tr>
<tr>
<td>1963</td>
<td>19,700</td>
<td>26,200</td>
<td>14,700</td>
<td>17,300</td>
<td>—</td>
</tr>
<tr>
<td>1964</td>
<td>21,000</td>
<td>26,700</td>
<td>15,700</td>
<td>17,600</td>
<td>—</td>
</tr>
<tr>
<td>1965</td>
<td>22,200</td>
<td>26,100</td>
<td>16,300</td>
<td>18,000</td>
<td>—</td>
</tr>
</tbody>
</table>

n.a.—not available.
\textsuperscript{a}Calculated by dividing total number of employees into total domestic operating revenues. The employee data are for a brief period of time in each year, while the total operating revenues pertain to the entire year.
\textsuperscript{b}Domestic operations only.
\textsuperscript{c}Includes Inland Air Lines, merged with Western on April 10, 1952.
\textsuperscript{d}Based on operating revenues for the year ended March 31, 1951.
\textsuperscript{e}Based on an estimate of total operating revenues of $930,000, calculated by applying average fares for 1951 (Appendix 7) to PSA's on-line O & D passenger traffic (Appendix 14).
\textsuperscript{f}Based in part on estimated revenues of $103,000 for January 1-27, 1954.
Summary

Reviewing the percentage differences for all three measures, and recognizing the biases inherent in them, it seems proper to conclude that, while operating two-engine aircraft, the successful intrastate carriers essentially equaled the real output per employee of the total trunk carriers, fell somewhat below that of Western (who was always one of the highest trunk carriers in these measures), and consistently exceeded the output per employee of the total local service carriers and Pacific. Relative output changed radically once PSA obtained four-engine aircraft. From 1957 through 1965, its real output per employee generally exceeded that of the total trunk carriers by more than 100 percent and exceeded that of Western by over 60 percent. It appears that the intrastate carriers utilized about 25 percent less labor per aircraft for generally comparable classes of aircraft and, therefore, should have greater output per employee. But, even if the estimated differences in input proportions are correct, they still do not seem large enough to account for the really impressive differences found in relative outputs per employee. Other factors must account for an appreciable portion of these differences.

It may be argued that the large differences in output per employee were due to the intrastate carriers' purchasing maintenance and sales services from other firms rather than producing them within the company. The best available information for CCA
indicates that its 1950 employee figure did include the maintenance, flight, and administrative personnel officially employed by its affiliated company, Airline Transport Carriers. There is no question, however, about its figure for 1954. The total employees of both CCA and ATC are combined in that figure. In the case of PSA, there is no possibility that total employment was understated because of the outside purchase of maintenance services. PSA consistently did its own maintenance at least as far back as early 1950. If anything, PSA's fuel sale and flight training activities inflate its employment figures and thereby understate the output of ASM and RPM per employee. On the other hand, there are indications that both CCA and PSA relied heavily on travel agents for sales promotion, ticketing, etc. It is not known if their reliance was more extensive than that of the certificated carriers, but it is known from personal observation that during the early 1960's PSA maintained fewer sales offices than the trunk carriers in the three major metropolitan areas of California.

The above data indicate why PSA in particular managed to survive and prosper during the period studied, but they still do not explain why its output per employee was so far superior to that of the certificated carriers. The following is a list of some factors that pertain to this matter, but it is by no means complete:
1. PSA utilized its aircraft more intensively (as described in the previous section), which served to increase its output of ASM and RPM per unit of employee input.

2. PSA operated relatively few aircraft types, thereby reducing employment for crew and maintenance training, engineering, aircraft evaluation, etc. Also, until April 1965, there was only one brief period (in 1960-61) when PSA operated two different aircraft types at the same time (other than during brief transitional periods).

3. PSA's pilots have always been paid for the number of scheduled miles flown, while certificated carrier pilots are paid for the amount of time flown. PSA's pilots, therefore, have a significant monetary incentive to fly as fast as feasible (more miles per hour), which serves to increase output per crew member.

4. Whenever possible, PSA operated its flights under visual flight rules (VFR) rather than under instrument flight rules (IFR). In contrast, the certificated carriers operated all flights under IFR, in accordance with an industry agreement reached through the Air Transport Association. VFR operations serve to reduce flying time for each segment and thereby increase productivity. It should be noted, however, that since the FAA requires
that all jet aircraft operate under IFR, PSA began to lose the advantage of VFR operations as of April 1965.

5. The specialization and resulting simplicity inherent in PSA's route and fare structures served to reduce personnel required to provide a given volume of reservation, ticketing, passenger and baggage handling, and accounting services, etc. These factors also decreased the training required for each employee.

6. The relative lack of regulatory proceedings and industry meetings reduced the need for personnel to conduct such matters, prepare reports, etc. (With the expansion of the PUC's regulatory powers in late 1965, PSA's regulatory activities and associated personnel requirements should be increasing.)

A thorough investigation of the reasons for PSA's greater output per employee is beyond the scope of this chapter. Indeed, it could well provide the basis for another major study. The crucial point to be made here is simply that the successful intrastate carriers were able to produce relatively more output per employee than the certificated carriers. In addition, as shown in the previous section, they also utilized their aircraft resources more intensively. The overall result of these and other unidentified factors was important differences in efficiency
between these carrier groups.

The intrastate carriers' utilization of resources appears to have been substantially more effective than that of the certificated carriers. They demonstrated that it is feasible to achieve more intensive utilization of aircraft than has been attained by the trunk carriers, mainly by installing more seats in coach aircraft (and essentially ignoring low-density, first-class configurations) and by managing to fill a greater proportion of those seats with paying passengers. In addition, they increased the productivity of certain piston-powered aircraft by operating them after they were discarded by the certificated carriers. The intrastate carriers also demonstrated that it is possible to achieve substantially greater output per employee than that of the trunk (and local service) carriers. The ways that the intrastate carriers used to obtain relatively greater productivity appear to be manifold, and substantial changes in certificated carrier operations would be required for them to attain similar productivity. These changes would include major revisions in the route structures of the certificated carriers to give them simple structures similar to those of the intrastate carriers. (Implicit in this would be a higher degree of specialization by each one of a greater number of carriers.) In addition, the rate of adoption of new aircraft types would be decreased, schedule patterns would be established to correspond more closely to
predictable fluctuations in demand, methods of employee compensation changed, different aircraft operating procedures adopted, fewer classes of service offered, a reduction in the amount of regulatory and industry activities undertaken, etc. Increases in real output per employee of over 100 percent are difficult to comprehend, but the evidence provided by PSA's operations indicate they could be achieved, at least in markets comparable to the major California markets, and, if market characteristics are a relevant factor, even greater increases in average employee output could be realized by carriers specializing in serving the major transcontinental markets.

From the viewpoint of this study, a relevant question is: Did the more intensive utilization of aircraft and the relatively greater output per employee by the intrastate carriers stem in whole or in part from the less stringent regulation under which they operated until late 1965? The evidence at hand does not provide a categorical answer to this question. The more intensive aircraft utilization and greater output per employee, however, are consistent with the significantly lower per-mile fares that the intrastate carriers charged. Given these lower fares, it was crucially important for the intrastate carriers to minimize the costs of their operations in order to survive. Obvious ways to decrease average costs per passenger would be to increase the number of seats in each aircraft and to schedule aircraft so that
a greater proportion of these seats were occupied. Another way would be to utilize labor inputs so that greater ASM, RPM, and revenues were obtained for each employee. These were actions that the intrastate carriers took, or, at least, that the viable intrastate carriers managed to take. Since the differences in passenger fares can be attributed more directly to differences in regulation, and since lower costs are required for survival under lower fares, the evidence on aircraft utilization and output per employee is consistent with the hypothesis that regulation, as practiced by the CAB, does have an adverse affect on efficiency in air transportation.

Conclusions

The evidence from the California intrastate carriers' experience seems to indicate that:

1. Nonregulated airlines can survive and provide reliable service with fares 30 to 50 percent less than those set by certified carriers under CAB control.

2. Although all nonregulated have not been successful, those that have survived have made profits with low fares. In particular, PSA's operating ratios and return on stockholder equity have been outstanding.

3. The surviving nonregulated airlines utilize their capital (aircraft) and labor inputs more efficiently
then do the CAB certificated carriers.

4. The physical operations of airlines are not characterized by significant economies of scale. Over a suitable route structure, 4 to 6 aircraft will yield minimum longrun average costs.
### Table 10-1

**Selected Financial Data, Operating Ratio, and Return on Stockholder Equity**

**Pacific Southwest Airlines, Various Years 1950-1965**

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Operating Revenues</th>
<th>Total Operating Expenses</th>
<th>Profit after Taxes(^a)</th>
<th>Stockholder Equity(^b)</th>
<th>Operating Ratio(^c)</th>
<th>Return on Stockholder Equity(^d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>$505,988</td>
<td>$489,939</td>
<td>n.a.</td>
<td>n.a.</td>
<td>96.8%</td>
<td>n.a.</td>
</tr>
<tr>
<td>1955</td>
<td>1,587,697</td>
<td>1,523,385</td>
<td>$243,997(^c)</td>
<td>n.a.</td>
<td>95.9</td>
<td>n.a.</td>
</tr>
<tr>
<td>1956</td>
<td>2,264,850</td>
<td>2,144,385</td>
<td>58,488</td>
<td>n.a.</td>
<td>94.7</td>
<td>n.a.</td>
</tr>
<tr>
<td>1957</td>
<td>3,126,254</td>
<td>2,727,079</td>
<td>399,175</td>
<td>n.a.</td>
<td>87.2</td>
<td>227.2%</td>
</tr>
<tr>
<td>1958</td>
<td>3,329,921</td>
<td>2,367,309</td>
<td>962,612</td>
<td>n.a.</td>
<td>83.1</td>
<td>43.1</td>
</tr>
<tr>
<td>1959</td>
<td>4,775,993</td>
<td>3,867,215</td>
<td>908,778</td>
<td>n.a.</td>
<td>81.0</td>
<td>43.1</td>
</tr>
<tr>
<td>1960</td>
<td>8,130,483</td>
<td>8,109,688</td>
<td>499</td>
<td>n.a.</td>
<td>99.7</td>
<td>0.0</td>
</tr>
<tr>
<td>1961</td>
<td>10,300,293</td>
<td>9,173,116</td>
<td>310,483</td>
<td>n.a.</td>
<td>89.1</td>
<td>n.a.</td>
</tr>
<tr>
<td>1962</td>
<td>14,204,915</td>
<td>10,803,179(^f)</td>
<td>3,382,777</td>
<td>3,007,734</td>
<td>76.1</td>
<td>45.5</td>
</tr>
<tr>
<td>1963</td>
<td>17,852,448</td>
<td>12,900,409(^f)</td>
<td>4,952,039</td>
<td>7,429,810</td>
<td>72.3</td>
<td>30.3</td>
</tr>
<tr>
<td>1964</td>
<td>20,773,372</td>
<td>14,827,433</td>
<td>5,945,939</td>
<td>10,075,046</td>
<td>71.4</td>
<td>29.2%</td>
</tr>
<tr>
<td>1965</td>
<td>24,015,261</td>
<td>19,605,184</td>
<td>4,410,077</td>
<td>11,504,770</td>
<td>81.6</td>
<td>17.7%</td>
</tr>
</tbody>
</table>

\(^a\)Profit after taxes and special items.
\(^b\)As of December 31, of each year.
\(^c\)Total operating expenses divided by total operating revenues.
\(^d\)Profit after taxes and special items divided by stockholder equity.
\(^e\)Includes gain of $206,150 on sale of DC-3 aircraft. Excluding this gain yields profit after taxes for 1955 of $37,847.
\(^f\)Reported total operating expenses reduced by $100,000 (1962) and $55,000 (1963) by deletion of investment tax credit that was added to provision for obsolescence and depreciation during those years.
\(^g\)Includes provisions for investment tax credit.
### Table 10-2

Operating Ratios for Total Trunk and Local Service Carriers
Western Air Lines, Pacific Air Lines, and Pacific Southwest Airlines
1949-1965

<table>
<thead>
<tr>
<th>Year</th>
<th>Trunk Carriers</th>
<th>Local Service Carriers</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Western</td>
<td>Total</td>
<td>Pacific</td>
</tr>
<tr>
<td>1949</td>
<td>94.6%</td>
<td>92.2%</td>
<td>102.1%</td>
<td>94.4%</td>
</tr>
<tr>
<td>1950</td>
<td>88.1</td>
<td>88.7</td>
<td>97.8</td>
<td>88.2</td>
</tr>
<tr>
<td>1951</td>
<td>83.9</td>
<td>83.4</td>
<td>97.9</td>
<td>98.4</td>
</tr>
<tr>
<td>1952</td>
<td>87.6</td>
<td>83.8</td>
<td>102.6</td>
<td>95.0</td>
</tr>
<tr>
<td>1953</td>
<td>89.9</td>
<td>88.7</td>
<td>103.1</td>
<td>104.0</td>
</tr>
<tr>
<td>1954</td>
<td>89.8</td>
<td>92.3</td>
<td>97.1</td>
<td>92.2</td>
</tr>
<tr>
<td>1955</td>
<td>89.2</td>
<td>85.9</td>
<td>98.8</td>
<td>96.0</td>
</tr>
<tr>
<td>1956</td>
<td>92.0</td>
<td>90.8</td>
<td>100.9</td>
<td>103.1</td>
</tr>
<tr>
<td>1957</td>
<td>97.0</td>
<td>88.1</td>
<td>100.9</td>
<td>100.9</td>
</tr>
<tr>
<td>1958</td>
<td>93.7</td>
<td>95.9</td>
<td>98.3</td>
<td>103.4</td>
</tr>
<tr>
<td>1959</td>
<td>94.1</td>
<td>81.5</td>
<td>99.5</td>
<td>97.5</td>
</tr>
<tr>
<td>1960</td>
<td>98.2</td>
<td>90.9</td>
<td>98.5</td>
<td>102.8</td>
</tr>
<tr>
<td>1961</td>
<td>100.5</td>
<td>97.6</td>
<td>94.7</td>
<td>91.6</td>
</tr>
<tr>
<td>1962</td>
<td>96.7</td>
<td>90.6</td>
<td>93.5</td>
<td>93.8</td>
</tr>
<tr>
<td>1963</td>
<td>94.7</td>
<td>81.5</td>
<td>94.7</td>
<td>95.0</td>
</tr>
<tr>
<td>1964</td>
<td>89.4</td>
<td>78.4</td>
<td>93.3</td>
<td>90.2</td>
</tr>
<tr>
<td>1965</td>
<td>87.2</td>
<td>82.4</td>
<td>91.7</td>
<td>90.0</td>
</tr>
<tr>
<td>Median</td>
<td>92.0</td>
<td>88.7</td>
<td>98.3</td>
<td>95.0</td>
</tr>
<tr>
<td>Range</td>
<td>83.9-100.5</td>
<td>78.4-97.6</td>
<td>91.7-103.1</td>
<td>88.2-104.0</td>
</tr>
</tbody>
</table>

n.a.—not available.
*Estimated.

*aTotal operating expenses divided by total operating revenues.
*bDomestic operations only.
*cBased on data for 12 years rather than 17 years.

### Table 10-3

Return on Stockholder Equity for Total Trunk and Local Service Carriers
Western Air Lines, Pacific Air Lines, and Pacific Southwest Airlines
1951-1965

<table>
<thead>
<tr>
<th>Year</th>
<th>Trunk Carriers</th>
<th>Local Service Carriers</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Western</td>
<td>Total</td>
<td>Pacific</td>
</tr>
<tr>
<td>1951</td>
<td>17.9%</td>
<td>17.5%</td>
<td>13.5%</td>
<td>6.6%</td>
</tr>
<tr>
<td>1952</td>
<td>18.5</td>
<td>15.0</td>
<td>-1.9</td>
<td>10.3</td>
</tr>
<tr>
<td>1953</td>
<td>14.0</td>
<td>8.3</td>
<td>-6.3</td>
<td>-7.5</td>
</tr>
<tr>
<td>1954</td>
<td>13.9</td>
<td>14.4</td>
<td>14.2</td>
<td>10.3</td>
</tr>
<tr>
<td>1955</td>
<td>14.8</td>
<td>17.0</td>
<td>7.5</td>
<td>18.9</td>
</tr>
<tr>
<td>1956</td>
<td>11.9</td>
<td>22.5</td>
<td>-4.4</td>
<td>-6.6</td>
</tr>
<tr>
<td>1957</td>
<td>4.8</td>
<td>15.5</td>
<td>-11.4</td>
<td>2.1</td>
</tr>
<tr>
<td>1958</td>
<td>7.7</td>
<td>9.2</td>
<td>10.7</td>
<td>-7.2</td>
</tr>
<tr>
<td>1959</td>
<td>9.6</td>
<td>24.8</td>
<td>0.5</td>
<td>23.6</td>
</tr>
<tr>
<td>1960</td>
<td>0.0</td>
<td>8.5</td>
<td>14.8</td>
<td>-10.9</td>
</tr>
<tr>
<td>1961</td>
<td>-5.2</td>
<td>2.2</td>
<td>21.2</td>
<td>15.2</td>
</tr>
<tr>
<td>1962</td>
<td>1.2</td>
<td>11.7</td>
<td>19.2</td>
<td>6.1</td>
</tr>
<tr>
<td>1963</td>
<td>1.9</td>
<td>21.6</td>
<td>13.0</td>
<td>-0.9</td>
</tr>
<tr>
<td>1964</td>
<td>17.1</td>
<td>25.5</td>
<td>16.3</td>
<td>26.4</td>
</tr>
<tr>
<td>1965</td>
<td>21.6</td>
<td>19.6</td>
<td>19.3</td>
<td>14.2</td>
</tr>
<tr>
<td>Median</td>
<td>11.9</td>
<td>15.5</td>
<td>13.0</td>
<td>6.6</td>
</tr>
<tr>
<td>Range</td>
<td>(-)5.2-21.6</td>
<td>2.2-25.5</td>
<td>(-)11.4-21.2</td>
<td>(-)10.9-26.4</td>
</tr>
</tbody>
</table>

n.a.—not available.
*Estimated.

*aProfit after taxes and special items divided by stockholder equity. The certificated carriers' return is based on the arithmetic mean of stockholder equity at the end of the 12-month period a year ago and at the end of each quarter of the current 12-month period. PSA's return is based on stockholder equity as of December 31, of each year.
*bDomestic operations only.
*cIncludes provisions for investment tax credit.

---

*Certificated carriers' return is based on the arithmetic mean of stockholder equity at the end of the 12-month period a year ago and at the end of each quarter of the current 12-month period. PSA's return is based on stockholder equity as of December 31, of each year.
Table 11-1

Average Number of Revenue Hours per Aircraft per Day
Certificated and California Intrastate Carriers
All Services, Selected Years 1952-1964

<table>
<thead>
<tr>
<th>Year</th>
<th>Trunk</th>
<th>Local Service</th>
<th>CCA</th>
<th>CTA</th>
<th>Mercer</th>
<th>PSA</th>
<th>TCA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1952</td>
<td>7.3</td>
<td>6.0⁹b</td>
<td>5.4</td>
<td>—</td>
<td>—</td>
<td>8.0</td>
<td>—</td>
</tr>
<tr>
<td>1953</td>
<td>7.7⁶c</td>
<td>6.0</td>
<td>n.a.</td>
<td>—</td>
<td>—</td>
<td>7.3</td>
<td>—</td>
</tr>
<tr>
<td>1958</td>
<td>7.5</td>
<td>6.5</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>6.6</td>
<td>—</td>
</tr>
<tr>
<td>1961</td>
<td>5.9</td>
<td>5.4</td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>7.0</td>
<td>—</td>
</tr>
<tr>
<td>1964</td>
<td>6.5</td>
<td>5.5</td>
<td>—</td>
<td>1.8¹d</td>
<td>0.8e</td>
<td>8.7</td>
<td>2.1f</td>
</tr>
</tbody>
</table>

n.a.—not available.

¹aCalculated by dividing the number of aircraft days assigned to service into revenue aircraft hours flown.

¹bScheduled service only.

²Excludes a small number of hours flown by Eastern with aircraft not assigned to its fleet. Also, excludes National's helicopter operation.

¹dCalifornia Time Airlines operated from September 19, 1964, through February 1, 1965. This figure applies to this entire period.

¹eMercer Enterprises inaugurated scheduled service on or about April 18, 1964. This figure applies to its first full 12 months of operation from May 1964 through April 1965.

¹fTrans California Airlines terminated service on October 7, 1964. This figure applies to its operation from January 1 through October 7, 1964.

Table 11-2

Coach Seating Configurations for Aircraft Operated within California by Both the Certificated and the California Intrastate Carriers 1949-1965

<table>
<thead>
<tr>
<th>Aircraft Type</th>
<th>Certificated Carrier</th>
<th>No. of Seats</th>
<th>California Intrastate Carrier</th>
<th>No. of Seats</th>
<th>Intrastate % of Certificated</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC-3</td>
<td>United</td>
<td>—</td>
<td>CCA</td>
<td>28 &amp; 32</td>
<td>—</td>
</tr>
<tr>
<td></td>
<td>Western</td>
<td>—</td>
<td>PSA</td>
<td>28 &amp; 31</td>
<td>Others 28</td>
</tr>
<tr>
<td>M-202</td>
<td>Pacific</td>
<td>40</td>
<td>CCA</td>
<td>44</td>
<td>110%</td>
</tr>
<tr>
<td>DC-4</td>
<td>TWA</td>
<td>62</td>
<td>CCA</td>
<td>60</td>
<td>97-111</td>
</tr>
<tr>
<td></td>
<td>United</td>
<td>64 &amp; 66</td>
<td>PSA</td>
<td>62 &amp; 70</td>
<td>Others 73</td>
</tr>
<tr>
<td></td>
<td>Western</td>
<td>66</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>L-049</td>
<td>TWA</td>
<td>80 &amp; 81</td>
<td>Futura</td>
<td>81</td>
<td>100-101</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Paradise</td>
<td>81</td>
<td></td>
</tr>
<tr>
<td>L-749</td>
<td>TWA</td>
<td>—</td>
<td>TCA</td>
<td>98</td>
<td>—</td>
</tr>
<tr>
<td>DC-6B</td>
<td>United</td>
<td>79</td>
<td>PSA</td>
<td>98</td>
<td>103-124</td>
</tr>
<tr>
<td></td>
<td>Western</td>
<td>87, 92, 95</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electra</td>
<td>Western</td>
<td>94 &amp; 96</td>
<td>PSA</td>
<td>98</td>
<td>102-104</td>
</tr>
<tr>
<td>B-727</td>
<td>United</td>
<td>113</td>
<td>PSA</td>
<td>122</td>
<td>108</td>
</tr>
</tbody>
</table>

¹aThe certificated carriers did not operate their DC-3's in coach configuration within California. United and Western installed 21 first-class seats in their DC-3's, while Pacific installed 28 such seats.

¹bTWA did not operate its L-749's in coach configuration within California. Its maximum first-class seating configuration for L-749's was 55 seats.
### Table 11-3

**Average Annual Passenger Load Factors for the Certificated and California Intra-State Carriers Scheduled Service, 1946-1965**

<table>
<thead>
<tr>
<th>Year</th>
<th>Certificated Trunk</th>
<th>Coach</th>
<th>Total Cert.</th>
<th>Total Local Service</th>
<th>Total Intrastate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>First Class</td>
<td>Character</td>
<td>Percentage</td>
<td>First Class</td>
<td>Character</td>
</tr>
<tr>
<td>1946</td>
<td>78.8%</td>
<td>-</td>
<td>-</td>
<td>37.9%</td>
<td>-</td>
</tr>
<tr>
<td>1947</td>
<td>65.7</td>
<td>72.9%</td>
<td>27.1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1948</td>
<td>58.7</td>
<td>72.9%</td>
<td>27.1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1949</td>
<td>61.2</td>
<td>72.9%</td>
<td>27.1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1950</td>
<td>68.9</td>
<td>72.9%</td>
<td>27.1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1951</td>
<td>63.3</td>
<td>72.9%</td>
<td>27.1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1952</td>
<td>62.2</td>
<td>72.9%</td>
<td>27.1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1953</td>
<td>61.2</td>
<td>72.9%</td>
<td>27.1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1954</td>
<td>62.3</td>
<td>72.9%</td>
<td>27.1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1955</td>
<td>62.4</td>
<td>72.9%</td>
<td>27.1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1956</td>
<td>62.4</td>
<td>72.9%</td>
<td>27.1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1957</td>
<td>59.4</td>
<td>72.9%</td>
<td>27.1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1958</td>
<td>58.9</td>
<td>72.9%</td>
<td>27.1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1959</td>
<td>59.5</td>
<td>72.9%</td>
<td>27.1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1960</td>
<td>56.1</td>
<td>72.9%</td>
<td>27.1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1961</td>
<td>51.6</td>
<td>72.9%</td>
<td>27.1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1962</td>
<td>46.6</td>
<td>72.9%</td>
<td>27.1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1963</td>
<td>51.7</td>
<td>72.9%</td>
<td>27.1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1964</td>
<td>49.9</td>
<td>72.9%</td>
<td>27.1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1965</td>
<td>49.0</td>
<td>72.9%</td>
<td>27.1</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Notes:**
- n.a.—not available.
- Some local service carriers operated small amounts of coach service in 1952-53 and from 1956 to early 1965. Their load factors were generally above their first-class load factors and, overall, equaled 51.3 percent. However, due to the limited quantity of coach service, the total local service load factor was no more than 0.3 percentage points above the first-class load factor in any one year.
- Partially estimated, includes all services.
- Coach service inaugurated November 4, 1948.
# RESOURCE UTILIZATION

## Table 11-5

Number of Employees per Aircraft Assigned to Service<sup>a</sup>

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Trunk and Local Service Carriers, California Central Airlines and Pacific Southwest Airlines, Selected Years 1949-1965</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Number of Employees per Aircraft Assigned to Service&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td></td>
<td>Year</td>
</tr>
<tr>
<td>------</td>
<td>------</td>
</tr>
<tr>
<td>1949</td>
<td></td>
</tr>
<tr>
<td>1950</td>
<td></td>
</tr>
<tr>
<td>1951</td>
<td></td>
</tr>
<tr>
<td>1952</td>
<td></td>
</tr>
<tr>
<td>1954</td>
<td></td>
</tr>
<tr>
<td>1955</td>
<td></td>
</tr>
<tr>
<td>1957</td>
<td></td>
</tr>
<tr>
<td>1958</td>
<td></td>
</tr>
<tr>
<td>1959</td>
<td></td>
</tr>
<tr>
<td>1961</td>
<td></td>
</tr>
<tr>
<td>1962</td>
<td></td>
</tr>
<tr>
<td>1963</td>
<td></td>
</tr>
<tr>
<td>1964</td>
<td></td>
</tr>
<tr>
<td>1965</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>Calculated by dividing average number of aircraft assigned to service into the total number of employees. Employee data are for a brief period of time in each year, while data for the average number of aircraft pertain to the entire year.

<sup>b</sup>Domestic operations only.

<sup>c</sup>CCA's average number of aircraft assigned to service during 1950 was partially estimated.

## Table 11-6

Average Annual Available Seat-Miles per Employee<sup>a</sup>

<table>
<thead>
<tr>
<th>Year</th>
<th>Average Annual Available Seat-Miles per Employee&lt;sup&gt;a&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Year</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>1950</td>
<td></td>
</tr>
<tr>
<td>1951</td>
<td></td>
</tr>
<tr>
<td>1954</td>
<td></td>
</tr>
<tr>
<td>1955</td>
<td></td>
</tr>
<tr>
<td>1957</td>
<td></td>
</tr>
<tr>
<td>1959</td>
<td></td>
</tr>
<tr>
<td>1962</td>
<td></td>
</tr>
<tr>
<td>1963</td>
<td></td>
</tr>
<tr>
<td>1964</td>
<td></td>
</tr>
<tr>
<td>1965</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup>Calculated by dividing total number of employees into annual average scheduled available seat-miles. Employee data are for a brief period of time in each year, while the ASM data pertain to the entire year.

<sup>b</sup>Domestic operations only.

<sup>c</sup>Includes Inland Air Lines merged with Western on April 10, 1952.

<sup>d</sup>Based on data that are partially estimated.
RESOURCE UTILIZATION

### Table 11-7

Average Annual Revenue Passenger-Miles per Employee<sup>a</sup>

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Annual Revenue Passenger-Miles per Employee&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Trunk</th>
<th>Local Service</th>
<th>California Intrastate</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Western</td>
<td>Total</td>
<td>Pacific</td>
</tr>
<tr>
<td>1950</td>
<td>136,000</td>
<td>163,000&lt;sup&gt;c&lt;/sup&gt;</td>
<td>48,000</td>
<td>87,000</td>
</tr>
<tr>
<td>1951</td>
<td>152,000</td>
<td>175,000&lt;sup&gt;c&lt;/sup&gt;</td>
<td>60,000</td>
<td>86,000</td>
</tr>
<tr>
<td>1954</td>
<td>209,000</td>
<td>214,000</td>
<td>77,000</td>
<td>119,000</td>
</tr>
<tr>
<td>1955</td>
<td>218,000</td>
<td>241,000</td>
<td>81,000</td>
<td>122,000</td>
</tr>
<tr>
<td>1957</td>
<td>226,000</td>
<td>246,000</td>
<td>87,000</td>
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</tr>
<tr>
<td>1959</td>
<td>239,000</td>
<td>303,000</td>
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<td>136,000</td>
</tr>
<tr>
<td>1962</td>
<td>266,000</td>
<td>384,000</td>
<td>109,000</td>
<td>153,000</td>
</tr>
<tr>
<td>1963</td>
<td>293,000</td>
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<tr>
<td>1964</td>
<td>314,000</td>
<td>446,000</td>
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</tr>
<tr>
<td>1965</td>
<td>333,000</td>
<td>431,000</td>
<td>147,000</td>
<td>170,000</td>
</tr>
</tbody>
</table>

n.a.—not available.

<sup>a</sup>Calculated by dividing total number of employees into annual average scheduled revenue passenger-miles. The employee data are for a brief period of time in each year, while the RPM data pertain to the entire year.

<sup>b</sup>Domestic operations only.

<sup>c</sup>Includes Inland Air Lines merged with Western on April 10, 1952.

<sup>d</sup>Based on data that are partially estimated.

### Table 11-8

Average Annual Operating Revenues per Employee<sup>a</sup>

<table>
<thead>
<tr>
<th>Year</th>
<th>Average Annual Operating Revenues per Employee&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Trunk&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Local Service</th>
<th>California Intrastate</th>
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<tbody>
<tr>
<td></td>
<td>Total</td>
<td>Western</td>
<td>Total</td>
<td>Pacific</td>
</tr>
<tr>
<td>1950</td>
<td>$9,100</td>
<td>$11,000&lt;sup&gt;c&lt;/sup&gt;</td>
<td>$7,000</td>
<td>$8,600</td>
</tr>
<tr>
<td>1951</td>
<td>9,800</td>
<td>10,700&lt;sup&gt;c&lt;/sup&gt;</td>
<td>7,600</td>
<td>7,800</td>
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<td>1954</td>
<td>12,600</td>
<td>13,000</td>
<td>9,300</td>
<td>11,800</td>
</tr>
<tr>
<td>1955</td>
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<td>14,600</td>
<td>8,800</td>
<td>11,000</td>
</tr>
<tr>
<td>1957</td>
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<td>14,800</td>
<td>9,600</td>
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<tr>
<td>1959</td>
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<td>19,900</td>
<td>10,700</td>
<td>13,400</td>
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<tr>
<td>1962</td>
<td>15,800</td>
<td>23,700</td>
<td>14,000</td>
<td>16,400</td>
</tr>
<tr>
<td>1963</td>
<td>19,700</td>
<td>26,200</td>
<td>14,700</td>
<td>17,300</td>
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<td>1964</td>
<td>21,000</td>
<td>26,700</td>
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</tr>
<tr>
<td>1965</td>
<td>22,200</td>
<td>26,100</td>
<td>16,300</td>
<td>18,000</td>
</tr>
</tbody>
</table>

n.a.—not available.

<sup>a</sup>Calculated by dividing total number of employees into total domestic operating revenues. The employee data are for a brief period of time in each year, while the total operating revenues pertain to the entire year.

<sup>b</sup>Domestic operations only.

<sup>c</sup>Includes Inland Air Lines, merged with Western on April 10, 1952.

<sup>d</sup>Based on revenues for the year ended March 31, 1951.

<sup>e</sup>Based on an estimate of total operating revenues of $930,000, calculated by applying average fares for 1951 (Appendix 7) to PSA’s on-line O & D passenger traffic (Appendix 14).

<sup>f</sup>Based in part on estimated revenues of $103,000 for January 1-27, 1954.
Since my colleagues, James C. Miller and Paul W. Cherington, have already told you more than you ever wanted to know about regulation of the air transportation industry, I will take it a step further and discuss the groups having the greatest impact on the future of air transportation. In commenting on those groups, I will examine their aims and objectives and how they will affect the greater glories we have all been led to expect.

In looking at my chosen topic, "Federal Regulatory Trends and the Emerging Profiles of Air Transportation," substitute "government agency interests" for "regulatory trends" and read "carriers and investors" where it says "air transportation." On the assumption that there is some kind of market (hard to dispute), it is these two major groups that determine what air transportation will look like. To be sure, the technologist and metal bender warrant attention since they helped develop air transportation that is safe, fast, comfortable, clean, silent, nonland-using, efficient, available, and reliable. But they function in large measure at the behest of the two major groups. (So much for the Harvard man's view of M.I.T.)

Having defined the two broad groups of concern, let me now turn to the general health of the industry. Growth is impossible without the very important capital inflow ingredient. But this means that profits are a critical element. By the end of 1970 the scheduled air carriers produced an aggregate loss of $150 million to $200 million. Unbelievable and unheard of in the history of the industry. As what has been the general response of the (financial) marketplace to the airlines from, say, 1965 to the present? Well, you get stock price curves that have a long term decline; there are nice bumps here and there, but the general stock price trend is adverse.
So let me offer a first finding; the financial markets are looking with increasing disdain on air carriers. Now to be sure there are other important elements in gauging the health of the industry: technological advances, fare reduction, safety (let's not kill people), and service and availability of aircraft. But if we agree that growth requires new capital, let's face the reality that there may be more attractive girls around (to would-be investors) than the airlines.

O.K., so much for a quick financial snapshot, let's look at carrier management. What do we know about the management of air carriers? From 1946 to 1966 the emphasis was on production. The market demand for air transportation was growing at a steady rate, and the carriers were fighting to keep up with it, while at the same time struggling with the problems of production, costs, service, and so forth. The classic factory problem! And scheduled air transportation has a dramatically successful track record in solving these problems. Prices to users have declined, quality of service has increased dramatically, and all told the safety record is admirable. In short, the production men in aviation delivered just like the production men in Detroit proved they could really respond to the requirement to produce. But like Studebaker, Packard, Pierce Arrow, Kaiser-Fraser (not to mention the Tucker Torpedo) production alone eventually proves to be not enough. Since 1966 managers have moved out of the production orientation and turned their attention to various problem areas like profits (Don Nyrop) and just day-to-day survival--keeping their respective carriers afloat. The airlines can all boast of being safe, clean, reliable, low cost, but unfortunately not profitable. That's the current predicament. Query? Do the airlines now have the kind of different managers needed in the 70's and 80's?

Airline managers have made several proposals recently vis-a-vis government regulation, the most common one requesting some measure of price competition, (price flexibility). Interestingly enough, in the same gasp they discuss constraint of capacity competition. Although today there is little competition, air carriers are competing in the form of capacity (frequency of service, etc.)
Perhaps this arrangement will be exchanged for a limited allowance of price competition and regulation or common agreements among airlines on capacity. How does this grab you? Does this sound like the voice of an airborne Alfred P. Sloan (1972 version)? or more like J.P. Morgan (1911 version)?

We talked earlier a bit about how the financial market seems to look at this industry. Let's get back to this area for a minute. Just at the time when the public is increasing its demands on the airlines, particularly in the area of environmental protection, the investment community is going sour on the industry. And the need for new cash gets more acute as traffic demands swing up again from the 1970 debacle. As an example of what the capital market thinks of air transportation, it's interesting to note that, according to the New York Stock Exchange, Avon Products is worth more than the combined values of 11 trunk carriers and Pan Am.

Now, investors fall into various categories with rather different objectives. Personally, I think that like lawyers, most of them should be shot. However, they exist and we must live with them. Commercial bankers are the most conservative, loaning money only when they think they can get their money back—a practice that has held them in good stead. In dealing with the airline industry recently they have restricted their offering to a bewildering array of notes. Investment bankers and the funds are a little different crowd, concentrating on the short term appreciation of an investment. Another source of capital which has only emerged within the last decade is the equipment leasing group, composed principally of insurance companies. This remains a stable source of capital, while the previously mentioned sources are in some jeopardy.

So much for high finance. Where is old Uncle Sam? or more specifically, what might the government do to improve significantly the prospects for air transportation? Below is a laundry list of ideas I have heard voiced over the years by various people in Washington.

- Clobber competition (other modes of transportation, such as buses). Note that railroads are already dead.
- Provide good traffic. ("Fly American!")
Provide cash for the support activities (e.g. airports).
Moderate competition.
Guarantee loans, for equipment leasing as an example.
Relieve uncertainties by making such agencies as CAB move.
Clock labor.
Assume the perspective of the carrier, not the shipper or the traveler.
Offer direct subsidy.
Lessen regulation.
Open up competition.
Provide R&D support.

This list is just a brief sketch of things that might be done. I'm sure you could add many other possibilities which might help or hurt. Question - what's likely to occur? As a start, let's recognize the confusion in directions, desires, and goals of the various government agencies. Let's take a quick run through some of these agencies and note how they influence the air transportation industry--we'll concentrate on the federal government just to "simplify" things.

Civil Aeronautics Board. In looking at the CAB over the past decade, I am bewildered as to what its goals and objectives really are. Generally speaking it seems to favor growth of the system, addition of service, but a competitive status quo. However, it has not been able psychologically or politically to support real efficiency in the system. Good new routes often go to bummers, to preserve some mythical competitive balance, which raises some hard questions. Do we want to try and make this system very efficient; do we want to have more people on the airplanes; do we want to get rid of things like cross subsidy; do we want to reward the successful carrier with more routes or do we want to go through the absurdity of saying we will award the Miami/L.A. route to the carrier barely able to stay afloat?

Department of Transportation. FAA has for a number of years been expanding to provide an adequate support system and doing a fairly good job of it. Growth and safety are their aims. Air carrier efficiency? Who knows?
The DOT policy office (TPI) is the only other part of DOT really concerned with the aviation industry, and it is still too new to define precisely its role and direction, although it seems to lean towards becoming an alter ego to the CAB.

**Department of Defense.** DOD actually impels a good deal of traffic. It operates a very big, slick, nationalized air system which is probably not very economical. What are its objectives? After scrubbing it all away, I think you could say that their objectives are two. One, a large scale organic in-house lift capability which means no good for commercial air transportation. Two, the lowest prices they can get when they use commercial systems. I don't submit, incidentally, that any of that is necessarily wrong in terms of DOD's responsibilities.

**Department of State.** In the main it seems fair to say that State has supported our national flag carriers.

**Department of the Treasury.** Treasury is concerned with keeping the debt down, watching the budget, and avoiding any long term commitments.

**Health, Education, and Welfare.** The environmental people within HEW wish the smoke was whiter and the planes were less noisy. That's about the level of their expertise.

**Department of Labor.** The position of Labor is quite simple--get the government out of the negotiation business.

**Department of Justice.** The Office of the Assistant Attorney General for Antitrust has been very consistent in its policy without regard to which industry is involved. A lot of competition is good, and more competition is even better.

**The White House.** The incumbents are pushing for more free enterprise and are efficiency oriented.

**Council of Economic Advisors.** Their position is somewhat analogous to the aforementioned White House philosophy.

**Office of Management and Budgets.** If there is a large deficit budget looming on the horizon, we will see the general route strengthening proposals in local air service come straight out of OMB. In short, Budget offices always rise above principal when principal is involved.
NASA. NASA consistently exhibits a desire to advance technology. "If we develop it, a use will be found!"

The Post Office. The postal service is concerned with the lowest cost to them. What does this mean? Well, what it certainly does not mean is a series of government agencies locked in phalanx marching towards a glorious aviation horizon. On the contrary, it adds up to a variety of (properly) conflicting aims and pressures. And those of us who favor aviation had best realistically grasp this fact.

In the foregoing remarks I've touched briefly on the financial markets, the carriers and the government. Does this all add up to any useful findings? On balance, I think so. Let me sum them up.

---Air transportation demand is good and growing, but
---The industry has real problems to tackle--congestion, pollution (real or imagined), noise/land use, and capital needs, and unfortunately
---Technological support is waning from its main historical source (DOD),
---Carrier earnings are on a long term slide, and capital markets are thinning out, while
---The views of government agencies are widely disparate.

In line with the above, I'll suggest several areas where changes are needed--

---Policy leadership in government. Perhaps DOT's policy office is now well enough equipped to handle this role. (TPI maybe an ugly broad, but in this context she's probably the only girl in town).
---Government dollars explicitly marked for R&D.
---Some revision in approaches to regulation. Old line regulation and production-minded management (complete with glass helmets and goggles) won't cut it in 1976.

Ladies and gentlemen, this is a jewel industry. It's fun and socially useful. But let us not be beguiled by pleasant surroundings and self congratulatory speeches. Let's face the real world around us and then get on with the job.
The Future of Regulation in the Airline Industry

Remarks of Paul W. Cherington, James J. Hill Professor of Transportation Harvard Business School and Chairman of the Board, Temple, Barker & Sloane, Inc. at the NASA/MIT Aviation Workshop, Waterville Valley, New Hampshire

July 21, 1972

The six propositions which this paper addresses can be summarized as follows:

1. Despite efforts toward deregulation, regulation of the airline industry is alive and well and can look forward to many more years of growth. In short, regulatory powers will expand rather than contract.

2. In part, regulation will expand because, when all is said and done, the airlines like it (or at least prefer it to market competition.) So do their lawyers and consultants.

3. In part, this is true because the market competition model put forward by many economists is neither very realistic in terms of the real world nor does it take into account many socio/political facts of life.

4. The market competition model, aimed primarily at an optimum allocation of resources, is neither particularly good nor bad but simply irrelevant in a society where the economic allocation of resources is of much less concern than formerly. Economists, in many ways, are like someone who is trying to improve the buggy-whip industry. It is no doubt fun; the models are no doubt elegant; but the results are largely beside the point since no one wants buggy whips anymore.

5. We would do much better to try to develop a new strategy for regulation so that the CAB can grow into a constructive force for the development of civil aviation, rather than being the somewhat benign nuisance that it is today, or deteriorating, as has the ICC, into a rather drab and unattractive home for the disoriented.
6. The elements of a new regulatory strategy would be first, to provide for the testing and introduction of new ideas and new services, aimed at new markets, much more promptly and effectively than today with far less attention to the creation of monopolistic competition for existing markets and services. Second, it would involve more responsive handling of industry and company crises on an administrative level, to clear these out of the way, and finally it would be focused on the attraction of new capital to the industry so that the interface of aviation economics with aviation technology can be fully exploited.

Before returning to a discussion of these six propositions, let me acknowledge that some of what I will have to say is based upon a study which Temple, Barker & Sloane, Inc. recently completed for Dr. Mundo of the Systems Analysis Office at the Transportation Systems Center. The study has not yet been released so that I will not quote from it or give its conclusions, beyond saying that it dealt with the impact of regulation on the growth in demand for air transportation. The interesting thing about our findings was to the effect that in the past regulation really hadn't mattered very much so far as growth was concerned, except to the extent that growth was influenced by the structure of the industry. Regulation had clearly influenced industry structure.

Returning now to the six propositions.

Proposition No. 1 - CAB powers will continue to expand. Deregulation is not in the cards. This is a good bet for almost any bureaucratic institution. It is almost a certainty for airline regulation. The only thing that might happen to CAB is that some of its powers might get transferred or usurped by DOT. But the total bundle of Government economic regulatory powers will not diminish. Unless CAB starts misbehaving (that is, becoming too effective) I would bet against any significant shift in power between CAB and DOT. That agency has not built up with the industry the kind of indebtedness which the airlines have to the CAB. Its attention is divided between several modes so that airlines can never be sure that they are not going to get "Northeast Corridorized." In short, DOT is an inter-modally balanced organization and that is not what aviation enthusiasts want.

Thus we have the CAB acquiring control over maximum and minimum international fares in 1972. No doubt other powers will gradually be added in the future.

It is safe to conclude that CAB is here to stay and that its powers will enlarge, not diminish. I am convinced of this by looking at the survivability of the ICC. Even when the majority leader in the Senate proposed the complete elimination of that agency (admittedly in a fit of pique), the ICC went right on cutting out its paper dolls, studying the tariff on Yak fat, pondering whether it was all right to abandon the rail line from Overshoe to East Overshoe (even though the trees were so large that no diesel could get through) meanwhile enjoying the spectacle of 60% of the eastern railroads slipping into bankruptcy. If an agency like that can survive (and get larger appropriations and have the chutzpah to ask for more powers), the CAB will surely flourish.
Proposition No. 2 - A second reason for believing that regulation will continue and will probably expand lies in the fact that it is what the industry secretly wants, or dislikes least. Certainly their lawyers and consultants are happy with things just the way they are and wouldn't enjoy deregulation at all.

No new upstart airlines are admitted to the club. If let in at all, they are only given permission to sit in the "strangers room" for a temporary period. The Board's procedures are well known and predictable even if its decisions often are not. Procedural order has much to recommend it as against the rough and tumble of an openly competitive brawl. The Board moves in the price area from time to time, but the main initiative on pricing is left up to the carriers. The Board does not give the carriers all that they ask for in the way of fare increases but as regulatory bodies go, it has been surprisingly benign in the fare area.

But there is more to it than the law of the survival of bureaucracies and the fears of the regulated. This leads to Proposition No. 3. The CAB will in part survive because the economists have not given us any attractive or realistic alternative to traditional regulation. The market competition model that they urge upon us is not of this world, and it ignores a large number of socio/political objectives that are very real.

The model says that there ought to be largely unfettered entry and exit, the ability to focus on markets where the demand is large and ignore those where demand is small. Also the model calls for vigorous price (not service) competition. Professor Jordan in his recent book makes a meticulously researched case for this approach based on the intra-California experience. I admire his craftsmanship and almost completely disagree with his conclusions. But whether we agree or disagree with the market competition model, the fact is that it is not very useful in today's world. For example, it ignores politics. We can all think of instances where politics have over-ridden economics. The important thing is not that this happens, but that no model which does not accommodate socio/political objectives will be accepted as a guide for policy-making. For example, political pressures are going to require a certain amount of cross-subsidization, a real "no-no" under the market competition model. Some people are going to have to serve East Overshoe. Ideally they can get directly subsidized for doing so. But mostly they can't. And when they can't, their good routes will have to supply the subsidy. If there are no "good" routes, there can be no cross-subsidization and no service in East Overshoe. Under open competition, there are no "good" routes.

The analysis used in defending the competitive model lays considerable stress on the fact that there appear to be few short-term operational economies of scale. Small companies can apparently compete with large ones on cost. I am not sure this has been entirely proven, but that is the way the numbers seem to run. But small companies almost certainly cannot compete with larger ones in terms of new equipment, and it is new equipment that explains much of the dynamism of air transportation. A B-747 is perhaps ahead of its time, but the industry would simply not exist as we know it today if it were still operating the DC-3, the DC-4, or the L-649. Greater productivity (and the greater passenger appeal) of new equipment has kept the industry moving forward, and no band of gypsy operators can provide that kind of forward impetus.
If the competitive model can be enlarged to include some of these facts of the real world, perhaps it can be "sold" for public policy use. As it is today, it is neither used or useful, except in the Alice-in-Wonderland nightmare of anti-trust.

Proposition No. 4 - The market competition model is essentially addressed to an optimum allocation of resources. As our resources have increased, this objective has receded somewhat in importance. We spend enormous sums on things and in ways which surely do not represent an economically optimum resource allocation, including in the transportation field alone the support of our non-competitive ship-building industry, massive aid for unwanted urban transit systems, extensive rivers and harbors work of dubious value except for private yachts and the like. Thus efforts to make regulation substitute for open market competition may be not only futile but positively harmful in that it focuses all the attention on the allocation of the resources to aviation and to various types of air transportation and very little on the distribution of the product in a broad and equitable manner. This is the real problem today, and it is one to which the competitive model (and regulation) gives relatively little attention. The focus of a new model should not be so much on the economic use of raw resources as on the efficiency and effectiveness of the distribution of the product.

This leads to a consideration of Proposition No. 5 - The possibility of developing a new regulating strategy for the future. Despite its critics, air transport is a remarkable servant in its ability to provide rapid mobility at relatively modest cost. While there is a good deal of hand-wringing to the effect that the air transport market has been largely developed and that future growth will be at a slow pace, a moment's reflection will indicate that this is almost certainly nonsense. In the first place only a relatively small proportion of the population flies in any one year (about 10%), and the bulk of them fly only once or twice a year (about 80% of those who fly). Thus the opportunities for market expansion are immense, even within the confines of existing services.

But there are some exciting new areas for mobility that have hardly been tapped as yet. Within Europe the packaged vacation tour at bargain prices (because operated in full aircraft) has become enormously popular - far more so than in this country.

Much more economical short-haul air transportation in STOL or VTOL aircraft should be technologically possible within the next decade. These and other essentially new markets, some perhaps not even dreamed of as yet, should be made available through the remarkable mobility that air transportation provides. But these services will not be made available broadly under present restrictive regulation and under a competitive structure that virtually insures that half of the product is thrown away at the plant door (in this case via a 50% load factor).

Each new air transport market and service has essentially been started and developed outside the established air transport industry - cargo, coach, charter and third level service. At the same time the established
industry has been a major force in bringing in new and more productive equipment. The specialist carriers and gad-flies have had neither the resources nor the assured future to do much in the equipment area. Perhaps, it is time that these forces were brought together.

We turn now to the sixth and last proposition of this paper - the elements of a new regulatory strategy. We have already suggested its keystone - the rapid opening up and spread of new services and markets. This could be accomplished in many ways - making awards to those who propose imaginative new types of service, holding an investigation or doing a study, with no lawyers allowed, to see what kinds of service people will want over the next decade and what kind of service new technology will permit, and then opening a proceeding to award certificates to those with the best proposals. There are at least two other elements. The first has to do with the length of time it takes for CAB to take action including giving the industry relief when it is in recession, either due to general economic recession or the actions of the Board itself, or both. For example, it took well over a year for the first capacity restriction agreement to come into force. Perhaps this was justified since it was a "first." But in future much prompter action, handled on an administrative, rather than on a quasi-judicial basis, would remove much of the pressure for upward price adjustments and would greatly help the financial posture of the industry. It is exactly this financial posture which is a third basic element of the new regulatory strategy. The rather erratic nature of airline earnings and particularly the recent heavy losses have led to a distorted debt structure for much of the industry and to mistrust on the part of a good deal of the financial community as to the financial attractiveness of the industry. The opening up of new markets and services will call for very large amounts of capital. Without a more attractive financial climate the nexus between economics and technology, so important for the future, cannot take place.
MERGERS AND ANTI-TRUST
ISSUES IN RECENT CAB CASES

by A. M. Andrews
CAB

July 19, 1972

Abstract

The airline industry is surveyed--particularly domestic trunklines--in relation to collective approaches to industry concerns. These actions are classified by the apparent degree of anti-trust issue present. Recent route merger cases are considered from the CAB staff viewpoint.
My talk this morning will deal with two subjects. One is airline mergers. This seems to be a rather popular item. Three other speakers have chosen it as their topic. You will hear views expressed by representatives of such government agencies as Justice and Transportation, as well as by an airline official directly involved in a recent merger. He, of course, is Mr. Edwin Colodny, of Allegheny, who immediately succeeds me on this platform.

In order to round out a full circle of viewpoints, I thought it might be helpful to give you the thoughts of the Bureau of Operating Rights. This is the staff arm of the CAB that has the function of participating in airline merger cases before the Board. Our Bureau views may permit some useful comparisons and contrasts with later speakers.

My other topic—which I will discuss first—concerns cooperative or collective working arrangements among airlines. These are commonly referred to as Section 412 agreements. This is a reference to the section of the Federal Aviation Act which requires the filing of every contract, agreement or other cooperative working arrangement between air carriers which would affect air transportation. Specifically mentioned in the statute are agreements which involve (1) pooling of revenues or service, (2) establishing rates or fares, (3) improving safety and efficiency, (4) preventing destructive competition, and (5) regulating schedules and service. Here too, as in the case of mergers, the Bureau of Operating Rights in the primary staff group responsible for recommendations to the Board members as to approval or disapproval of such arrangements.

These two topics do have a relationship. In one sense an airline merger may be considered to be the ultimate form of cooperative working arrangement between airlines. This is so since one carrier cooperates to the point of actually going out of existence as an independent firm. In each case—be it merger or 412 agreement—
anti-trust issues may be present. And in each case any Board order of approval immunizes the arrangement from the applicability of the anti-trust laws.

In essence anti-trust laws are designed to assure that competing entities do not collectively engage in activities which diminish their competition with each other. Neither should collective activities harm some other person—like another competitor or a consumer.

As you are aware, the Federal Aviation Act contemplates a competitive airline system. Competitive forces—subject to regulation to avoid any destructive action—are the means by which the statute seeks to assure high quality air service needed by the traveling and shipping public. In such a statutory atmosphere, what is the proper role of cooperation among airlines in lieu of competition among them? I will attempt to point toward possible answers.

Some degree of cooperation among airlines seems vital from the traveler’s viewpoint. The nature of air travel is evidence of this. In fiscal 1971 there were some 107 million domestic passenger journeys. In 16 percent of the case—, involving some 17 million individually travelers, two or more airlines were used to complete the journey. Such a high volume of interline passenger traffic places a very high premium on uniform arrangements in various aspects of passenger handling. This, then, accounts for a large proportion of cooperative arrangements governing through-ticketing, baggage handling, and so forth. Similar uniform arrangements cover other through transportation services such as freight and mail. In no sense would it appear that these kinds of arrangements are inimical to competitive objectives.

Another large class of cooperative arrangements—although not vital to the passenger or shipper—have economic, rather than uniform service, basis. These have the objective of reducing carrier costs through the more effective utilization of capital investment. Examples are the joint sharing of station equipment, arrangements for aircraft maintenance and lease, joint use of city terminals, and so forth. Typically, these widespread arrangements have little effect in eroding competition or adversely affecting third parties.
There may be agreements in a murky middle ground area. But perhaps we should swing to the other extreme for benchmarks.

One area of acknowledged restraint of trade, where the impact of concerted actions on third parties raises anti-trust problems, involves the relationship between carriers and their ticket agents. Here the carriers have collectively developed detailed provisions for selection and retention of agents. They have also established rules relating to defaults and financial irregularities, and uniform commission rates for the sale of various types of air transportation. The problem which is created by uniform industry conduct in its relations with the agents is that individual carrier initiative in employing the services of such third parties is reduced to the level needed for a unanimous agreement. In approving these arrangements in the face of such anti-trust problems the Board found that in the absence of an agreement travel agents and air carriers would bid commission rates up to the highest level the market would bear. Also if carriers offered different commission rates a travel agent might find it difficult to serve as an impartial objective advisor to the traveling public.

A somewhat similar situation exists in relation to carrier agreements affecting labor unions. Under the airlines mutual aid agreement if a carrier is subjected to a strike it receives financial help from other members of the mutual aid pact. Possibly, this cools the ardor of the individual carrier to seek a prompt settlement. In approving the agreement, the Board found that it would contribute to the financial stability of air carriers. The Board further found that the agreements would not cause a deterioration in labor-management relations or destroy effective collective bargaining.

One Board case stands squarely for the proposition that competitive impact on third parties can be decisive. In 1959 the members of the Air Traffic Conference of America entered into an agreement entitled VOLUMAIR. Under the agreement the members of ATC proposed a program of concerted activities in the domestic commercial charter
market. This was designed to facilitate the collective availability of aircraft for charter service. The Board disapproved the arrangement after concluding that the agreement runs counter to anti-trust principles. The Board felt that such public benefits as would flow from the arrangement were outweighed by the broader public interest in safeguarding the fledgling supplemental air carrier industry in the nation's air transport system.

In the area of procurement it is clear that anti-trust problems can be present if collective airline purchasing power is utilized. The Board has permitted local service carriers to purchase collectively through a separate corporation owned by the participants. However, the stringent conditions attached to the Board's approval probably reduced the value of such authority, and the corporation was subsequently dissolved. In somewhat related instances the Board permitted collective design, negotiation and purchase of wide-body aircraft support equipment. The Board has also permitted the creation of a joint air carrier corporation to provide liability and hull insurance for wide-body aircraft. While there was widespread interest in both cases, there was no direct opposition and they were approved substantially in the form submitted.

With respect to trade associations, there continue to be issues concerning access to such associations and fairness of internal procedures, such as voting rules. These have been raised both with regard to IATA and the ATA. On the question of access, this is primarily applicable to ATA. There appear to be incipient issues concerning the exclusionary aspects of such matters as: collective airline tariff publishing; publishing of schedules in the OAG; access to Joint Airline Military Traffic offices; the availability of the Universal Air Travel Credit Plan; and the selection of local cartage agents for cargo pickup and delivery. These matters are not burning issues at present, but they do represent items about which interest is being exhibited in some quarters.

Finally, there are scheduling agreements of two sorts. One stems from the limitations of airport and air traffic control capacity
around congested airports. The other involves schedule reduction agreements in certain major markets by certain major trunklines to prevent wasteful competition leading to excess capacity during a period of airline depression.

Scheduling agreements of the first type are designed to level out the use of congested facilities throughout the day in some equitable fashion. Such agreements are likely to continue to the extent that there continue to be overly-congested facilities.

Whether or not the second class of agreements, the schedule reduction agreements in major markets, are to become a normal way of life is an issue facing the Board during the current summer. Opponents of such agreements include other air carriers and the Department of Justice. They contend that joint agreements among competitors to limit capacity undo the competitive system envisaged by the Federal Aviation Act. They feel that by allowing carriers to stabilize their competitive activities in some markets, such agreements free up resources to be unleashed against non-signing competitors in other markets. Proponents of such agreements contend that they allow the aggregate product--airline seats--to be produced more closely related to market demands. This, they say, reduces the costs incurred in operating excessive flights. The Board will thus have to decide the controversial question of whether or not to grant pending requests for continuation of such arrangements beyond their presently scheduled termination in October.

I realize that the treatment here of collective airline arrangements is not exhaustive. But perhaps some insights are evident. On the one hand it is apparent that cooperative airline arrangements are necessary, can serve the traveling and shipping public, and can appropriately reduce costs. On the other hand the exercise of collective economic power with adverse impact on others can present a real problem. The Board in such instances will have to balance considerations of anti-trust with considerations of public interest of an air transportation nature. It does not seem possible in advance to establish
explicit guides as to what may or may not be acceptable. It does seem evident, however, that developing environment and ecological problems over the recent past portend an impact on traditional concepts of freedom to compete. The likelihood is for some compromises in this area.

I would now turn to the matter of airline mergers.

Merger discussions have probably been engaged in by all federally certificated route carriers in the airline recessionary economic cycle that is, hopefully, now ending. Previous down periods also were characterized by at least a large amount of merger talk—and some significant activity. In the last airline depression, in the early 60's, a Pan American-TWA merger application was filed and later withdrawn. An American-Eastern proposal was disapproved. And a failing regional trunk, Capital, was allowed to be absorbed by United to form the largest U. S. air carrier.

During the current cycle, seven route carrier merger applications have actually been submitted to the Board. Four involve mergers between two trunk carriers. A fifth involves a merger between two local service carriers. The remaining two relate to mergers between two carriers that are primarily domestic trunks, on the one hand, and two carriers specializing in Caribbean service, on the other hand. The Bureau of Operating Rights has actively participated as a party and has taken a position in all of these cases.

To date the Board has acted on four merger applications and has approved each of them. Two have resulted in consummated mergers, those between American and TCA and between Allegheny and Mohawk. One was aborted after approval, that is the Northwest-Northeast merger. One, involving Delta and Northeast, is now awaiting consummation which is scheduled for August 1.

The Bureau of Operating Rights favored the approval of each of these four mergers. A principal basis for the Bureau's position—which the Board shared for the most part—was that one partner was financially and competitively weak or failing. In this situation the stronger, dominant carrier offered the assurance that service would be continued and improved. Net financial impact was also considered
in detail. This included the important question of whether the merged company would operate more or less efficiently than either of the pre-existing airlines, both individually and on the average. In arriving at our position we balanced these "public benefit" factors against the negative aspects. The negative aspects were principally increased concentration in the industry, and diversionary impact on other carriers. Secondarily, we took into account the "private benefits" of the merger—that is, the effect on stock and bondholders, and on employees and creditors of both airlines.

In this group of four merger cases DOT favored the Delta-Northeast merger, and the Justice Department favored the Allegheny-Mohawk merger. These agencies did not participate in the other cases.

At this point it might be useful to clarify the roles of Justice, Transportation and the CAB. You may have some question concerning the necessity for three government agencies becoming involved in particular airline mergers. The CAB, of course, has final responsibility for approval or disapproval of airline mergers. This is subject to review by the President, as a matter affecting foreign relations, where international routes are involved. Justice participates as a party in CAB merger cases. This is primarily in situations where a significant issue of anti-trust policy may be present. DOT also participates in airline merger proceedings before the Board. It selects those cases where it believes significant transportation policy issues may be present. DOT has the role of coordinating governmental transportation policy. The executive agencies are free to suggest merger guidelines and policy irrespective of the pendency of particular merger applications. The CAB on the other hand is limited in this respect to the role of approving or disapproving on an ad hoc basis. Individual merger applications must be decided on a formal record developed in such cases.

Still pending are three merger cases: the American-Western and Eastern-Caribair cases are before the Board for decision. The Northwest-National case is now awaiting oral argument before the Board.

The Bureau opposes all three of these mergers. Our conclusion with regard to both the American and Northwest cases is that the proposed mergers would be antithetical to the preservation of a competitive
multi-carrier air transportaion system. They would, therefore, result in undue concentration. On the long-term, we think that undue concentration will lead to higher costs and overall lessening of efficiency as well as higher prices, and less responsive service. We feel also that they bring the evils that inhere in the concentration of too much economic power in too few hands, including labor's. Our view is that air transportation is inherently competitive in character and can operate at optimum efficiency for the general economy under competitive conditions. This can be distinguished from operating at optimum profitability for the stockholders of any one firm, or of a small group of firms. Balancing the marginal positive factors favoring these two mergers, we concluded that the negatives outweighed. In this process, we gave particular weight to the fact that all the merger partners involved are prosperous, growing, soundly managed carriers with bright futures as independent entities.

The Department of Justice agreed with this basic approach, while the Department of Transportation did not. DOT appears to believe that any merger not creating a high degree of monopolies in specific city-pair markets should be approved. This apparently means that mergers between airlines whose systems do not overlap extensively should be approved.

In the case of the Northwest-National, we also stressed that there was no plan of integration for the two airlines, and that management dissension and labor unrest could cause serious difficulties.

The Eastern-Caribair merger is altogether different, in our view. Caribair is a failing carrier that is authorized to provide local-type service principally among the islands of the Caribbean. We think it should not be converted into a mainland-Caribbean trunk operation in what is, after all, the second largest area-type market in the world--the U.S.-Caribbean/Bahamas vacation market. Such a basic restructuring of a major area-type market should be effected in a careful, gradual fashion through route cases--rather than at one fell swoop in a merger case. This is so particularly in light of the diversionary impact on
Pan American. Neither Justice nor DOT took any position in this case.

At such time as the Board ultimately rules on the remaining undecided merger cases we will have completed the current cycle of proceedings. These decisions, in toto, should provide useful, concrete criteria for airline merger policy in lieu of the hypothetical guides which have been the subject of much discussion during recent periods.

This concludes my presentation.
Abstract

This presentation will discuss DOT's policy with respect to evaluating airline mergers. Included within this presentation will be a discussion of: (1) DOT's statutory responsibilities; (2) DOT's view of the interrelationship of airline merger policy and overall airline policy; (3) the executive branch criteria for domestic airline merger proposals; and (4) DOT's position in several recent merger proceedings, including the Allegheny-Mohawk, American-Western, Delta-Northeast, and Northwest-National.
It is indeed a pleasure to be here for this workshop and I would like to thank the joint sponsors, MIT and NASA, for this opportunity to discuss what I, as a trial attorney in the General Counsel's Office, understand the Department of Transportation's airline merger policy to be.

As is indicated in the summary of my discussion, I will focus on the following general areas:

-- DOT's statutory responsibilities with regard to the formulation of national transportation policy;

-- DOT's view of the interrelationship of airline merger policy and overall airline policy;

-- The Executive Branch criteria for domestic airline merger proposals, which are designed to assist the Executive Branch agencies in evaluating domestic merger proposals;

-- And finally, DOT's position in several recent merger proceedings, including the Allegheny-Mohawk, American-Western, Delta-Northeast and Northwest-National cases.

The Department of Transportation participates extensively in proceedings before the Civil Aeronautics Board, among other regulatory agencies, and, as a consequence of the several merger applications filed recently, we have been actively involved in four major merger cases in the last year.
You have already heard today from Mr. Andrews of the Civil Aeronautics Board, Mr. Colodny who expressed the airline viewpoint on mergers and Mr. Farmer of the Antitrust Division of the Justice Department, and you may be wondering why the Department of Transportation participates in these cases.

The Department of Transportation is the Executive Department charged by Congress with exercising general leadership in the identification and solution of transportation problems with responsibility in the Secretary of Transportation to provide leadership in the development of national transportation policies and programs.

Mergers of major transportation companies (all the air carrier trunklines are listed among Fortune's top 50 transportation companies) in many instances have an impact on both the quality and cost of transportation services available to the public, and can have far-reaching effects in terms of restructuring a transportation industry. These matters are necessarily of vital concern to DOT and, as a consequence, participation by DOT in these proceedings is necessary and appropriate for the discharge of our statutory responsibilities.

In addition, the President is required by Section 801 of the Federal Aviation Act to review all mergers in which international routes are involved to determine whether the resultant route transfers are consistent with the foreign aviation policy of the United States. In that regard, it may be necessary for the Executive Branch agencies to participate to develop a full record on these issues, for on occasion,
the President has found it necessary to alter a Board recommendation when foreign policy requirements have dictated such a result.

It is sometimes claimed that all or most U.S. airlines (at least the trunklines) should be rationalized by merging them into a smaller number of systems (four, five, or six being the most common numbers mentioned). Lest there be any question in that regard, the Executive Branch criteria specifically state that they should not be interpreted as implying encouragement to airline mergers in general, or in specific cases. That was not their purpose. The Executive Branch, and, in particular, the Department of Transportation supports a policy of vigorous competition among a considerable number of air carriers. Often, in fact, the Department of Transportation has been the subject of criticism for taking positions which are said to be "too pro-competitive".

In the American-Western case, the Department argued that the merger would increase competition by replacing a carrier (Western) with a history of ordinary performance as a competitor with one (American) that all the parties to the proceeding agreed competes hard and well. As a consequence of the limited number of carriers authorized to serve any given market, the replacement of one carrier by a more vigorous competitor is bound to improve the quality and degree of competition in the affected markets. The carrier opponents of this merger criticized us for encouraging such competition. Again, in the Northwest-National case, we argued that the merger would increase competition in the air carrier industry by providing additional competitive services and
permitting the "new" Northwest to compete on a more equal footing with such rivals as United, Pan American, and Eastern. Again this position was criticized, and in fact, the main argument advanced by Eastern in opposition to the merger was that the "new" Northwest would be too strong a competitor.

In the Domestic Passenger Fare Investigation, the Department has argued strenuously for the Board to permit price competition in the airline industry by adopting a "zone of reasonableness" in setting fares. Under our concept, the Board would establish a maximum and minimum lawful fare in each market and then the carriers would be left to compete by offering fares anywhere within the zone. Although our proposal received the strong support of the Antitrust Division, it met stiff opposition on the part of many carriers. The Board has recently heard oral argument in the case and we are hopeful that our proposal will be adopted.

And finally, the Department has supported more liberalized rules for charter travel, arguing that such liberalization is beneficial to the traveling public and should be permitted so long as substantial impairment of scheduled service does not result. I am sure that Mr. Binder will amplify the Department's position on this matter on Friday during his discussion of "International Air Transport and Federal Policy".

Returning to merger policy, the Department's attitude is to simply take airline mergers as they come. Mergers are the result of healthy
business procedures, long recognized as a form of company self-improvement. In as dynamic an industry as the airline industry, they are merely signs of a healthy industry restructuring itself. All mergers are certainly not prohibited in either regulated or unregulated industries, and as recognized by Congress, mergers of transportation companies have different requirements than mergers in the unregulated portion of our economy. Accordingly, the analytical techniques of the antitrust laws (such as the market share standards developed under the Clayton Act to test grocery store and beer company mergers) have little relevance to airline mergers under the Federal Aviation Act. Secor Browne, the Chairman of the Civil Aeronautics Board, has aptly described the attempt to use such analytical techniques for airline mergers as the "clam gauge test" for mergers. If you think about it, you will see the sheer folly of such an approach. In airline mergers, we are dealing with a regulatory body with a demonstrated expertise for evaluating competition in the airline industry. Accordingly, we believe that the appropriate tests for measuring competition are those set forth in the Executive Branch criteria which I will discuss shortly.

In attempting to develop criteria for evaluating airline mergers under the Federal Aviation Act, it is important, of course, to know if average cost varies with firm size. At approximately the same time that the Department was preparing the criteria, we were also conducting a study, for use in the Domestic Passenger Fare Investigation, to determine whether costs increase, decrease or remain the same in the domestic
airline industry -- such studies being generally referred to as economies of scale studies. This study was relevant to the fare investigation in order to determine what pricing policy the Department should recommend to the Board, but was also applicable to mergers where the relationship of average cost and firm size is also an important policy determinant.

In this study, conducted by Dr. James C. Miller (who was here last week and will again appear Friday), multiple regression analyses were performed on airline data by carrier and by year, for the years 1962-1968, to determine if a relationship existed between available ton-miles, average stage length, market density and costs (measured by operating expense per available ton-mile). (For those who are interested in the details of the study, I have brought a copy of the study for your perusal, but I suspect that the most productive approach for pursuing questions about the study would be to talk to Dr. Miller when he is here on Friday.) In summary, the results of this regression analysis indicate a tendency toward constant returns to scale (that is, constant costs over the relevant range of service) when available ton-miles and market density are increased proportionately, and increasing returns (that is, falling average cost) when expansion takes place over new routes. In both cases, however, the effect on average cost is barely perceptible, stage length being a more important determinant of the level of average cost. For practical purposes, then, we concluded that the industry is characterized by constant returns to scale and that, as a consequence, increasing the size of the firm through merger is unlikely to produce significant unit cost increases or decreases.
In light of this study, which indicates the indecisiveness of sheer size on the matter of costs, we believe that changes in size per se should not be determinative of the outcome of a merger, and that the focus in evaluating airline mergers should be on the impact of a merger on industry performance. The Executive Branch criteria are intended to assist the Department in measuring this impact.

During the spring and summer of 1971, the Department of Transportation, in consultation with the Department of Justice, prepared the Executive Branch criteria for domestic airline merger proposals. The purpose of these criteria for evaluating domestic airline mergers is to assist the Executive Branch agencies in deciding whether to intervene in airline merger cases before the Civil Aeronautics Board and in deciding what recommendation, if any, should be made to the Board concerning the merger. Although these criteria were designed by those Departments for general use by the different Executive Branch agencies, each agency necessarily will apply them in light of its respective statutory responsibility. In the case of the Department of Justice, as alluded to above, this will be primarily under the antitrust laws, and in the case of the Department of Transportation, primarily the Department of Transportation Act, other related statutory and policy provisions, and basic operational and economic factors relevant to the transportation system of the nation.

As is recognized in the statement accompanying the criteria, certain caveats are in order:
First of all, it is not possible to devise a set of general criteria that will completely cover each and every fact situation. There will be instances where certain criteria are not applicable, or where a criterion must be extended or refined, or where additional data are applicable. At the same time, the criteria are meant to be looked at as a whole. There is not any one criterion of overriding significance.

Second, because of limited resources, Executive Branch agencies may not intervene in all merger proceedings.

And third, not all agencies evaluating factual material and applying these criteria will necessarily reach the same conclusion.

In order to reconcile public objectives with business objectives, the preparation of these criteria has drawn extensively on two types of background data:

(1) the relevant statutory and policy backgrounds; and
(2) the relevant airline operational and financial factors.

With regard to the statutory and policy background, we reviewed existing regulatory statutes and other applicable policies governing airline mergers in order to define criteria already present in law and policy as found in the Federal Aviation Act, its legislative history, and the interpretation it has been given by the Board and the courts. Consideration was also given to standards used by Federal agencies and the courts in appraising mergers under other regulatory statutes and the antitrust laws, particularly Section 7 of the Clayton Act. With respect to the economic facts of the industry, we analyzed efficiency, profitability,
service, structure of the airline passenger market, and economies of scale in airline operations.

Although I do not wish to burden this discussion with the intricate details of the criteria themselves, I do think it would be instructive in giving some insight into DOT's approach to mergers to briefly highlight the major factors which we consider in evaluating an airline merger, and indicate how the various criteria were applied in certain cases.

(For those who are interested, I have some copies of the criteria and will be glad to distribute them at the end of the discussion.)

Basically, the criteria are designed to provide a means for evaluating the following aspects of a merger:

Impact on competition;

Likelihood that it would breed, or trigger, other mergers;

Impact on other carriers;

Benefits resulting from the merger;

Financial health of the merger partners; and

Protection afforded employees.

As discussed earlier, competition plays an important role in maintaining a sound air transportation system and the competitive impact of a merger on the air carrier industry should be carefully analyzed.

The criteria provide that a merger should not result in either the elimination of effective competition, or an excessive market share for the surviving firm in significant city-pair, regional or national markets for airline services.
In general, air carriers compete on a city-pair basis. They compete for the business of the traveler who wants to get from point A to point B. In order to measure that impact, the criteria provide three basic tests:

Test 1. Mergers which involve the significant lessening of competition in the major markets (defined as the 100 top city-pair markets measured by number of passengers plus those of the 100 top city-pair markets measured by number of passenger miles which are not already included), especially the larger ones, must be regarded as carrying a heavy burden of proof, certainly the elimination of an effective competitor (one having at least 10% of the market) from a city-pair market having as much as 1% of the total industry passenger miles would be cause for most serious scrutiny.

Tests 2 and 3, which are designed to analyze the impact of a merger on competition in all city-pair markets, work in the following manner:

First of all, one would identify markets in which a given anti-competitive impact would occur:

One such test would first ascertain in which markets the merger would eliminate an effective competitor (usually regarded as a carrier with a 10% market share).

Another such test would ascertain in which markets the merger would combine two carriers, each of which had less than a 50% market share, to form a carrier with a 50% or greater market share.
And then one would evaluate the overall magnitude of the markets so identified.

For each test, the size of the markets affected need not be especially large in comparison with the overall industry in order to attain a degree of significance worthy of concern. But, as the total traffic in affected city-pair markets exceeds 1%, and certainly as it approaches 3%, the competitive effect becomes more significant and warrants careful scrutiny.

In examining these city-pair criteria, it was interesting to learn that the carriers participate in traffic in markets in which they are not authorized to provide service. For example, in 1970, Northwest carried 1,310 passengers and National 4,130 passengers in the New York-Los Angeles market, even though neither carrier is authorized to serve that market. When we investigated the matter, we found that this traffic was the result of passengers traveling on circuitous routings, such as by way of Minneapolis in the case of Northwest, and Miami in the case of National.

Although air carriers generally compete on a city-pair basis and the focus must remain on the merger's impact on competition in city-pair markets, the effect of a merger on competition must also be considered in terms of regional and national markets. In the Northwest-National merger, for example, we considered the regional impact of the merger by analyzing the number of passenger originations by carrier and State for the two regions arguably affected by the merger -- the northeast corridor and the southern region of the country. In the northeast, the analysis revealed
that the region will continue to be dominated by American, Eastern, United and TWA, and that fifteen carriers will remain, not to mention the substantial intermodal competition in this corridor, which will be unaffected by the merger. Likewise, the analysis indicated that the Southern region will remain Delta and Eastern country and no less than twelve other major carriers will continue to serve the region.

The other basic competitive consideration is that a merger should not result in undue concentration within the air carrier industry. Although relative size in the airline industry is an important consideration, it is not suggested in the criteria that size alone should be the only or even the major merger criterion. On the other hand, a proposed merger that would result in a substantial share of an appropriate market must be viewed as carrying the burden of proof that the anti-competitive impact would be balanced by benefits to be realized by the public, and, as the market share of the resulting firm increases, the burden of proof to establish counterbalancing benefits would become increasingly heavy.

In the American-Western case, we recognized that the principal problem presented by the merger is the post-merger size of American (post-merger American would carry almost one fifth of the domestic ton-miles carried by all U.S. carriers). We believed that balancing the benefits resulting from the merger against one potentially serious detriment, size, showed that the merger should be approved.

The criteria further provide that a merger should not be likely to lead to extensive reactions and defensive merger proposals by competing
carriers so that the end result will be a restructuring of the industry and excessive concentration in a few firms. Although the effect that a particular merger is likely to have in breeding, or triggering, other mergers is a most important consideration, there does not appear to be a way of analyzing this question with precision.

Board approval of a merger may trigger mergers in one of two ways:

(1) it could indicate that the Board would be likely to approve other mergers and as a result other carriers would consider proposing mergers, and

(2) it could also create a situation in which other carriers would have to merge to avoid financial difficulties.

Analysis of the first alternative must necessarily involve consideration of various relevant factors, such as the impact of a merger on competition in city-pair markets, to determine the precedential impact of Board approval of a merger. But in this regard, it is important to remember that any merger proposed as a result of misreading the Board's signal obviously could be disapproved. In a regulated industry, the trigger potential of a merger must be viewed in a different light than in the case of an unregulated industry.

With regard to the second alternative, consideration should be given, among other things, to the impact of the merger on individual carrier market shares, the protection of connecting traffic and whether the particular merger may have a "run-on-the-bank" effect. For there are only so many suitable merger candidates for any particular carrier
and a carrier may conclude that the way to avoid disappointment is to merge early.

A series of mergers could easily undermine the existing competitive structure of the industry, even though no one of the mergers in the series taken by itself could be found objectionable under the remaining criteria. If a merger seems likely to trigger such a series, the total competitive effect should be examined.

One of the requirements of the Federal Aviation Act is that the Board is to pursue sound economic conditions in the air transportation industry. Accordingly, the criteria provide that a merger should not result in substantial foreclosure of competition for interchange traffic or other excessive injury to other carriers.

A merger which would severely injure other carriers might so disrupt sound economic conditions in the industry that it should be disapproved. In examining the direct injury, consideration should be given to whether the merger will so increase the market power of the merged carrier (for example, by being able to offer more seats or schedules or more advertising) that a third carrier, or other carriers, will find it substantially harder or impossible to compete for competitive or connecting traffic. Indirect injury may come about over a longer period of time through the impact of the merger on costs and financial ability, and will surface in the form of the weaker carrier's inability to purchase adequate equipment or promote its service.
An end-to-end merger of two airlines which connect at points of substantial traffic interchange can foreclose competitors from connecting traffic which was previously subject to free competition. Although this diversion can take place simply because the merger may permit offering better service, it can also take place when service improvement is not offered, for example, because a passenger seeking connecting service is more likely to contact an airline providing both legs of the route or is more likely to contact the better-known airline. Again, this diversionary impact must be carefully considered in evaluating the impact of the merger on other carriers.

An airline merger should be accompanied by significant operational or service advantages so that there is greater efficiency or lower costs to the public. More effective use of aircraft and equipment, more economical financing, new route patterns and innovations in management -- these are required for the health and further growth of the industry.

The longer term characteristics of the airline industry are rapid traffic growth and expansion into new markets with different characteristics in terms of fares and schedule requirements. A fundamental need of the industry is for continued adjustment, and the major effect of a merger should be to accommodate this need. As a consequence, the criteria provide that a merger should bring about substantial operational, service, or organizational benefits for the surviving firms so that the public will receive significant benefits such as greater efficiency and better service, and the size of the airline resulting from the merger should not be such as to produce significant diseconomies.
In the case of a merger of a relatively effective carrier and one that is marginal, or in the case of two marginal carriers, the criteria provide that the resulting benefits of the surviving firm should be corrective of the original difficulty of the weaker merger parties. The public may in some cases benefit from acquisition by a stronger carrier of an airline whose potential for maintaining viable operations is limited for some demonstrable reason, but it is questionable whether absorption of a marginal firm is in the public interest if the surviving firm is thus put in jeopardy. In the Delta-Northeast case, one of the reasons that the Department supported the merger was that Northeast, a carrier in serious financial difficulty, could be absorbed by Delta, a financially healthy carrier, with profitable results -- a benefit to the air carrier industry as well as the traveling public. As mentioned by Mr. Colodny, the criterion was also relevant to the Allegheny-Mohawk merger.

With regard to the impact of the merger on employees, the criteria provide that the labor protective conditions (such as integration of seniority lists and displacement allowances) set forth in the United-Capital merger case should be imposed, unless it can be established that it would be in the public interest to alter or replace the standard provisions. In the Northwest-National case, the Department believed that the integration of the work forces of the two carriers raised the possibility of labor problems which we did not believe were adequately covered by the standard United-Capital conditions, and, accordingly, recommended that the Board fashion conditions to alleviate the problems.
Any airline merger will have some effect on the structure of the airline industry, but mergers are certainly not prohibited *per se* because of this. In the American-Western case, one of the reasons that the Examiner recommended disapproval of the merger was that he felt that the merger would upset the existing national airline structure consisting at the time of the "Big Four" and the "Smaller Seven" trunklines. As we argued in our brief to the Board in that case, and recent Board approval of the Delta-Northeast merger which created a "Big Five" rather than a "Big Four" and Allegheny-Mohawk which created a carrier much like a regional trunk has demonstrated, such a static way of looking at airline industry structure is misplaced. In as dynamic an industry as the airline industry, one simply cannot expect its structure to remain the same for long periods of time.

Board route policy has also stressed carrier development and has not been designed to freeze any particular size distribution or number of firms. Thus the Board has pursued a continuing policy of permitting existing carriers opportunities to expand over new routes and has permitted entry of new carriers when a need has been shown for such services. In a merger case, we do not believe that the Board should be concerned with preserving a particular number or size distribution of carriers. Rather, the increased size of a carrier or a reduction in the number of firms in the air carrier industry is critical, we believe, only to the extent that overall industry performance, measured by the impact of the merger on rates and service in the affected markets and in the industry as a whole, is effected.
It is likely that rates will increase over time if the combination of two carriers results in a less efficient operation and overall costs increase. It is also possible that a substantial lessening of competition, insignificant city pairs, or other relevant markets could lead to implicit price collusion between the collusion between the carriers who remain. As a result of such conscious parallelism or price leadership, or simply less intensive competition, service to the public could deteriorate and fares rise unnecessarily. If a merger were to decrease competition substantially so as to result in increased costs, the Board might well be seriously concerned about the merger's impact on industry structure. Even assuming, however, that the elimination of one firm from the domestic air transportation industry and a resulting change in the size distribution of the remaining firms does have some effect on industry performance, that effect must be kept in perspective. As Dr. James Miller testified on behalf of the Department of Transportation in the Northwest-National merger case, "While the performance of the industry may be a function of the number of firms and their size distribution, of much greater significance is the regulatory environment -- the degree to which the Board allows and encourages competitive forces to bring about greater efficiency, lower prices, and improved service".

If the Board is concerned about maintaining competitiveness within the airline industry and insuring good performance, it should consider amending those aspects of its policies which reduce competition. Minor but far-reaching changes in the Board's policy toward encouraging price
competition (such as recommended by DOT in the Domestic Passenger Fare Investigation) and more liberal attitudes toward the entry of new firms and the expansion of existing firms into new competitive markets, would be far more likely to promote effective competition than adherence to a rigid policy toward industry structure.

During the past year, the Department has evaluated four airline mergers (Allegheny-Mohawk, Delta-Northeast, American-Western and Northwest-National) in light of these criteria, has found that they are consistent with national transportation policies and has recommended to the Civil Aeronautics Board that the mergers be approved. Since the facts of each merger are different, the reasons offered by the Department in support of each merger varied from case to case.

In Allegheny-Mohawk, the Department recommended approval of the merger as being in the public interest since it would result in numerous new single carrier services in markets where the carriers were limited previously to providing connecting service, increased competition for the large trunklines in a number of important regional markets and provide a solution to Mohawk's financial difficulties. On March 28, 1972, the Board approved the merger and it was consummated shortly thereafter.

The real significance of this merger for the public interest, however, is that Allegheny is beginning to take on some of the characteristics of a regional trunkline. Merged, it is serving the entire northeast quadrant of the country, ranks as the sixth largest U.S. airline in terms of passengers enplaned, has increased its market identity at the significant
hubs of Pittsburgh, Cleveland, Detroit and Buffalo, and now stands in a much stronger position in both new and pending route cases.

In Delta-Northeast, the Department believed that the merger would benefit the public by substituting a financially healthy carrier and vigorous competitor (Delta) for a chronically loss-ridden carrier and a generally weak competitor (Northeast) which will, in turn, result in improved service and livelier competition over Northeast's system and throughout the east coast-southeast area. Although, as I mentioned above, Northeast was not a failing carrier, it was a carrier characterized by chronic financial problems and a consequent inability to provide vigorous competition. The substitution of Delta for Northeast, we believe, will improve the overall health of the air carrier industry. On April 24, 1972, the Board approved the merger, but it has not been consummated to date, pending the consideration of petitions for reconsideration by the Board.

In American-Western, the Department urged approval because we believed that the merger will provide benefits to the public in terms of improved service in the form of new through plane routes in several markets that will be of value to the traveling public and, as discussed above, will result in the replacement of a strong competitor for a carrier with a history of very ordinary performance, lower costs reflecting, among other things, consolidation of operations at common locations and improvements in aircraft utilization which, in turn, flow from an improved route structure and a better mix of aircraft without diverting substantial
amounts of traffic, reducing competition, triggering other mergers, or resulting in undue concentration within the air carrier industry. This merger is still pending.

Finally, the Department supported the Northwest-National merger since we believe that the merger will serve the public interest by providing --

-- The "new" Northwest with an opportunity to offer substantial amounts of new service to the public without significantly increasing the capacity offered by the surviving carrier;

-- Reduced costs resulting from savings in services and personnel at common stations and in aircraft maintenance; and

-- Increased competition without materially affecting any carrier's financial health, triggering other mergers or adversely affecting the structure of the air carrier industry.

The case is now before the Board and oral argument will be held next Wednesday.

Taken as a whole, these mergers provide several interesting parallels. First of all, each of them involves a minimal impact on actual competition, and, in fact, one of the purposes of the mergers was to make each carrier a stronger firm and thus better able to compete with its rival carriers. Moreover, the public will receive tangible benefits in
the form of numerous new services. And finally, each of these mergers will fill previously existing gaps in the surviving firm's systems, such as Delta's chronic inability to get to the northeast and thus will result in the rationalization of their route structures.

As you can see, it has been a busy year for the Department in terms of evaluating airline mergers, and we believe that the Executive Branch Merger Criteria have been useful in that effort.

Thank you.
Abstract

Justice Department airline merger policy is developed within the context of the Federal Aviation Act, in which there is an unusually explicit reliance on competition as a means of fulfilling statutory goals. The economics of the airline industry appear to indicate that low concentration and vigorous competition are particularly viable and desirable. Several factors, including existing regulatory policy, create incentives for airlines to merge whether or not an individual merger promotes or conflicts with the public interest. Specific benefits to the public should be identified and shown to clearly outweigh the detriments, including adverse competitive impact, in order for airline mergers to be approved.
In the formation of regulatory policy, the Justice Department will continue to urge upon regulatory commissions the basic legal point that "to a very great extent, competition is our fundamental national economic policy," and the basic factual point that economic regulation by administrative agencies can be supplemented and made more effective by the self-regulating device of competition.

The Justice Department has been rather selective in intervening and participating in airline merger proceedings, and has usually participated only in cases of unusual significance. We participated in the American-Eastern proceeding in the early sixties, and have participated in two of the recent round of merger proposals, the American-Western and National-Northwest cases. In each case, we have concluded, after studying the evidence, that the proposed merger should be disapproved because of its anticompetitive effects.

Since the Department's policy with respect to airline mergers has mostly been developed in the context of the trunkline merger proceedings to which we have been a party, my remarks will be directed primarily toward that type of airline merger -- the merger of domestic CAB-regulated trunklines.

I. The Statutory Context

There are two ways in which section 408(b) protects against anticompetitive mergers. First, the "antimonopoly proviso" provides that no merger shall be approved when the result would be "to create a monopoly and thereby restrain competition or jeopardize another air carrier not a party to the merger." Second, the merger standard requires that mergers must be found consistent with the public interest to be approved, and as I will demonstrate below, the public interest standard considerations into the process of merger approval.

First a word about the antimonopoly proviso. Its rather peculiar wording has not been subject to much interpretation in agency proceedings or in court, probably because many merger proposals which would clearly create substantial monopolies are never filed - and it is fortunate that they are not. This in turn may be because the antimonopoly proviso is a flat prohibition, not a balancing test, and applicants do not have the opportunity, as they do in the public interest balancing process, to argue offsetting public benefits.

The Air Mail Act of 1934, the first statute imposing economic regulation upon air carriers made it illegal for air mail contractors serving parallel competitive routes to merge. -/The drafters of the economic regulatory provisions which were central to the Civil Aeronautics Act and later the present Federal Aviation Act strictly and specifically prohibited the creation of monopolies through merger. The modifiers "unduly" and "unreasonably" were struck from the proviso, and discussion by the legislation's sponsors in the Senate indicated that the intent was to forestall "rule of reason" interpretations. -/The clear result is to remove from the Board any discretion to approve a merger which would violate the proviso, even if the Board feels that the merger otherwise would be quite desirable.

-/Air Mail Act of 1934, ch. 466, §15; 48 Stat. 938.
Airline merger standards are strongly influenced by the fact that the Federal Aviation Act and its legislative history evidence a heavy reliance on competition, both generally and specifically with respect to mergers. The Act makes clear that the purpose of economic regulation is to promote the public interest, and defines several specific elements to be taken into consideration in regulatory decisions based upon the public interest. Unlike other transportation regulation statutes, the Federal Aviation Act specifically provides that "(c)ompetition to the extent necessary" is one of these specific elements of the public interest. This is an unusually specific reliance upon competition for an economic regulation statute, and calls for an exceptionally close examination of the consequences of regulatory actions upon the competitive relationships among the regulated firms.

The specific merger section of the act, section 408 also evidences the high value placed upon competition in regulated air transportation. The "antimonopoly proviso" of that section is to my knowledge unprecedented in other transportation regulation statutes. It is clear that it was intended by the Congress to express a desire that mergers not lead to anticompetitive situations.

As an indication of the intention of the Congress with respect to airline mergers, Senator McCarran, who is credited with being the author of the bill, said:

"I have tried studiously and zealously to select the language from the decisions of the Supreme Court, from the rulings made by Commissions, from my experience, and from

\[\text{Federal Aviation Act, section 102(d), 72 Stat. 740 (1958), 49 U.S.C. 1302(d)}\]

my training in the law-- which will do two things: First of all, comply with the anti-trust laws of the country so as to provide the greatest protection for competition. Secondly, give a high degree of flexibility to human judgment when I select an agency to exercise human judgment."

Despite the rather clear evidence of the procompetitive thrust of the Federal Aviation Act and its merger section, it has been argued that because of the wording of section 408, and the fact that the section was worded slightly differently in draft bills which were not enacted, the Board is constrained to approve merger applications when their impact on the public interest is doubtful; in other words, that section 408 places the burden of proof upon the opponents of merger applications. -/ (Section 408 says the Board shall approve merger applications unless it finds them inconsistent with the public interest.) I believe it is somewhat strained to conclude that the Congress decided to reverse the procompetitive thrust of the Act -- in one of the most important sections of the Act -- without some explanation in the legislative history. The language of section 408 hardly shows a clear intention to do.

The precise wording of the standards for regulatory approval in various sections of the Federal Aviation Act, and in other transportation regulation statutes, varies considerably, and agencies and courts correctly look to the regulatory purpose of the Act and the particular section to resolve issues of burden of proof, rather than searching

-/- 83 Cong. Rec. 6729-32

-/- See Brief of the Department of Transportation to the Civil Aeronautics Board, Northwest-National Merger Case, Docket 23852
for hints from slight differences in language.

An example of this approach is provided by the standard for approval of agreements among competitors under section 412 of the Federal Aviation Act. That section provides that the Board shall disapprove such agreements that it finds to be adverse to the public interest. This appears to be negative wording like that of section 408(b), yet the Board explicitly applies the following standard in section 412 cases: if the transaction would have a substantial anti-competitive effect under established antitrust principles, it should not be approved unless approval is the only way to meet a serious transportation need or secure an important public benefit. The Supreme Court has approved this test as a basis for agency disapproval of a transaction under a section of the Shipping Act with very much the same language as section 408(b).

One other section of the Federal Aviation Act relates to approval of mergers: the Board must approve the transfer of routes from one carrier to another, as provided in section 401(h). The Board has repeatedly held that an affirmative showing of consistency with the public interest is necessary for such a transfer.


Acquisition of Marquette by TWA, 2 C.A.B. 1,4 (1940); Pan American Airways, Inc. et al. - Merger, 2 C.A.B. 503,505 (1940); acquisition of Cordova Air Service by Alaska Airlines, Inc. 4 C.A.B. 708, 709 (1944) Acquisition of Mayflower Airlines, Inc., by Northeast Airlines, Inc., 4 C.A.B. 680,681, (1944); United-Western Acquisition of Air Carrier Property, 8 C.A.B. 298, 301 (1947); Mackey-Midet Acquisition Case, 24 C.A.B.51,56 (1956); Delta-Chicago & Southern Merger Case, 16 CAB 647, 685-686 (1953); Frontier-Central Merger Case, E-26968, June 24, 1968, I.D. p.2
Merger proponents have tried to escape the provisions of this section by taking some passing language from a court decision or two that the "public convenience and necessity" standard for transfer of route authority is not identical to the "public interest" standard applicable to merger approval. They then try to whisk away the fact that route transfer is usually the primary objective for which certificated airlines are merged, and assert that the section 401(h) standard somehow does not apply.

It would make little sense for the Board to require a showing of affirmative public benefit for the award of new routes or the transfer of routes apart from a merger, and yet require only a showing of neutral effect on the public interest when the route transfer takes place in conjunction with a merger. Making it easier to acquire new routes through merger than otherwise would create a powerful incentive for mergers and further concentration, and would have an adverse impact on the structure of the airline industry.

Apart from the specific requirements of the Act, there are reasons more or less generally applicable to the regulated industries why regulators should be extremely cautious in approving mergers. To begin with, the Supreme Court has made clear that the fact that an industry "is a highly regulated industry critical to the Nation's welfare makes the play of competition not less important but more so." -/ I will discuss the specific application of this principle to the airline industry later, but the general point is that excessive concentration and other market structure characteristics are quite significant in industries which are subject to economic regulation. _/

_/ Id. 368.
Exit of a regulated firm through merger can have a special competitive significance not present in the exit of an unregulated firm.

Further, the quality of the regulatory decision making process is enhanced if the burden of proof is put upon merger proponents. Merger applicants have more access to and familiarity with the particular facts of their business than prospective opponents. Merger partners initiate the timing of the merger process, and can begin preparing their legal case well in advance of the formal proposal or the application for regulatory approval. Therefore, the merger partners may be in a better position to prove their case than the opponents are to prove theirs.

Finally, the burden of proof should be placed upon the side which will suffer the least irreversible damage if the wrong choice is made. If a merger proposal is denied when in fact it would have brought net public benefits, it can be approved later when more convincing evidence comes to light or the error is perceived. The public benefits which the merger might have brought in the interim could be achieved at least in part by internal growth. But if a merger is mistakenly approved and consummated even though there would be no net public benefits, the merger would be practically impossible to undo, and the detrimental effects would be extremely difficult to mitigate.

The "failing firm" doctrine

Up to now, I've been talking about the high road to merger -- securing approval by proving that the proposal would promote the public interest. There is also a low road-- under the failing firm doctrine, approval of an undesirable merger can be secured by proving that the alternatives are worse.

See Direct Testimony of Dr. George Eads in the Northwest-National Merger Case, CAB Docket 23852, pp.6-7
It should be kept in mind that the failing company doctrine originated as a defense to antitrust suits, and comes into play only if it is established that the merger would be contrary to law absent the prospect of failure. It is not the policy of the Justice Department (or anyone else, to my knowledge) that an airline has to prove it is failing in order to secure approval of merger. There are frequent laments that this is the policy in effect now, but I believe these complaints miss the point. Our view of the law is that the failing firm doctrine is the only way an airline can get merger approval without proving net public benefits. It is the only way to secure approval of a merger proposal whose net impact is recognized to be detrimental to the public. Healthy, profitable firms certainly can merge - if they prove that their merger will benefit the public.

This leads to another common misconception about the failing firm defense - a misunderstanding of its purpose. The doctrine is not so much out of sympathy for the firm in difficulty as it is a practical effort to minimize damage to the public from business failure.

The reasoning of the failing firm defense is that although the merger will have an adverse impact upon the public interest, those adverse consequences will do less damage to the public interest than the failure of the firm, or the other alternatives available to prevent this failure. This is the most important point of the Supreme Court decisions which have dealt with the failing firm doctrine. 

The rationale of the failing firm defense requires those who seek to invoke it to prove that the merger is the "least anticompetitive alternative." As the Supreme Court has noted, if a merger is consummated despite the existence of less anticompetitive alternatives, "the benefits of competition, acknowledged by Congress, would be sacrificed needlessly." 

One distinction should be drawn before we leave the subject of failing firms. In a number of cases, the Board has approved mergers because of the financial weakness of the acquired firm, without making the findings which would be required to support the application of the failing firm doctrine. To my knowledge, however, these have been cases in which the Board also did not find competitive problems which would otherwise bar the merger. Thus, these cases were not "failing firm" cases, but really cases where the Board found that the merger promoted the public interest. 

II. Application of the Federal Aviation Act to Airline Merger Cases

In order to protect the public interest, the Act requires the Board to take cognizance of the policies of the antitrust laws and the analytical techniques developed and used by the courts in applying those laws. In merger cases, the pertinent statute is Section 7


_/ Northwest Airline, Inc. v. CAB, 303 F. 2d. 395,397 (1962).


_/ United Airlines Transport Corporation - Acquisition of Western Air Express Corp., 1 C.A.A. 739, 741 (1940).
of the Clayton Act, and the appropriate analytical techniques are the same as are used in the application of Section 7.

This does not mean that the Board is required to determine whether a proposed merger would violate the Clayton Act; rather the Board is to "make findings related to the pertinent anti-trust policies, draw conclusions from the findings, and weigh these conclusions along with other important public interest considerations." Adverse antitrust findings are not conclusive, as they might be in a Clayton Act case; they and the other detriments are to be weighed against the benefits of the transaction to ascertain the public interest. Thus, the Board might disapprove a merger with less than grave anticompetitive consequences if the merger would bring few benefits, or approve a badly needed merger despite substantial anticompetitive consequences.

Even if the courts did not specifically require the use of analytical techniques developed in antitrust cases, the use of conventional antitrust analysis is quite appropriate in regulatory proceedings because

the basic goal of direct governmental regulation through administrative bodies and the goal of indirect regulation in the form of antitrust law is the same -- to achieve the most efficient allocation of resources possible.

_/_ Northern Natural Gas Co. v. Federal Power Commission, 399 F. 2d. 953, 961 (D.C. Cir. 1968) (Citations omitted.).


In order to define the competitive detriments of a transaction, the Board must look to the effects in the various markets which would be affected. Markets are defined in terms of the line of commerce (referred to as the product market) and the section of the country (referred to as the geographic market). Although there may be specific city pairs or regions where non-trunk carriers compete with trunks and should be included in the market for antitrust purposes, trunk airlines compete mostly with each other, and the product market for analyzing a merger between trunks is generally considered to be composed only of the trunklines. In a merger between a trunk and a non-trunk the competitive impact would have to be analyzed both in trunk markets and the appropriate non-trunk markets.

There is also general agreement that airline mergers should be analyzed in city-pair, regional and national geographic markets, although there is some difference of opinion as to the significance of these various types of markets. /\ 

One word of caution is in order: there can be markets within markets, in both the product and geographic sense, and it may be reasonable to examine a merger in terms of several different markets, with some of the markets in other market. /\ The competitive inquiry should not focus on rigid definitions of markets, but rather the likely competitive consequences in as many relevant markets as are meaningful, based upon the economic facts in the particular part of the air transportation industry which is involved. The complexity of market analysis leaves much room for merger applicants to rely on sleight-of-hand: they can always point to another decision in which the Board examined a given market, argue that their application does not damage competition in that market, and ignore markets where there are

/\ See Joint Brief of the Applicants to the Civil Aeronautics Board in the American-Western Merger Case, Docket 22916, and the Brief of the Department of Justice in the same case.

damaging effects. It should be kept that there are a number of possible markets, and an anticompetitive impact in any of them must be taken into account.

There is a variety of techniques available for evaluating competitive impact in city-pair markets. City pairs in which the merger would reduce the number of competitors should be identified, and the severity of the impact pinned down as much as possible. This can be done by looking at the market share of the merged firm, and using it as an index of its ability to dominate the market. Competitive advantages which may arise from backup traffic or high identity at particular points should be identified. The magnitude of the affected city pairs should be quantified in some way, such as gross revenues or revenue passenger miles. The city pairs can be categorized according to the likely market effect, and their magnitudes within each category can be aggregated to gain a rough idea of the magnitude of the total impact. We believe it is important to compare the city pairs in which anticompetitive results would follow merger with the city pairs in which service benefits could be expected, although we recognize that such comparisons can rarely if ever be precise.

Less attention has focused on competitive impact in particular regions of the country, although there are several reasons it may sometimes be helpful to group several city pairs together for analytical purposes. Examples of regional markets would be particular groups of city pairs radiating out of a single point or a group of points, or an entire section of the country.

There is little serious dispute that trunk airline mergers should also be analyzed in terms of a national market. This national market is not equivalent to the national market for automobiles, where the same firms compete with each other in all parts of the country. But
even trunks which do not compete with each other in any city pairs are in some senses competitors in the national market. The impact of decisions such as what seating configuration to offer, what type of advertising campaign to conduct, and what type of aircraft to buy tends to spread throughout the industry even though the particular decision may have been motivated initially by a desire to meet a specific competitive threat encountered on only a few routes. In fact, many of the most vital decisions as to cost allocation, competitive effort and operational planning are made on a national or regional basis.

What are the possible anticompetitive results of a merger in the context of a national market? Perhaps the most important is concentration of economic power in commercial decision making. As I have noted, the Supreme Court has made clear that the presence of comprehensive economic regulation in an industry does not eliminate, but increases, the significance of economic concentration. The trunk airline industry is characterized by a small and historically declining number of firms, with no entry by new firms. The trunk airline industry is more concentrated than most American industries.


_/ There are presently ten domestic trunk airlines (assuming consummation of the Delta-Northeast merger); the largest four firms have about seventy percent of the business, and the largest six about eighty percent. See Briefs of the Department of Justice in the American-Western Merger Case, Docket 22916, (Brief to Examiner, pp.15-17) and the National-Northwest Merger Case, Docket 23852, (Brief to Board, pp.30).

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Perhaps more significantly, as will be discussed later, the industry appears to be more concentrated than it would be if there were no economic regulation.

As the examiner noted in the National-Northwest proceeding, concentration of this magnitude "can give rise to a number of well recognized evils," and some of them appear to be present in the airline industry. It is not clear to what degree existing concentration has deadened incentives for commercial and technical innovation and distorted resource allocation, but one thing is clear: the industry is sufficiently concentrated that an increase in concentration through merger requires ample justification.

Another adverse impact which can come from merger is a distortion of competitive relationships among airlines which can arise from differing size. It is clear that, other things being equal, larger airlines have advantages due to size. These include the ability to support traffic in one market with backup traffic from another related market, the greater public familiarity of larger enterprises; an abstract feeling that in the words of Northwest Airlines "bigness is goodness;" advantages from advertising on a larger scale; and the fact that a carrier with more traffic at a given point can provide more services, sales and promotion at that point. /

Recommended Decision of Examiner Park, supra, p. 30

The advantages of size have long been recognized by the Board in deciding merger cases. American Airlines Acquisition of Mid-Continent Airlines, 7 C.A.B. 365,387-89 (1946). See "balance doctrine" cases cited in Brief of the Department of Justice to the Hearing Examiner, American-Western Merger Case, Docket 22916, p.17.
All of these factors create competitive advantages whether or not there is any difference in service to the public. In fact, very seldom do they include improved service to the public or greater efficiency. In the context of CAB price and entry regulation, the primary result of the advantages of size is to confer upon larger firms a degree of "market power" in that their actions are somewhat insulated from the pressure of their competitors' actions, and they have a degree of power over those competitors' actions. The number of trunk airlines is so small, and the imbalance in size distribution is such, that the Department has expressed concern at the market power which would result from the combination of two smaller trunks, National and Northwest. A fortiori, this concern also applies to the merger of larger trunklines.

Two similar detriments from the disappearance of a competitor are the loss of "yardstick competition" which can arise from comparisons between carriers which do not directly compete, and the loss of a divergent voice in the regulatory process, and consequently a limitation on the number of alternative actions, viewpoints and information presented to the regulatory agency for consideration. 

____________________________________


_/ The District of Columbia Circuit Court of Appeals has warned that the quality of regulatory decisions can be lessened if regulated firms limit the number of alternatives presented to the regulatory agency. Northern Natural Gas Co. v. Federal Power Commission, supra, at 973.

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The Supreme Court's decision in the El Paso Natural Gas case shows that a merger's impact on potential competition weighs importantly, even in a regulated industry. In the trunk airline industry, where entry is essentially closed to new firms, potential competition among existing firms on particular routes is more important than it would be in an industry with unregulated entry. Unlike the unregulated competitor, a trunk airline today can be confident that new entrants into its markets will not come suddenly or without warning, and perhaps more importantly, that such new entrants will come from the ranks of the very few existing firms whose route systems have a viable connection with the subject markets.

It is frequently remarked that there are usually several applicants in new route award cases. It does not follow, however, that the disappearance of a potential competitor is necessarily unimportant. Because differing route characteristics make some applicants more logical recipients of new authority than others, and rule out some applicants the value of a potential competitor needs to be evaluated in each specific instance.

Since I promised a few words on the comparative roles of competition and regulation, I will make two brief comments on that subject. I will leave detailed commentary on the economics of the industry to the econonists, but I think it is appropriate to point out that the economic characteristics of the airline industry are such that the Federal Aviation Act's relatively heavy reliance on competition as opposed to

regulation is quite well suited to the industry. In the recent trunk-line merger proceedings, a great deal of economic expertise has been brought to bear upon the economics of the airline industry, but the net result has been a relatively simple conclusion: within the size range represented by the trunk airlines, there are no economies of scale. With respect to trunk air carriers, the proposition that there are no economies of scale does not appear to have been subject to serious dispute in the economic literature or in recent merger proceedings, which examined the area thoroughly. Considerably less attention has been paid to the question of whether there are economies of scale for smaller air carriers, but there are some indications that all economies of scale are realized by the local service carriers, and perhaps by firms with only a handful of aircraft. In the absence of government economic regulation, it appears that there would be very few barriers to entry other than the cost of meeting applicable safety standards. Consequently, the primary barrier to entry in the regulated industry is the requirement of a certificate of convenience and necessity. Most economists who have studied the question have concluded that the inherent economics of the industry are not such that destructive competition could be expected in the absence of economic regulation, and they

omite to entry in the regulated industry is the requirement of a certificate of convenience and necessity. Most economists who have studied the question have concluded that the inherent economics of the industry are not such that destructive competition could be expected in the absence of economic regulation, and they

_/ See Recommended Decision of Examiner William J. Madden in the American-Western Merger Case, Appendix D, Docket 22916; Recommended Decision of Examiner Robert L. Park, supra, Appendix G.

question whether there is any need for economic regulation in the first place. 

The absence of economies of scale or other barriers to entry and the apparent absence of opportunities for profitable predation indicate that the trunk airline industry would probably be reasonably competitive and efficient without economic regulation. Accordingly, the usual merger policies applicable to nonregulated firms would appear to be appropriate unless economic regulation creates conditions which require departure from that policy.

The impact of regulation upon concentration in the airline industry, largely explained by the work of Bill Jordan who was here last week, is an important element in understanding the significance of regulation in that industry. Dr. Jordan's testimony for the Department of Justice in the American-Western case pointed out that if there were no regulation, there would be far less interest in airline mergers, since the asset the acquiring firm is most interested in is the certificate authority of the acquired firm. The results of his investigation of the California intrastate carriers during a period of virtually no economic regulation strike a startling contrast with the history of regulated airlines: none of the unregulated firms went out of business through merger, but the exit of carriers certificated by CAB has always been through merger. In fact, the route authority of regulated air carriers is a valuable

_/ See sources cited by A. Kahn, The Economics of Regulation, pp. 219-220.


asset which they would not have in the absence of regulation. It is not surprising that they never leave business without getting something in return for this asset.

Economic regulation in this industry, as in other "inherently competitive" industries appears, then, to have created a powerful incentive for concentration. This influence appears to have been reinforced, moreover, by CAB's decisions with respect to entry. Although existing firms have been placed in competition with each other to an increasing degree, no new firms have joined their ranks, and with the elimination of firms through merger, the number of firms in the trunk and local service industries has steadily declined since 1938, when economic regulation in its present form was instituted. We have stated that this "closed entry" situation must be taken into account in setting merger policy, and requires that the effects of the loss of a competitor must be closely scrutinized.

In conclusion, I can summarize these remarks as follows: existing law places a high value on competition, and requires that airline mergers be approved only very cautiously- The economics of the airline industry are such that existing law serves the public interest reasonably well.
ONE AIRLINE'S VIEW OF Mergers

Presented At The
1972 Summer Workshop On
"AIR TRANSPORTATION SYSTEMS ANALYSIS AND ECONOMICS"
(Sponsored by Massachusetts Institute of Technology
and National Aeronautics and Space Administration)

Waterville Valley, New Hampshire

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Washington, D.C.

July 19, 1972

It is a privilege to have this opportunity to appear
before the M.I.T./NASA workshop in the company of the distinguished
lecturers on your program. My reason for being here is that
Allegheny has been involved in airline mergers.

There was little, if any merger activity in the six
years following the United/Capital merger in 1961. But it has
been a very active period in the past five years. Since 1967,
there have been six mergers approved by the CAB:

Frontier/Central - now Frontier
Bonanza/West Coast/Pacific - now Hughes Air West
Allegheny/Lake Central - now Allegheny
American/Trans Caribbean - now American
Allegheny/Mohawk - now Allegheny
Delta/Northeast - successor to Northwest/Northeast

Seven airlines have disappeared in the process. If the pending
American/Western and Northwest/National mergers are approved, two more carriers will go into history.

As of today there are eleven trunklines - soon to be ten - or perhaps only eight.

And there are eight local service or regional carriers.

What causes this periodic tendency for industry restructuring through merger? In its simplest terms, it is the opportunity to expand ones marketing area and increase productivity by a quantum amount without the necessity of following the arduous, tortuous path required to obtain certificates of public convenience and necessity under section 401 of the Federal Aviation Act.

Routes - this is the why of mergers - combined with one other critical ingredient: a willing partner to the agreement. With the exception of the currently pending American/Western and Northwest/National agreements, all significant mergers have involved a relatively strong carrier and a relatively weak carrier in financial difficulty. In the latter case, one might question whether the partner was truly "willing" since the marriage could more aptly be characterized as a "shotgun affair" dictated by the financial facts of life. Yet in most instances, the merger partners have had a strong affinity for each other because of the complimentary nature of their route structures. Certainly this has been the case in the two Allegheny mergers since 1968 - Lake Central and Mohawk.
Allegheny's growth from a small carrier to the 6th largest domestic carrier as measured by passenger boardings is the product of several factors:

1) its location in the most populated section of the U.S.
2) an aggressive, continuing effort to expand to profitable markets via the certification route under section 401
3) a program to harness the traffic potential of smaller cities through use of the "Allegheny Commuter" concept
4) expansion through merger
5) a financial program to support continuous, rapid growth

In the limited time available, I will comment on the role mergers have played in Allegheny's development, and some of the significant problem areas associated with mergers.

I. BACKGROUND OF ALLEGHENY'S MERGERS WITH LAKE CENTRAL AND MOHAWK

In the early 1960's, Allegheny began thinking in terms of its long-range future. At that time our system had severe limitations - the Middle Atlantic States, with Boston and Washington, D. C. on the east, and Pittsburgh, Cleveland and Detroit on the west. A rather restricted area for a jet age route system, further complicated by route restrictions prohibiting competition with trunklines.
We developed a program to obtain new routes from the CAB. We also made a study of what mergers might do for Allegheny. We looked at the potential of the Mohawk, Piedmont and Lake Central systems. Lake Central made the best choice for several reasons:

1) its routes to the west of Allegheny's system would give Allegheny access to several major cities - Chicago, St. Louis, Indianapolis, Dayton, Louisville, Cincinnati and Columbus

2) Lake Central and Allegheny had common cities at Washington, D. C., Baltimore, Buffalo, Detroit, Cleveland and Pittsburgh

3) Lake Central's management had concluded that Lake Central's financial future was shaky and was willing to consider a merger

4) Allegheny was more than twice the size of Lake Central, thus assuring that Allegheny's personnel policies and collective bargaining agreements would prevail

In the Mohawk situation, there were some like factors to the Lake Central situation:

1) Mohawk would give Allegheny access to Minneapolis, Rochester, Syracuse and Montreal

2) 19 cities were common to both carriers including such important points as Boston, Hartford, Providence, New York, Albany, Philadelphia, Washington, D. C., Pittsburgh, Buffalo, Toronto, Cleveland, Detroit and Chicago
3) Allegheny was about twice the size of Mohawk.

There were, however, some major differences between the Lake Central and Mohawk situations:

1) Mohawk had obtained nonstop rights in most of its markets within the system, such as New York to Rochester/Buffalo, Cleveland to Albany/Hartford, and Buffalo-Boston. By contrast, Lake Central in 1968 had a highly restricted route system requiring intermediate stops between most of its larger cities. To develop Lake Central's market potential required an aggressive program seeking CAB approval for nonstop rights in such markets as Chicago-Pittsburgh, Indianapolis-New York and St. Louis-Pittsburgh in order to develop the flow potential of the merged Allegheny/Lake Central system. We were fortunate that our program coincided with a positive policy of route strengthening at the CAB, prior to the recession of 1970. We were successful in large part, except for opening up Philadelphia. Also, we were dealing with monopoly markets (except for Pittsburgh-Chicago). Thus we could not really integrate the Allegheny-Lake Central systems for about 18 months after the merger.

Within six weeks of merger with Mohawk, Allegheny was in a position to schedule through flights between the Allegheny and Mohawk systems, on an economical basis, because of the
compatibility of routes at the common terminals of Buffalo, Cleveland and Detroit - without asking for new CAB authority.

2) Mohawk was seriously in default on its $78 million of senior and subordinated debt, aircraft leases, as well as delinquent in accounts payable. It was, frankly, on the verge of bankruptcy. It had suffered a five month pilot strike. At the end of the 1st quarter of 1972, it had about $18 million due but unpaid on loans and leases. Mohawk's net stockholder equity had dropped from $16 million in 1966 to minus $8 in 1971 - a $24 million swing.

In the Lake Central situation Allegheny simply assumed all of Lake Central's outstanding debt obligations.

Not so in the Mohawk situation. It was necessary for the long term subordinated creditors to accept the fact that their investment could not be assumed by Allegheny. Thus the merger agreement provided for an exchange of Allegheny convertible preferred stock with warrants for $28 million of Mohawk subordinated notes and debentures.

In addition, the Mohawk senior debt had to agree to (a) a moratorium of all principal and interest payments until merger completion; (b) refunding of the debt as part of Allegheny's senior indebtedness and compatible with the merged corporation's debt servicing ability based upon profit and loss and cash flow projections for the combined operations.
Allegheny's senior debt also had to accept some modifications, in the form of a rescheduling of a small portion of principal payments.

3) **The accounting treatment** was quite different. The Lake Central merger was handled as a "pooling of assets", which meant that all of Lake Central's assets and liabilities were included in a consolidated balance sheet. Thus, Allegheny accepted the book values of the Lake Central aircraft fleet without adjustment. One of the negative aspects of the Lake Central merger had been the restricted utility of the 25-passenger NORD 262 aircraft, 12 in all, which Lake Central had purchased in 1965. Allegheny retired these aircraft in 1969, along with Allegheny's F-27 fleet - and at that time wrote down the net investment in these aircraft by $4.3 million, which was charged against earnings.

Allegheny desired to protect against a similar situation in the Mohawk merger as it related to Mohawk's fleet of 17 FH-227 propeller aircraft. We had concluded that the useful life of the FH-227 was limited in the post-merger period because of economics, and would be the first aircraft type to be phased out post-merger. Accordingly, as a condition to the effectiveness of the merger, Mohawk was required to write-down the investment in FH-227's by at least $9.4 million.
In addition, Allegheny was paying approximately $6.3 million as route acquisition costs,\(^1\) which are to be amortized over a 40-year period.

Thus Allegheny was required to account for the merger as a purchase.

I would like to comment on a few related aspects of mergers:

1) **Management** - If one thing is clear it is that there can be only one surviving top management. It is not practical to expect two carriers to meld their senior management on an equal basis. In both of our mergers, Allegheny management has remained, with relatively few additions from Lake Central or Mohawk. One need only recall the debacle at Air West created with three equal partners trying to run the merged operation until rescued by Howard Hughes. At the Board of Directors level, Allegheny took five of Mohawk's 12 directors.

\(^1\) **Route acquisition costs** — amount of all Mohawk obligations assumed by Allegheny, plus the value of the common stock, stock purchase warrants, value of preferred stock and stock purchase warrants issued, less the fair value of the assets acquired from Mohawk at merger date.
Yet at the same time while the sword of Damocles hangs over the heads of the carrier being absorbed, their management must be kept reasonably intact to run the airline — a delicate situation. Mohawk did lose some officers while the case was at the CAB.

2) Personnel - The ultimate success of a merger is very much dependent on the rank and file employee groups merging in the fullest sense of the word. Pilots, mechanics, hostesses and ground services personnel are called upon to accept strangers as equals. This means seniority integration on a fair and equal basis, and a host of other considerations affecting individuals such as shift assignments, days off, and so on.

The CAB has an elaborate set of conditions attached to merger approvals. These labor protective provisions are designed to minimize the impact of mergers on employees and to provide for dismissal and displacement allowances and real estate protection.

Allegheny has had a minimum of difficulty with its personnel. Prior to the merger, pilots, mechanics, hostesses, ground services and reservation personnel of both companies had all agreed on seniority integration. As a matter of fact, pilot training commenced eleven weeks prior
to the merger.

For the groups organized under collective bargaining agreements, Allegheny's contracts were the surviving agreements. A challenge in the federal courts to this position was made by the Teamsters in the Lake Central merger. The Teamsters represented the mechanics at Lake Central, and IAM represented the Allegheny personnel. The federal court rejected the challenge, upholding the right of the majority group to have its labor agreement survive and supersede the agreement of the minority group.

Likewise, in a situation where Lake Central's ground personnel were organized and Allegheny's were not, we successfully upheld the position that Lake Central's labor agreement could not be imposed on the unorganized Allegheny personnel. The Railway Labor Act, which governs collective bargaining in the air transport industry, requires that representation be on the basis of the wishes of a majority of the craft and class. Unlike the situation under the National Labor Relations Act, minority unions are not recognized. Consequently, Allegheny's employees group, which had chosen to remain unorganized could not have the representation of Lake Central's union imposed upon it.
In the Allegheny/Mohawk merger, we had a rather unique situation, where ground services and reservations of both carriers were not organized. To meet the Labor Protective Provision requirement of fair and equitable seniority integration, we established a procedure for the agents of each company to select their own representatives for purposes of negotiating an agreement. Little did we realize the long, drawn-out negotiations which were to follow. Some of the Allegheny personnel were initially inclined toward the position that since Mohawk was in trouble, and Allegheny was the surviving carrier, Mohawk personnel should not be given full credit for their Mohawk employment time. One position was that the Mohawk people should go to the bottom of the seniority list, particularly at the common stations, and be the first laid-off. Because of my position as the senior Allegheny officer responsible for customer service functions, I found it necessary to hold meetings at several of our large stations, such as Boston, where both carriers operated, to respond and explain what was required. After several weeks of meetings, the agent representatives finally reached a fair and equitable agreement - and it has proven so in actual experience. It was significant that former Lake Central personnel were very helpful
in bringing about this agreement.

Allegheny personnel have an outstanding record in achieving harmonious employee integration in both the Lake Central and Mohawk mergers. A large part of the credit also goes to Lake Central and Mohawk employees. It is in sharp contrast to the employee frictions which have arisen in most other mergers, and most recently in the American/Western and Northwest/National mergers, which have been marked by outright opposition including lawsuits brought by certain employee groups. Based on the record so far in those two cases, it is fair to predict a lengthy period of unstable labor relations at both companies should the mergers be approved.

3) Merging the Operations

While all the esoteric planning was going forward to achieve approval by the CAB, the President, stockholders and financial groups, those who are charged with the day to day operation of the airline were moving along at an accelerated pace. Following the merger agreement in April, 1971, Allegheny established an internal committee called the "Operations Department Merger Committee" to oversee the nuts and bolts aspects of the merger. Target date for accomplishing the merger was 9 months - February 1, 1972. That period was utilized to establish the post-merger systems,
manuals, training programs, marketing concept, facilities planning, personnel programs, and a hundred other critical policies. Again, to assure a relatively stable operation, in most cases Allegheny's procedures were utilized, to avoid confusion and the necessity of resolving close issues.

What happened after April 6, 1972, when the CAB and the President approved the Allegheny/Mohawk merger?

- five days later, the Boards of Directors met to take final action approving the merger
- the next day, April 12th, we legally merged
- six weeks later - June 1st, all five Mohawk crew bases had been consolidated with Allegheny's three bases at Boston, Pittsburgh and Washington, D. C., all FH-227 aircraft had been retired from scheduled service, four additional BAC-111 aircraft had been added to the fleet, and a new schedule marrying the two systems was being flown
- the month of June saw 870,000 passengers board Allegheny - and producing a very profitable operation

I shall conclude these remarks with a personal observation: the ability to merge air carriers under the provisions of the Federal Aviation Act contributes to the development of a sound air transport system. It does this by permitting the replacement of weak links with stronger, and
without government being the originating force. The government can react to but not sponsor mergers. After all, there is nothing sacred about the grandfather carriers - they "happened". The same can be said of the original local service carrier certifications. Under our private enterprise concepts, there is more good than bad in the ability of individuals to explore and propose those changes which the government regulators should consider in developing a dynamic transport system for the future.

* * *

-14-
International Air Transport Policy
Charles Butler/CAB

In international matters, the Civil Aeronautics Board gives advice and assists the State Department in negotiating. Mr. Butler will discuss the Board's policies and guidelines and, in particular, how they relate to the President's Policy Statement and its interpretation by the DOT.

1. In the time afforded me, I would like to touch briefly on a few points concerning international air transportation, and thereupon, try to answer any questions you may have for me.

2. I first like to observe that the business of international air transportation in the world at large reflects the policies and approaches of many governments. Each has its own views on how the flag air services should be instrumented, the purposes to be served, the amount of competition desired or permitted, and the degree of governmental involvement in the business. The United States has one view of the matter, the Europeans have their view, and the Latin Americans have another, and in-between come the smaller countries that may not have their own airline but do provide important tourism destinations. The varied promotional and regulatory environment described makes the business of international air transportation both predictable and non-predict-
able, depending on how one wanted to read the situation.

3. The political environment for international air transportation insofar as it concerns the United States alone is shaped by the roles of the Civil Aeronautics Board (CAB), a part of the Legislative Branch, and of the Executive Branch. The CAB is, by law, responsible for the economic regulation of the nation's air transport industry including the domestic and international sectors. In this capacity, it grants certificates of convenience and necessity to U.S. air carriers for domestic and international operations and licenses to foreign air carriers for operations to the United States, among other economic functions. The Board also has a statutory mandate to promote the air transport industry, not just to regulate it. In my mind, the Board's mission to both promote and regulate has not compromised one function at the expense of the other, but rather it has served the nation well, judging by the record.

4. The grant of certificates to U.S. air carriers for international operations and of licenses to foreign air carriers for operations to the United States has to be approved by the President. In economic proceedings of the Board, the Department of Transportation (DOT), and any agency or person, are privileged to present their views to the Board. While the Act is not altogether specific on agency roles, there is an obvious rationale for a
Presidential responsibility in matters affecting our relations with other countries. It is equally desirable to have the views of the DOT and others in aviation proceedings in the interest of overall transport planning and policy guidance. Otherwise considered, there is also purpose in the Congress' desire to entrust strictly economic regulatory responsibilities to an independent agency, namely, the Civil Aeronautics Board.

5. Turning to substantive economic matters, I made my view known recently on how we should go about trading aviation rights with other countries. It was essentially the Yankee idea that you get dollar for dollar, that you trade fair value for fair value. It is an equation which calls for balanced economic trade between the United States and the other country. If this has not always been the kind of economic position that the United States has adopted, it was the kind of position that we could ill afford not to adopt. We have unquestionably been too liberal or not very careful in some of our aviation trade dealings with other countries, giving too much for value received. We have bought to too much in other instances, with the result that we have traded away what we did not have to. Whatever the explanation -- U.S. benevolence, etc. -- our aviation trade imbalances with other countries cannot be permitted to stand.
6. Belatedly, we have become very concerned of late with the trade terms of bilateral air transport agreements which put the United States at a decided trade disadvantage. Mr. Binder referred to one situation where something concrete has been proposed and something is being done about it. That is the Irish situation ... a very old matter, I hasten to add. For 25 years, we have tried to negotiate our way into Dublin without success. Air Lingus, the designated Irish trans-Atlantic carrier, serves Boston, Chicago, and New York in the United States and Dublin in Ireland. Our carriers serve Shannon, but not Dublin, which in our view gives the Irish carrier a competitive advantage. Air Lingus has been enjoying a 4 to 1 revenue advantage in the U.S.-Ireland market over our two U.S. carriers in the market, namely, PAA and TWA. Under a Board order which was issued this summer, and which has now been stayed by the White House for the balance of the year, the right of Air Lingus to serve New York would be cancelled. It will continue to have the right to serve Boston and Chicago.

7. The United States has requested capacity talks with the Netherlands. Our figures show that the Dutch have been carrying approximately 60 per cent over their own homeland traffic between the United States and The Netherlands. The Netherlands has been simply acting as a traffic gathering or funnelling point, and as an "artificial" stopover point. Relevantly, the Amsterdam Chamber
of Commerce provides a cost-free day in Amsterdam to any passenger who wants to stop over there. A passenger who otherwise would be a transiting passenger becomes under the circumstances a stopover passenger, with the further result that the origin traffic which can be claimed is inflated.

7A. In terms of a strictly U.S.-Netherlands air passenger market, the 12 weekly frequencies operated by KLM between Chicago and Amsterdam cannot be justified in terms of the traffic that the Netherlands if capable of generating. There is one U.S. air carrier flying out of Chicago to Europe, compared to 10 foreign air carrier flying out of Chicago to Europe, compared to 10 foreign air carriers serving Chicago, but this fact doesn't alter the picture. The one U.S. air carrier has one nonstop a day, and that goes to London. The artificial stopover is just an added factor in the problem. The capacity talks with the Netherlands are slated to take place in the fall.

8. We are currently faced with a capacity problem involving another European country, specifically, the United Kingdom. Relevantly, the British Government recently issued an order disapproving National Airlines' increase in capacity in its service between Miami and London from four 747 and three DC-8 frequencies weekly to a daily 747 service. In retaliation, the United States issued an order against BOAC, the British carrier
serving the London-Miami market, requiring it to file schedules with the Board for approval. This action was pursuant to Part 213 of the Board's Economic Regulations, which came into effect in 1970. The regulation has been used by the United States, so far, against Australian, Argentine, and Spanish carriers, and now against BOAC.

9. The British action against National Airlines is inconsistent with the spirit and letter of the bilateral air transport agreement signed by the two countries at Bermuda in 1946. That agreement was the first to reflect what has become known as the Bermuda capacity principles and what has become an integral part of all the agreements we have signed since. In essence, these principles describe the discretion of airline management to schedule the capacity it deems necessary in the light of its market judgment. If after a reasonable period of time, the other party to the agreement believes the new capacity is excessive, it may ask for consultations leading to a capacity adjustment, but only after the market has first been allowed to test itself. In our current view, the British action against National Airlines is contrary to the terms of the agreement, and if it is allowed to stand, it would invite other countries to similarly move upon U.S. carrier operations.
10. In the overall United States-Europe air passenger market -- including scheduled and non-scheduled/charter movements -- we originate two-thirds of the traffic moving in the market. This figure has prevailed for a long time, in spite of the various efforts made to increase the flow of foreign visitors to the United States. Apart from this fact, our carriers are hauling only about 45 per cent of the total traffic in the market, a situation which has existed for the past several years. We were a little worse off in the early 1960's when in one year U.S. carriers carried only 35 per cent of the North Atlantic market, so that there has been some improvement over time. The situation describes, on the other hand, a continuing source of balance of payments problem and corresponding need to do something about it as the aviation negotiation table.

11. The Deputy Assistant Secretary of State for Economic Affairs stated in a recent speech in Washington that the United States must take into account the origin of traffic and the balance of payments impact in granting and exchanging air rights with other countries. I agree with him. The economic equation to be struck must go beyond a simple exchange of routes and a calculation of estimated U.S. carrier revenue. It must consider the volume of traffic that can be realistically generated by the other country and enjoyed by our carriers. The United States is dealt a heavy economic blow if the spending by travellers in the market
is all one way, that is, the other country gets all or most of the transportation revenue and visitor spending, and we have only served to supply the travellers.

12. By way of concluding my remarks, I'd like to focus briefly on the place of the charter, or supplemental, air carrier in the marketplace.

13. That the charter air carrier has a place in the sun goes without saying. This observation is easily conveyed by traffic statistics for the U.S. - Europe air passenger market. In 1963, a total of 2.5 million passengers were transported in either direction by commercial air carriers across the North Atlantic, including scheduled passengers and a small number of charter passengers. In 1970, the total stood at 8.5 million, including nearly 2.5 million charter passengers or about 25 per cent of the total. Put another way, in just seven years, the number of charter passengers in the North Atlantic market has grown to the point where in 1970 it equalled the combined total of scheduled and charter passengers carried in 1963. These statistics also serve to convey, I believe, the observation that the volume of scheduled traffic in the market has also expanded rapidly in the same period.

14. Charter travel with particular reference to ITC's -- inclusive tour charters -- have experienced a tremendous growth
in the intra-European air passenger market. Literally millions of people "charter" from northern European cities to the sunny resort areas in Spain, the Mediterranean, and North Africa. The development of the intra-European ITC market is the product of the last ten or so years. When it began, there was little or no scheduled air services connecting the cities in the north of Europe and the resorts in the south of Europe. The European air charter industry went to work and produced a service and not a need where none existed previously, with obvious success. It did not have to contend with a scheduled air transport industry, and that obviously solved or obviated a problem, depending on the way you look at it. This is a very different picture from the development of charter travel between the United States and Europe, where there was a going, scheduled industry in the market, established for many years.

15. The rapid growth in charter travel in the U.S. - Europe and intra-European air passenger markets is recognition of a strong public demand for low-cost vacation air travel. It is a demand which stated in another way is very price sensitive. It is also recognition of the willingness of potential travellers to pool their travel plans with others, that is, leave, travel, and return together. Otherwise described, we are talking about the bulk, group, or mass market ... however you want to call it.
We are also talking about the continuing growth of the pleasure travel market which is rapidly overtaking the business travel market as the main source of business for the carriers, and which we can expect to increase to dominant proportions in all international markets in the years ahead. It is already dominant in some markets, as may have been indicated.

16. The position of the Board on the value of charter services is well known, I believe. In a recent pronouncement on the subject, it had this to say:

"The Board is convinced that the time has come to recognize new concepts of charter air transportation, and that charter regulations should be framed in a manner which will promote rather than inhibit the public demand for bulk air transportation."

These words were expressed by the Board in its Order, 72-6-91, of 21 June 1972, in which it disapproved IATA Resolution 045 governing passenger charters.

17. The Statement on International Air Transportation Policy, made by the President in June 1970, calls upon this country to reach intergovernmental agreements with other countries with the objective of providing a stable political platform for international charter operations. As matters now stand, scheduled air services are covered by bilateral air transport agreements, but
the right to operate non-scheduled/charter air services is granted on a strictly unilateral basis. As a practical consequence, international charter operations are for the most part subject to a wide range of unilaterally imposed restrictions. The President's Policy Statement left open the question whether the intergovernmental agreements covering charter operations should be sought on a bilateral or multilateral basis.

18. The position of the Board is that the bilateral road is the most practical or realistic course of action to follow. We have participated with other agencies in the development of a model of a bilateral air charter agreement. Representatives of the Department of State and the Board have held talks with a few countries about signing a charter bilateral, but with inconclusive results. The "selling" effort continues.

19. The charter part of the Policy Statement speaks of the necessity of taking steps to prevent impairment of scheduled and of charter services. In this regard, there seems to be a difference of opinion between the Department of Transportation and the Board on just how we should go about determining or anticipating impairment. The view of the Board is that you cannot determine on a a priori basis how many people will be available for travel on scheduled services. I side with the Board in believing that the market place is the best judge of the number
of people needing scheduled services. Apart from saying this, let me say that I don't really know what is defined by the word "impairment" or at what point either type of service is allegedly impaired. Or what shouldn't be impaired. The Policy Statement furnishes only a pragmatic suggestion as to what constitutes impairment.

20. At such time as someone -- a carrier, that is -- feels "impaired" or thinks he will be, the Board is ready to listen to both sides of the argument. Many issues and factors would have to be considered ... the kinds of fares in the market, the ability of the management of the airline, the policies of the other country ... some quantitative in nature, others qualitative. In one sense, the subject of impairment is not new, but it is one that the Board has had to consider in almost every decision it has had to make over the many past years. The point to be made perhaps is that there are few decisions -- in government, at any rate -- which can be reached on a strictly mathematical or numbers basis. But, let me also quickly say that the Board has an open mind on the subject, and would be very receptive to any model planning approach that would facilitate its tasks.

20A. As a practical matter, however, we are obliged for the most part to utilize an incremental approach to our problem-
solving and decision-making needs, checking our heading at each step of the way and going on from there, with the hope that we end up where a realistic, comprehensive, long-range planning capability would take us, if we contemporarily had that kind of capability.

21. Returning to the case at hand, I don't think that we can determine on a regular basis what proportion of the market ought to be reserved for international scheduled air services. This is the position I have taken at the Board and that is the position given by the Board's General Counsel at recent Congressional hearings. I think that the issues involved are too complex and far-reaching and in the final analysis we must reach our decisions on the basis of reasoned judgments in large part. Any impairment formula could easily lead us into a system of market allocations, and that certainly would not afford a basis for healthy market growth. I might say here in passing that this is one reason the Board has not chosen to participate with the Department of State and the Department of Transportation in charter talks with the European Civil Aviation Conference (ECAC). The direction of such talks could only take us towards a plan for allocating the market, rather than a plan for developing it.
22. What both the charter, or supplemental, air carriers and the scheduled air carriers must face up to is, the continued need to promote their product -- to sell their service -- to innovate, to create opportunity. I don't suggest that merchandising in a highly competitive market is easy, but I do suggest that without imagination and innovation and work in the marketplace, the results do not favor the public in terms of low-cost transportation and efficient allocation of resources nor do they favor the carriers. I am not suggesting a laissez-faire market climate, rather I am suggesting that there would be nothing in it for anyone if we simply rested our oars and waited for the market to come our way.

23. This concludes my presentation.

24. Are there any questions.

Question - Should the use of U.S. manufactured airplanes by foreign carriers be considered when negotiating bilateral agreements?

Answer - No. They purchased the U.S. aircraft because it was the best aircraft and they got fair value in that exchange. They got a good economic aircraft. It doesn't become part of the operation of the bilateral agreement. On the other hand, the U.S. passenger who is going out
and spending his money overseas is a different matter. For example, if the foreign carriers are carrying 54% of the traffic, that is a negative flow of gold for the U.S.

Q. - Did you say KLM flies 12 times a week from Chicago to Amsterdam?
A. - That's right.

Q. - Does a U.S. carrier have the rights from Chicago to Amsterdam?
A. - We have the rights from any point in the U.S. to Amsterdam. Generally, the way we describe the routes is from the U.S. to the point in the foreign country and, if we can negotiate it, to a point beyond. We also try to obtain intermediate points if we can do it. The Dutch have rights in New York and Chicago, I don't think they have Boston, but they have rights into Miami out of Netherlands Antilles.

Q. - Is there any American carrier service out of Chicago to Amsterdam right now?
A. - There is no American carrier service anywhere except to London, and that's one flight a day during the summer time.

Q. - Out of Chicago?
A. - Yes. There are 10 foreign carriers serving Chicago.

Q. - Is that because we don't serve them or have we refused to serve them?

A. - U.S. carriers have chosen not to serve. Now, I'm not suggesting that the KLM-Chicago service is out of line. I'm suggesting that one U.S. carrier operates from Chicago to Europe nonstop and there are ten foreign airlines out of Chicago to Europe - most of it a daily service. ILM has 12 flights a week. Under the principals of the bilateral agreement, we have to ask whether those flights are being scheduled to handle U.S. - Netherlands traffic?

Q. - Don't any of those KLM flights stop in London?

A. - No.

Q. - They are all nonstop?

A. - Yes, they're all nonstop. KLM had to give up their rights to intermediate points in order to get Chicago.

Q. - Could I ask what the detriment is to the United States of carrier competitiveness in actually scheduling flights for passengers who are going to go from country A to country B, and then on to country C?

A. - Well, generally speaking, it will have an unfavorable competitive effect on the efforts of the U.S. carriers
to provide service to country C. For example, if a U.S. carrier flies one plane from the U.S. to Greece, nonstop, and KLM offers one plane, one-stop service via Amsterdam between the U.S. and Greece -- and offers a free day in Amsterdam, as I mentioned before -- there is bound to be a sloughing-off of the traffic from the direct services between Greece and the U.S.

Q. - Isn't KLM going to be able to resurrect all these services that foreign carriers have got in past agreements from the U.S.?

A. - Not necessarily, I don't think. We paid the price for multiple designations in most of our agreements. KLM and the Netherlands have done very well in their transport agreement with the U.S. They have access to New York and Chicago. The Belgians would also tell you that the Dutch have done very well in their relations with the U.S. They are trying to do the same thing.

Q. - What does KLM offer to induce passengers to fly KLM?

A. - It's just a competitive service. It's just the same service, the same kind of airplane, it may be the same number of stewardesses, but it may be a different uniform. It's the same price for carriers.
Q. - Do you mean there are more Americans traveling on KLM?
A. - Many foreign nationale prefer to fly their own national airline. The Irish like to fly Irish Airlines; the Japanese like to fly on Japan Airlines; Americans, however, like to fly on foreign airlines.

Q. - Don't the Japanese get a discount on their own airlines?
A. - I'm not sure. Not legally, they don't.

Q. - Do they get a discount in their own country?
A. - Well, if they do, it's not legal. I know that this happens in a lot of countries. To get out of Prague, unless you fly with CSA you pay 100% more. To fly out on a U.S. carrier, if you're a Czech citizen you have a 100% exit tax. You don't pay that if you fly on CSA but you do pay it if you fly Pan Am.

Q. - What would it take to suspend or cancel flights from or to the U.S.? In other words, does your Department have the power to cancel flights, or does it have to be a Board action? Take the Irish situation, for example.

A. - It is a Board action and involves two-step action. First, the U.S. under the terms of the bilateral agreement gives notice of renunciation of part of the
bilateral agreement. That takes one year to run.
A year ago in August the U.S. gave Ireland a notice
to terminate part of the air transport agreement
which gave them the rights to New York. The Depart-
ment of State gave that notice. Then the CAB started
a proceeding based on a show cause order as to why
the Irish Airlines' rights to New York should not be
withdrawn. The examiner has now recommended his
decision and the Board has the case before it and will
make its recommendation to the President for his final
disposition. The rights were granted to the Irish
by the Board pursuant to the air transport agreement.
If the basic agreement is altered so that the rights
to New York are no longer there, the Board will then
take the steps to review whether the permission it
granted pursuant to the agreement should not be
withdrawn.

Q. - Is this a one year lag then?
A. - It can take 12 months and any agreement or part of an
agreement can be denounced.

Q. - What kind of a response do you have for cases like the
British action against National?
We have a regulation called Part 213. We can require that schedules be filed for approval. Generally speaking, this is reserved as a means of retaliation. Where the United States carrier has had its operation restricted by a foreign government unilaterally, then the U.S. under Part 213 of the Board's regulations can issue an order requiring the carrier to file schedules for approval within 30 days. For example, with the Australians, the CAB refused to let them schedule their services of the 747's to the U.S. They had just taken delivery of the plane but couldn't schedule it to the U.S. There was the plane sitting there and they did not know what to do with it. That was rather effective from our standpoint.

Q. - So you do have a quick response mechanism?
A. - Yes. I was in London on the first of July talking with the British about this problem of National Airlines. Ten days later the Board came out with the first part of the order requiring BOAC to file schedules. The second shoe has yet to be dropped on what and what not might be approved.

Q. - National had very little time to comply?
A. They had a few days, to comply.

The British order was to be effective on the 26th of June, was issued on the 19th, I think, and it required National to move down from a daily 747 to 4 days a week with a 747, and 3 days a week with a DC-8. Now, when we got in London on the 30th of June, Friday afternoon, we asked the British if they would at least suspend the application of the order until over the weekend because National was going to have to turn passengers away. In other words, they had booked more passengers than a DC-8 can handle. The British refused. The first night that the order went into effect National operated the DC-8 and had to turn 60 passengers over to BOAC. The next night out of Miami, National had to turn over 100 passengers to BOAC because they couldn't accommodate those passengers already booked on National because the requirements reduced the size of the airplane. One of the figures we showed the British indicated that in June only 4 days out of the whole month could National have accommodated the passengers they actually carried on the narrow bodied aircraft. The other 26 days of the month they required something larger than the regular DC-8, the only other plane they had, to handle
the passengers. But this hasn't made any difference. I think the British are a little irked that National wouldn't accept the proposal by BOAC to pool on Miami-London and split the frequencies. National could have four 747's and BOAC would have three. They would have daily 747 service to London and everybody would be happy and there would be competitive equity. National declined the offer and said they were going to take a chance with going daily. National had a 90% increase in passengers over the previous year in the month of June. The load factor was 46%, not high, but when you have a 160% increase in capacity, a 46% load factor is good. In a 4,000 mile flight, a 35% load factor is about break-even, so they are not losing money. It is not an uneconomic operation. The facts show that BOAC's 707 operation can do as well against National's 747's. The place where BOAC broke down was, they were flying their 747's empty when they ran head to head with National. They just couldn't go with the 747's.

Q. I would like to clarify a point that was made earlier. I would think that the Bermuda Agreement is a most misunderstood overworked agreement. Would you say that
this fact alone would justify any action by your agency? Is that a reason by itself for you to take any action you want to?

A. I don't think that it would be by itself. It would probably be part of a number of factors that would influence this particular decision. In trying to evaluate routes, you put down a number of factors that make up an economic exchange of routes. The number of passengers flying the route, the number of points that you get, and the markets that have been made available to you. But what has been suggested is that we have to crank in the idea of the benefits that are flowing to that foreign country not only from the number of passengers being made available which is normal, but in addition, the amount of outflow into that country of U.S. dollars because of the tourism. I agree with that. The tourism account in the U.S. is dreadful as far as balance of payments are concerned. We've got a National Tourism Resources Review Commission that's been working for a couple of years now trying to come up with some answers to how we redress the imbalance in the tourism account. And, as I understand it, they've come against a blank wall -- as everybody has.
Q. - A point of view, and I would like to clarify it, the Board's view and your expression of it is that you can't determine these bench-marks on charters and scheduled services ahead of time and I heard you say that the market should be allowed to work this out. How do you relate that general position to the kind of charter regulation that the Board has or would adopt? How much constraint can you put on the operation of the market if given that approach?

A. - I'm glad you asked that because that's a point I missed. The Board feels that as a regulatory body it is essential to proceed step by step. If you look over the history you will see a gradual liberalization of Board policies and Board regulations as far as charters are concerned. It has been a step by step process. I think that because we are unable to judge the potential impact of a given Board action, it is essential to take a step by step approach to regulation so that we can evaluate conditions after the first step and find out what the next step should be. Suppose the Board just wiped out all affinity requirements, no advance purchase, no limitations whassoever on charters, that would be a rather substantial step and might be like
steping off the 10th floor without an elevator. That long first step may do you damage that you can't correct in time, given the regulatory process that you have to go through. I think that it is rather essential that you look at regulations in a sensible, orderly fashion. We are set up at the CAB to regulate an industry, not to run an industry. We'd probably be the world's worst airline managers. We're not designed for that. That's what gives me some pause and problem with all the innovations the CAB is supposed to come up with that were suggested this morning. The airlines run themselves under a system of regulation. They are not utilities in the sense of having monopolies.

It is not possible to sit and analyze a situation today as far as charters are concerned. We cannot say that because this is the distribution of traffic that is now being carried on scheduled airlines we can predict that in 1975 this will be the relationship or should be the relationship between scheduled service and chartered transportation. You use the term "benchmark". I think that is a convenient term, but it still requires telling the Board that it should sit down and examine
the whole spectrum of North Atlantic traffic, determine how much of that is demand transportation, how much of it needs scheduled service, and then issue an order that says New York-London in the summer can have no less than 2 flights a day from New York; one flight a day from Los Angeles; one flight a day from Chicago, and all the rest are available for charter transportation. But, what basis do we have to do that? What factual probative evidence would we have in a proceeding like that? How could we sit and say this factor should be taken into account, this one should not? Can't we get a better answer by letting the market go at it?

Q. - You are not letting the market go at it, that is the problem. It is obvious that it will continue as it has for years. But, the Board's star position, in my judgement, constrains the potential use of charter transportation substantially. If your remarks are any sign, the new charter regulations will also constrain the use of that authority to some degree. Granted that you like to move in comfortable steps so that you don't over-reach, but I could make the argument that the Board is much too conservative, that the steps are
too small, that the constraint should be loosened much more rapidly. At that point the question is what criteria do you use or does anybody use to choose the amount of constraint? I find no comfort in looking at criteria with the approach that you will do it on a step-by-step basis so that you always feel that you have the situation under control. For all anybody knows about market pressure and market demands for this kind of travel maybe we could be moving at 3 times the rate. Because we don't have any benchmark to know where we are going with this exercise there is no way of telling whether we are too slow.

A. I guess the inclination that I've seen in the Board so far is to wait until we get to the point where we are looking at impairment, or possibly begin to see it because of a complaint that is filed by either the scheduled carrier or by the charter operators, if there are two separate classes by the time that comes, and determine whether or not the impairment has taken place. For example, we don't try to determine in advance what the appropriate level of schedule service should be under bilateral agreement. We say that we must do an ex post facto review. Let the carrier
schedule it and then after a reasonable period, review the experience. If the review shows that the carrier has overscheduled itself, we will make an adjustment. We don't determine things in advance, except for subsidy. The subsidy levels, I think, are the only area where the Board has said, two flights a day in each direction is the minimum required for a subsidy operation. When you get in to other aspects of the Board's work like adequacy of service for instance, the Board doesn't determine that on an a priori basis. Most of the adequacy of service cases at the Board have been very complicated. The main feature is that it looks at facts and what has happened in the market or in the various markets and determines whether or not the airlines have scheduled sufficient service to meet their certificate requirements.

Q. - Why then doesn't the Board consider taking the same approach to charter operations? It's the management's discretion as to how much scheduled operations the carrier wants to operate, the kind of plane he wants to use and so forth. Some of them might make the argument that a charter operator of any kind should be able to make the same decision and offer his services
in any way he likes according to any criteria and preference he has. That's the market working. The Board is not letting that happen, it never has, at least, as far as charter specialists are concerned.

A. I think that somebody used the phrase that it is very subjective. I think someone used it this morning or this afternoon, and that it would be a very subjective conclusion to reach. What are your criteria for determining what elements go into scheduled service requirements vs. charter service requirements? I think that it is just a genuine difference of opinion and since the Board would be the agency that would have to decide this thing, it should determine what issues are involved. There is not an inclination to try to crystal ball it and determine what the future relationship between charter services and scheduled services ought to be. We haven't had a sufficient test period. We don't have sufficient basic information to know what proportion of the traveling public on the North Atlantic requires scheduled transportation, and what is available for charter services. We can't predict that today. It's preferable to let the scheduled operators operate chartered service and also let the supplementals operate
the charter services and let the scheduled services diminish. I disagree with the notion that scheduled services have to remain at least at the level they are today and may even have to increase if they can do so. I don't accept that. This is because there are different ways to provide for the product that the consumer is looking for in air transportation. We don't have to do it the way we did it 25 years ago.

Q. - Let me return to your comments on the European experience. You made a comment that the charter markets that developed in Europe are not in competition with the scheduled carriers. Was there anything to prevent the scheduled carriers from developing them?

A. - Well, it is actually more complicated than that. You have the scheduled carriers competing with the charter specialists on charter service as well as their own scheduled service. But let me ask a question. If the Board does not engage in some kind of a more relaxed policy on charter, how are we ever going to find out what the charter potential is? What European experience tells me is that the only way you can develop charter service is not to compete with scheduled flights and you say that on the North Atlantic you can't do that.
However, on the North Atlantic you've actually got charter competition provided by both scheduled carriers and by charter specialists.

A. - Let me say that these competitive factors are not lost. They raise serious questions for all of us to consider. As I said earlier, the key point to consider is what kind of service is the public demanding?
COMMERCIAL AIRCRAFT DEVELOPMENT & THE EXPORT MARKET

by Joseph Snodgrass
Aerospace Industries Association

July 20, 1972

Abstract

In the past several years, industry has been faced with a number of elements which endanger the future of commercial aircraft development: a decline in federally funded R&D programs; a general decline in the economic health of the domestic airlines; the increased cost of development which may be several times the net worth of the company; the development overseas of common market and manufacturing consortia; and foreign manufacturers receiving significant financial support from their national governments. These last items have acted to significantly increase the pressure in the export market placed on the U.S. manufacturers. Unless immediate and innovative solutions are found to combat these elements, the future of the industry is in jeopardy.
(Ladies and) gentlemen, I represent the Aerospace Industries Association, the voluntary trade association representing many of the U.S. manufacturers of aerospace vehicles and equipment. My paper today is largely based on a recent study conducted by our Aerospace Research Center. I present this paper more in the hope of provoking discussion than in providing information.

In 1971, for the first time in this century, the United States registered a negative balance in its trade with foreign nations, shocking the complacency of those who had long regarded American competitive superiority as an immutable fact of life.

The U.S. trade deficit is symptomatic of the sweeping changes taking place in international competition. The trade fortunes of many nations -- notably the members of the European Economic Community and Japan -- are in the ascendancy while those of the United States are in disquieting decline. There are many contributing factors to this turn of events\(^1\) but principal among them is the determination of other industrialized nations to upgrade their own economies by capturing greater shares of the international market.

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\(^1\) "Our international competitive position has been weakening for a variety of reasons: changes in international trading practices and patterns; developing inequities in both agricultural trade and the proliferation and preferential arrangements for industrial products; basic changes in the U.S. economy; and a monetary system whose lack of flexibility resulted in intolerable burdens being thrust upon the United States as we continued to meet our international economic and security obligations. These problems were brought to a head as a..."

Footnote continued on page 1-A.
result of inadequate increases in productivity, excessive domestic inflation over the last half of the sixties, a breakdown in the class international monetary and domestic adjustment mechanism and, of course, massive short-term capital flows." Peter G. Peterson, Secretary of Commerce, then Assistant to the President for International Economic Affairs, "A Foreign Economic Perspective," December 27, 1971, page ii.
As they have already demonstrated, they have the ability to do so. Their determination is backed by a willingness to provide government support in areas of export promise.

In this atmosphere of intensified international competition, a key engagement in coming years will be the economic battle for supremacy in sales of commercial air transports. This is an area of vital importance to the balance of trade because of the enormity of the anticipated market.

The U.S. was able to take an early lead in supplying transport aircraft due to its strong economic position among the countries of the world coupled with the bank of available research and development data that it possessed at the end of World War II. During and before the war, the nation had conducted an aeronautical R&D program of extraordinary magnitude. From the technological base thus provided, American companies were able to develop commercial products rapidly and with minimal financial strain.

In the postwar decade, U.S. plane builders further benefited from new technology made available by advancing military R&D. It was a period of leapfrogging technology which induced rapid obsolescence, requiring the military services to initiate frequent development "starts" over a wide range of aircraft types. Civil transport builders benefited either directly (from military cargo plane development) or indirectly (from airframe, engine and other technology).

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2 Civil Aviation Research and Development Policy Study, a joint study by the Department of Transportation and the National Aeronautics and Space Administration, Supporting Papers Volume, March 1971, p. 28.
Of additional advantage to U.S. industry has been the size of the American domestic market for transport aircraft. By 1950, domestic air traffic, as measured in passenger miles flown, had mushroomed to eight times the 1940 level. Except for flattening-out periods in the late 1950's and in the last few years, the growth curve climbed dramatically over the past two decades. This growth fostered airline demand for more airplanes and more types of airplanes. "American manufacturers enjoyed an assured U.S. domestic market of sufficient size to break even on development, manufacturing and testing costs on almost all new aircraft introduced. Export sales were the major source of profits. In contrast, European builders were restrained by the realization that they could expect to break even on a new aircraft only if substantial export sales could be achieved. In the face of tariff and other trade barriers, and severe American competition, they were seldom inclined to take the risk."  

The domestic market provided other competitive edges. Strong airline demand allowed long production runs, which reduced manufacturing costs, hence unit price. The many different services provided by U.S. airlines inspired development of a broad range of aircraft offerings, each type tailored to a particular service need. Thus, U.S. manufacturers were able to blanket the spectrum of civil transport requirements. (Chart 1).

The U.S. commercial aircraft industry is now able to produce whole families of aircraft models simultaneously. It presently possesses the

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physical resources to turn out eight different models at an aggregate rate of 77 airplanes per month. However, in contrast to this capability production during 1971 averaged 16 per month.

A final advantage accrued from the intense competition among American manufacturers for both the domestic and foreign markets. This promoted advancement of aggressive marketing techniques, including brilliant support by the Export-Import Bank and post-sale support features more attractive than those offered by foreign competitors.

Continuing technological excellence, coupled with the other advantages cited, enabled the U.S. to maintain marked dominance of the world air transport market over the quarter-century-plus since World War II. In 1954, the peak year of U.S. supremacy, 86.6 of the civil transport aircraft operating with free world airlines were of American manufacture. In other years, the proportion ranged from more than 70 percent to well over 80 percent. Today, it is about 76 percent.5

The advent of automated weaponry in the 1950's brought a reduction in the number and types of military aircraft needed, hence a marked decline in Department of Defense prototype starts. Although transport manufacturers continued to profit indirectly from the military deposits in the U.S. technological bank, the degree of direct fall-out declined sharply.

5 International Air Transport Association, "World Air Transport Statistics," (Annually)
Today, however, we are faced with the distinct possibility of losing our long-held market superiority and the attendant economic benefits. In the short term there are two factors exerting a negative influence. These are the poor economic health of the operators which reduces the domestic demand for transport aircraft and the current national malaise of anti-technology which has dulled our traditional national appetite for research and development. In the long term there are factors less likely to go away at work.

A changing tide of events over the past decade or more has eroded most of the traditional American advantages and at the same time provided foreign manufacturers with certain competitive advantages over their U.S. counterparts.

This swing of the pendulum has resulted primarily from the establishment, among foreign governments, of national objectives related to capturing greater shares of the world civil aviation market. The governments of Western Europe and Japan have provided strong financial support toward the attainment of these objectives, particularly in the key area of research and development aimed at improvement of national technical competence. An indicator of the intensity with which they have pursued these aims is a comparison of U.S./foreign aerospace R&D growth in recent years. The growth rate for the European Economic Community has averaged about 15 percent annually, compared with 6 percent of the U.S. The disparity is even greater in consideration
of the fact that the European nations have focused sharply on trade-oriented R&D while the U.S. figure includes substantial though declining commitments to defense and space as well as civil aviation R&D.

A major influence on improvement of the foreign competitive posture has been the growing adoption, in Europe, of the consortium approach to aircraft development. The advantages of multinational cooperation are outlined in a statement by France's Union Syndicale des Industries Aeronautiques et Spatiales:

"Cooperation makes it possible to undertake programs that would be beyond the means of a single country. Financing is broken down to dimensions that can be digested by each partner, as these programs are subject to inter-governmental agreements, the danger of breaking off contracts is eliminated. In this way, existing facilities for research, development, testing and production, the real capital of the partners, can be orchestrated and used to the greatest possible efficiency. A further significant advantage is that production batches are larger, as programs are designed to meet the requirements of all the countries involved, and this means that unit prices are finally lower." 6

Intensified R&D, cooperative venturing and other measures have combined to reduce American competition. For example, consolidation of the EEC internal market by means of consortium development and built-in sales to participating members has negated the long-standing U.S. advantage of broader home market. "The European countries, working together, now constitute a market that approaches the American market in size. It can therefore provide the large production runs which American industry has claimed as its own unique advantage."

As it did in the U.S., the broader market tends to influence development of a wider range of aircraft types, because of differing kinds of service provided by the airlines of cooperating nations. It is Europe in combine, rather than the U.S., which now boasts the more extensive range of commercial aircraft offerings.

Foreign competitors have also successfully modernized their marketing techniques. They now have sufficient strength to offer the same "total package" as U.S. manufacturers, which includes training, spares, repairs and other after-sale support. They have, in fact, acquired a degree of marketing superiority by virtue of government aid. "In addition to direct loans and subsidies to their manufacturers, foreign governments have shown willingness to support their industry marketing efforts by means of attractive

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financing arrangements, including longer payback periods than those legally permitted by the U.S. Export-Import Bank. They have also adopted practices eliminating requirements for supplier financial participation and for guarantees from the government of the purchaser; in some cases, they are also providing substantially lower interest rates.”8

With regard to technological capability, years of intensive R&D effort has substantially upgraded the posture of the foreign competition. The U.S. still enjoys a margin of superiority in general technological competence, but the gap has narrowed considerably. In certain specific areas, there is no gap at all; in others, foreign nations hold the lead. “Some foreign-built aircraft and items of equipment have already attained a quality equal or superior to products from the United States…”9

If this is not enough, there is the enormous problem, little known outside aviation circles, called the "money barrier." It is the inability of American plane builders to finance the development of new types of aircraft essential to effective competition. Development costs have risen to the point where it takes upward of a billion dollars to translate an advanced technology design into an operational airplane. No individual manufacturer can afford resources of that order. Private investment capital is no longer available to the extent required; a number of contributing factors have inclined the financial community to the view that the potential return does not justify the risk.(Chart 2).

9 CARD Policy Study, Supporting Papers Volume, p.5-29
This chart presents a horror story in condensed fashion. This is the financial history of a development program for a hypothetical new technology subsonic jet transport. From the first day until the program generates income (well after the first deliveries) a negative cash position of some $1.4 billion has developed. Is there a prudent manager in any industry that will expose his company to a financial risk equal to many times its net worth for a program which only breaks even at the end of its ninth year?

As a result, no advanced commercial transports are being developed in the United States at this time. Unless the financing dilemma is resolved, American competition in the world market will be limited to sales of the existing family of wide-body jetliners and improved variations of them, demand for which is expected to continue for about another decade. These airplanes embrace only a narrow portion of the future air transport spectrum. There are no American counterparts for several new types being developed by foreign manufacturers, who enjoy the strong financial backing of their governments. At best, the U.S. can expect a lesser share of the total market than its traditional 70 percent - 80 percent; at worst, the U.S. share could dwindle to nothingness by the mid-1980's.

This situation arises at a time when (1) the competitive challenge from abroad has reached its greatest level of intensity and (2) the U.S. is already experiencing a marked deterioration of its overall international trade posture.

The Market

An early solution to the financing problem becomes doubly important in
consideration of the vast size of the projected market for civil transports. Forecasters anticipate, by 1985, a fourfold growth in airline passenger traffic and an even greater expansion of air cargo movement. This growth will induce heavy demand for new commercial transports, including types already in service or in development and, in later years, advanced-technology airplanes not yet in development. It is estimated that sales in the 1974-1985 time span will amount to an enormous $148 billion, a sum approximating the value of all aircraft -- civil and military -- produced in the U.S. during the past 20 years (Chart 3). Continued American pre-eminence in the market can bring economic benefits of exceptional order, not only in international trade balances but also in such areas as gross national product, employment and tax receipts. Conversely, American inability to compete would have shattering deleterious impact in all those areas.

The Economic Impact

At stake in the world air transport competition during the 1974-1985 period is the very substantial sum of nearly $78 billion. This represents the difference in sales between (a) the estimated U.S. share of the market of American plane builders are able to compete in all categories of transport demand and (b) the estimated share if U.S. competition is restricted to the already-developed wide-body jetliners.

If the U.S. does compete in all categories, it can expect to capture 90 percent of the long-range market, 80 percent in the medium-range category and 70 percent in the short-haul class. This would amount to a total sales volume for the 12-year period of $118 billion, or an annual average sales level of more than $9.8 billion. The average represents more than double
the current level of commercial transport sales and clearly implies national economic benefits of large order. Of particular importance would be a balance of trade contribution of $5 billion annually.

If the U.S. does not compete with new types of aircraft, it is estimated that foreign nations will capture more than 70 percent of the total market. The U.S., by virtue of continuing sales of wide-body jetliners and evolutionary improvements of them, can expect a total volume of over $40 billion. The potential loss of business translates into 1.5 million man years of lost U.S. employment or a payroll loss of $30 billion. Additionally, there would be a loss of nearly $11 billion in federal income taxes alone. The impact on the balance of trade would be drastic. By 1976, the current positive balance in airplane trade would become negative and by 1985 the deficit would grow to $4.5 billion annually. The cumulative negative balance of trade in aircraft would exceed $18 billion (Chart 4).

Alternative Solutions

For years to come, there may be no way of financing major aircraft developments entirely by private U.S. capital. Yet the problem demands immediate solution because of the long lead time associated with aircraft development (Six years or more).

The answer may lie in U.S. government assistance to offset the support provided to foreign competitors by their governments. Government/industry cooperation is consistent with the policy recently affirmed by President Nixon: that government aid to private sector research and development is "necessary and desirable" in cases where the national interest is involved and the required investment is beyond the capability of private industry.
The Administration is considering a number of proposals for government/industry cooperation in civil transport development. Some of the proposals are directed toward solidifying the domestic market by improving the financial health of the transport manufacturers' customer, the U.S. airline industry. Others deal more directly with the development financing problem, for example, tax incentives; methods of increasing fall-out from military development; antitrust exemptions to permit American manufacturing consortiums; government-guaranteed loans; and government sharing of profits and risks with the manufacturer. Each has its advantages and disadvantages; none has emerged as a completely viable solution.

Study and review of the various options has made it evident that finding a solution acceptable to the Administration, the Congress, the public and the industry will be extremely difficult. The prospect of government assistance or participation in aircraft development raises at once, for industry, the spectres of government control of management and technical decisions; serious erosion of the traditional competitive environment; tarnished public image, and one more step towards the possibility of government ownership.

Further, any plan to improve the state of the manufacturing industry must presuppose good economic health of the air lines. Yet, barring some unforeseen rapid improvement in the industry's financial posture and a change in the private investment climate, some formula for government/industry cooperation must be found. The alternative is cession of American pre-eminence in commercial airplane manufacture, with all the consequences such forfeit implies -- loss of trade posture, productivity, taxes and jobs, and not inconceivably, loss of a vitally important segment of American industry.
In summary, we seem to arrive at the following conclusions:

**Research and Development**

The apparent national loss of confidence in and understanding of the role of technology in our society must be overcome. We, as a nation, must appreciate the direct inter-relationship between technological advance and national progress. With this recognition we must begin to restore the foundation of our neglected technology with new vigorous research and development programs in aeronautics.

**U.S. Competitive Handicaps**

In a new era of stronger competition from abroad for world civil air transport sales, U.S. manufacturers are at a distinct disadvantage. A major problem is the inability of U.S. plane builders to finance the advanced aircraft developments that are essential to their ability to compete. Foreign competitors enjoy varying degrees of government support in financing new developments. The traditional funding sources of U.S. industry -- corporate finances and private investment capital -- have dried up. Unless a new approach to development financing is forthcoming, the U.S. industry's ability to compete will be sharply limited and the international civil transport market, long dominated by the U.S. will go by default to foreign competitors.

**Government/Industry Cooperation**

The broad economic impact of commercial airplane sales justifies support of U.S. manufacturers to offset the support foreign competitors are getting from their governments. Government/industry cooperation in research and development is consistent with current Administration policy. The Administration is considering a number of proposed initiatives for such cooperation,
but no viable solution has emerged. It will be difficult to find a solution acceptable to all parties, yet it must be found.

A Matter of Urgency

The financing problem cannot be put aside until a more propitious time. It takes several years of development effort to translate a design into an operational airplane. Foreign competitors are already flying several types of aircraft for which no U.S. counterpart exists and with each day the chances of retaining U.S. market dominance diminish. If the nation is to realize the economic benefits available from the coming round of aircraft sales, a way of breaking the money barrier must be found immediately.
Contributions of Foreign Sales to Broadened Production Base

- 33% FOREIGN SALES OVER PAST 12 YEARS
- 328 BILLION

U.S. SALES
- ONLY
- U.S. PLUS FOREIGN SALES

UNIT
PRICE
Higher
Lower

QUANTITY
Cash Requirements
Large Commercial Aircraft Program
Private Financing

CUMULATIVE NUMBER AIRCRAFT DELIVERED

PRIVATE FINANCE
CUMULATIVE
NEGATIVE
INVESTMENT
DOLLARS

0 30 60 90 150 210 270 330 390 450 510

PROGRAM START
Commercial Transport
Aircraft Sales

1974-1985
(Billions of Dollars)
Impact On Commercial Transport Aircraft Balance Of Trade

$ BILLIONS

YEAR

In all of the debate that has revolved around the charter issue, one principle has been accepted by all -- namely, that Governmental charter policy must not jeopardize the maintenance of an economically viable network of scheduled air service.

While there has been disagreement as to the extent to which specific proposed charter rules do threaten a viable scheduled network, nobody -- not even the most ardent supporter of supplementals -- has challenged the overriding proposition that a healthy scheduled network is essential.

Recently, however, the discussion has taken a new turn. Some, including the DOT, have posed the question: "Granting that a scheduled network is essential, is it possible that the essential size of that network is less than the size now operated? Is it possible, in other words, that a significant contraction from today's scheduled system would be acceptable in the public interest?"

I submit that the only valid answer to these questions is: No. Contraction could occur only on terms that would be unacceptable to the national interest.

To document this position, we must get down to cases, and examine some fundamental aspects of scheduling in international air service. I will draw my examples from TWA's experience for the sake of convenience. I can assure you that the picture would be essentially the same if I used the experience of other carriers.
First, we must recognize that international air markets do not have dense traffic volumes to begin with, and this leads to a thin level of schedule frequency on even the largest routes. There seems to be great misunderstanding on this point, derived no doubt from the types of schedule frequency levels to which we are accustomed on domestic routes. Domestically, it is quite common for routes of consequence to have as many as ten or more daily flights per carrier.

There is no similarity whatever between such domestic patterns, and the situation on international routes. Consider, for example, the basic year-round pattern that TWA operates across the Atlantic -- that is, the pattern we operate in all but our peak summer season.

Chart 1 shows the total frequency we operated to Europe this past winter and spring. All told, it comprised 14 departures per day.

Let's place that in some perspective. Chart 2 compares our entire transatlantic frequency with the daily frequency operated by Allegheny Airlines on just a single domestic route of moderate size, New York - Pittsburgh. This past winter, Allegheny operated 11 daily frequencies on just that one route.

Bear in mind that our transatlantic pattern served four separate U.S. gateways, and provided all of our service to such major destinations as England, France, Spain, Portugal, Italy, Switzerland, Germany, Greece, Ireland, Israel, and Egypt.
And to cover these vastly important areas, over the world's largest overseas route, we operated a grand total of three more daily departures than Allegheny operated on the single route New York - Pittsburgh.

This contrast should help at the outset to test the credibility of any suggestion that the essential level across the Atlantic might be something less than today's. I must assume that such suggestions start from misunderstanding about the base level of international schedule frequencies -- misunderstanding that probably stems from domestic norms.

But let's move on to another significant point.

Other than in peak season, there is only one transatlantic route -- New York - London -- where TWA has been flying more than one non-stop flight per day. When you're down to one flight per day, there really isn't much room for further contraction.

And this is particularly true when considering the nature and level of foreign flag service, and the impact this has on the level we must maintain if we are to remain competitive.

Chart 3 shows TWA's versus foreign flag schedules, in all markets we are authorized to serve and where non-stop service is operated either by TWA or by our foreign competitor.
Note these facts:

1. There were only four markets where TWA provided more capacity than the foreign national carrier.

2. There were five markets where the foreign carrier matched TWA.

3. But there were eighteen markets where the foreign carrier provided more service than TWA.

This scarcely suggests a situation where there is room to contemplate actual contraction from current TWA levels, while still preserving a viable, strong competitive posture for U.S. flag service.

The question may be asked: Why doesn't TWA fly more than the pattern I have shown? Why don't we match our foreign flag competitors on every route they serve?

The reason is simple, and has great relevance for the whole issue of charters vis-a-vis the maintenance of a scheduled network. In the highly seasonal transatlantic market, traffic density is quite thin for most of the year, in most of the markets.

Thus, in the six months through March of this year, our average transatlantic load factor was only 44%. And that, bear in mind was prior to any further erosion of scheduled traffic to charters; it included the benefit of carrying many personal and pleasure travelers at promotional discount fares; it related
to a basically conservative pattern of frequency -- one trip per day on even the primary traffic markets. Most of our foreign competitors are government-owned and/or government-supported, and this helps to account for the differences shown above.

Incidentally, our Government has expressed concern about the thin nature of U.S. flag schedule patterns across the Atlantic.

For example, let us note some little-quoted passages of the President's Statement on International Air Transportation Policy. For example, that Statement said:

"Every effort should be made to improve U.S. carrier competitive performance vis-a-vis foreign flag carriers in some markets, particularly the North Atlantic. Continuing to improve the quantity and variety of services in such markets would enhance our competitive standing."  [Emphasis added]

Note particularly the call for improving the "quantity" of U.S. flag service.

This Policy Statement could scarcely be reconciled with a present suggestion that the essential level of U.S. flag service might be something less than that now operated.

Note also the following in the President's Policy Statement.

"This policy should take into account the public's need for additional or improved air services, including new direct services from U.S. points other than major gateways..."
Here again, that statement could not be reconciled with a suggestion that we contract from even the present scope of scheduled service. When the President's policy refers to the public's need for new direct services from other U.S. gateways, can it seriously be suggested that the public does not need at least the once-per-day frequency we now operate in major markets?

Incidentally, shortly before the President's Policy Statement was issued, the Department of Transportation filed petitions with the CAB and those petitions got more specific in expressing much the same points. Thus:

. The DOT expressed concern that Swissair provided direct service between Chicago and Zurich, while no direct U.S. flag service was available on a through-plane basis.

. It expressed concern about the fact that U.S. flag carriers were authorized to provide direct scheduled service to Europe from only 12 points in the U.S. "As a consequence," DOT said, "a vast area of the United States...is almost entirely lacking in the faster, more convenient, service that direct routes to Europe would provide."

. The DOT expressed concern that traffic between the United States and some European markets "is carried largely -- in some cases almost entirely -- by European flag carriers, even though United States citizens make up most of the traffic."
So here we have a series of policy statements -- by the President, and by the 
DOT -- all forming one general pattern. They expressed concern about the number 
of markets where foreign flag carriers already scheduled more service than U.S. 
flag carriers. They suggested a public need for more direct scheduled U.S. flag 
service from more points in this country.

In terms both explicit and implicit, these expressions of concern called for 
more -- not less -- U.S. flag scheduled service.

When we relate these statements to the facts I have cited earlier as to the 
limited frequency we presently operate in almost all transatlantic markets, it 
is difficult indeed to visualize the public interest being adequately served 
with a lesser level of U.S. flag service.

Perhaps it will be suggested that a reduction to even less than one frequency 
per day might be viable because such cutback by U.S. carriers might be matched 
by foreign flag operators. Even if we overlooked the deterioration of service 
convenience if all carriers on a route dropped to service once every few days, 
reliance on such a competitive development would be a fragile and implausible 
reed on which to rest the future of U.S. flag service.

The track record of foreign flag carriers simply does not support the assumption 
that, on the type of major routes here discussed, they would make less-than-daily 
service competitively viable by dropping to that same level themselves.
For example:

. In the off-season, TWA drops from non-stop to one-stop service on New York - Zurich. But Swissair maintains non-stop service.

. In the off-season, TWA has been dropping from daily to once-per-week service on New York - Shannon. But Aerlingte maintains daily service.

. In the off-season, TWA drops from two non-stops to one non-stop New York - Paris. But Air France maintains two daily non-stops, thereby providing the only daytime service eastbound.

As noted, most of our foreign flag competitors are government-owned and/or government supported. To each one, its route to the United States represents its primary international market. To each one, this represents the primary opportunity to gain productive utilization on its most expensive aircraft, such as 747s now, or for some, Concorde in the future. And beyond this, almost all European countries regard it as being in their national interest that frequent scheduled service on the Atlantic be provided by a national flag carrier.

To assume that foreign flag carriers will cut back to less-than-daily service in major markets, just because U.S. flag carriers might have to do so, is to make an assumption at odds with past history or present experience.
Against the perspective of the preceding discussion, let us now turn to one of the specific recent proposals for defining the essential level of U.S. flag service at substantially below current levels.

In recent testimony before the Senate Commerce Committee, Paul Cherington testified on behalf of the supplemental carriers. He recommended that the level of essentiality for scheduled services be determined by excluding those passengers now traveling on scheduled airlines at various promotional fares, and then computing the number of seats that would be required to handle the remaining traffic, at a load factor of over 60%.

Mr. Cherington did not discuss any specific results of his proposal, so let me supply a few.

On New York - Paris -- our second largest transatlantic route -- Mr. Cherington's proposal would define TWA's "essential" level as being the equivalent of about one 707 flight every two days, or one 747 flight every four days.

As we have already seen in Chart 3 above, this is a route where, even in the winter, our foreign flag competitor operates two non-stops every day -- a 747 and a 707.

Is it realistic to say that in this market the level of essentiality for TWA is either a 707 every other day, or a 747 every four days? Could TWA possibly remain competitive on such a basis with a foreign flag carrier that could reduce from its current level and still have a daily 747 remaining? Could such a competitive relationship possibly be squared with the Presidential and DOT policy statements quoted above?
I previously noted the DOT concern about the absence of U.S. flag through-plane service to match Swissair's one-stop service between Chicago and Zurich. DOT was so concerned that it suggested the possible need for certificating a new U.S. scheduled carrier into Chicago - Zurich to remedy such deficiency in that market of distinctly secondary size. That's an interesting backdrop against which to view the present Cherington proposal, which would define the level of essentiality at about one 747 every four days for TWA in a market of such major importance as New York - Paris, which is roughly 30 times the size of Chicago - Zurich.

The proposal stems from two premises, both of which are faulty. The first is that economically viable scheduled service in competition with the foreign carriers could be supported on full fare traffic alone. The plain fact is it could not.

The second faulty premise is that anybody traveling on scheduled services at discounted promotional fares does not need, desire, or benefit from scheduled service, and hence should not be included in the base level of traffic for determining an "essential" level.

This is like saying that anybody who buys a refrigerator in a discount house didn't really need that refrigerator, or else he would have avoided the discount.

This concept of disenfranchising the low fare passenger from scheduled service ignores the fact that our scheduled system has developed over decades -- long
before supplementals were significantly in the picture -- with a very strong promotional drive to encourage personal and pleasure travel. This was done in recognition that business travel alone did not contain the potential growth to support the advancing technology of air transport.

Even the first family of jets -- which now seem almost small by present standards, but which seemed very large indeed by the standards of 1959 -- could not have been supported if the marketing base of this industry had been confined just to passengers traveling for business reasons.

The scheduled carriers recognized long ago that the best service for the total public -- business and non-business traveler alike -- depended upon promoting growth in both sectors, and serving both jointly with a type of equipment and a type of service that neither could support in isolation.

So, for decades past, one of the prime goals of the transatlantic scheduled industry has been to aggressively promote the growth of pleasure travel through all forms of marketing, including particularly promotional pricing.

By 1966 -- a time when the supplementals were still just a minor factor -- the scheduled industry had already developed the personal and pleasure market to the point where it accounted for three-fourths of total transatlantic travel.
The Cherington proposal would now ignore the fact that low cost travel has for years been built right into the whole structure of the scheduled air transport system. Ignoring this fact, it would attempt to define the future essential level of scheduled service on the basis of just one part of the market now using scheduled service. And thus it leads to such unreal results as a New York - Paris pattern for TWA of one 747 flight every four days.

It is very difficult to see how such a proposal could possibly benefit the general public, or that part of the public that is interested in low fare service.

Before closing, I should like to anticipate two questions that might be raised by this discussion.

First, since my data on frequencies related to the non-peak season, a question may arise as to whether our summer peak season frequencies alter the picture markedly.

In the summer, we do operate seasonal increments to our capacity. But they do not alter the picture fundamentally. A major part of our summer overlay brings direct service -- or a rounding out to daily direct service -- to secondary markets where winter traffic levels have not thus far been able to support such service. Thus, we have in the summer added direct service in markets like Detroit - London, San Francisco - London, Washington - Paris, and Philadelphia - London.
Significantly, even in the summer, there are only three routes on our transatlantic system where we operate more than one daily frequency. (Chart 4)

The second question I'd like to anticipate relates to the 747. Is it possible that we could reduce capacity, without dropping out of markets, by just replacing 747s with 707s?

On paper, yes; in the real world marketplace, NO. Certainly there are many days and many flights on which we could wish the B-747 were a smaller plane. But that wish cannot alter the fact that the wide bodied comfort features of the 747 have become the new competitive standard for all major transatlantic routes.

TWA has not been overly aggressive in assigning 747s to our Atlantic routes. Indeed, as shown on Chart 5, there is presently only one route where we operate a 747 and where our foreign flag competitor does not. But there are actually many routes where we have not upgraded to a 747 and where our foreign competitor has.

So here again, we cannot find in this area a means of safely reducing our capacity, while remaining adequately competitive.

So I come back to the point I made earlier. Of course there is a minimum essential level of U.S. flag service in international operations. But it most assuredly is not just a small fraction of what we are now operating. It is at least as large as the base we now have, if not larger.
Recognition of this basic fact is essential to the formulation of a sound policy of charter regulation as this impacts upon the maintenance of a healthy, viable, competitive network of scheduled U.S. flag air service.
## Chart 1

**TWA Transatlantic Pattern**

**Average Day, Winter 1971/72**

<table>
<thead>
<tr>
<th>Route</th>
<th>Nonstop Daily Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>New York–London</td>
<td>3</td>
</tr>
<tr>
<td>New York–Frankfurt</td>
<td>1</td>
</tr>
<tr>
<td>New York–Paris</td>
<td>1</td>
</tr>
<tr>
<td>New York–Geneva</td>
<td>1</td>
</tr>
<tr>
<td>New York–Milan</td>
<td>1</td>
</tr>
<tr>
<td>New York–Lisbon</td>
<td>1</td>
</tr>
<tr>
<td>New York–Madrid</td>
<td>1</td>
</tr>
<tr>
<td>New York–Rome</td>
<td>1</td>
</tr>
<tr>
<td>Boston–London</td>
<td>1</td>
</tr>
<tr>
<td>Boston–Paris</td>
<td>1</td>
</tr>
<tr>
<td>Chicago–London</td>
<td>1</td>
</tr>
<tr>
<td>Los Angeles–London</td>
<td>1</td>
</tr>
</tbody>
</table>

**Total** 14

*Note: Excludes three segments which had only one flight per week.*
CHART 2

TWA TRANSATLANTIC PATTERN COMPARED WITH ALLEGHENY

NEW YORK - PITTSBURGH PATTERN

AVERAGE DAY, WINTER 1971/72

<table>
<thead>
<tr>
<th>TWA Transatlantic Nonstop Pattern</th>
<th>Allegheny New York-Pittsburgh Nonstop Pattern</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flight 702 New York-London</td>
<td>Flight 905 Newark-Pittsburgh</td>
</tr>
<tr>
<td>Flight 700 New York-London</td>
<td>Flight 841 LaGuardia-Pittsburgh</td>
</tr>
<tr>
<td>Flight 708 New York-London</td>
<td>Flight 909 Newark-Pittsburgh</td>
</tr>
<tr>
<td>Flight 740 New York-Frankfurt</td>
<td>Flight 863 LaGuardia-Pittsburgh</td>
</tr>
<tr>
<td>Flight 800 New York-Paris</td>
<td>Flight 857 LaGuardia-Pittsburgh</td>
</tr>
<tr>
<td>Flight 832 New York-Geneva</td>
<td>Flight 859 LaGuardia-Pittsburgh</td>
</tr>
<tr>
<td>Flight 842 New York-Milan</td>
<td>Flight 847 LaGuardia-Pittsburgh</td>
</tr>
<tr>
<td>Flight 900 New York-Lisbon</td>
<td>Flight 849 LaGuardia-Pittsburgh</td>
</tr>
<tr>
<td>Flight 904 New York-Madrid</td>
<td>Flight 771 Newark-Pittsburgh</td>
</tr>
<tr>
<td>Flight 840 New York-Rome</td>
<td>Flight 901 Newark-Pittsburgh</td>
</tr>
<tr>
<td>Flight 754 Boston-London</td>
<td>Flight 839 LaGuardia-Pittsburgh</td>
</tr>
<tr>
<td>Flight 810 Boston-Paris</td>
<td></td>
</tr>
<tr>
<td>Flight 770 Chicago-London</td>
<td></td>
</tr>
<tr>
<td>Flight 760 Los Angeles-London</td>
<td></td>
</tr>
</tbody>
</table>

Total: 14 Daily Departures          Total: 11 Daily Departures
## Chart 3

**TWA Transatlantic Pattern Compared with Foreign Flag National Carrier**

**Winter 1971/72**

<table>
<thead>
<tr>
<th>Route</th>
<th>Daily Nonstop Frequencies</th>
<th>Carrier With Leading Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>TWA</td>
<td>Foreign Flag</td>
</tr>
<tr>
<td>New York-Shannon</td>
<td>*</td>
<td>1</td>
</tr>
<tr>
<td>New York-London</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>New York-Frankfurt</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>New York-Paris</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>New York-Geneva</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>New York-Zurich</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>New York-Milan</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>New York-Lisbon</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>New York-Madrid</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>New York-Athens</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>New York-Tel Aviv</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Boston-Azores</td>
<td>*</td>
<td>*</td>
</tr>
<tr>
<td>Boston-Shannon</td>
<td>-</td>
<td>*</td>
</tr>
<tr>
<td>Boston-London</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Boston-Frankfurt</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Boston-Paris</td>
<td>1</td>
<td>*</td>
</tr>
<tr>
<td>Boston-Zurich</td>
<td>-</td>
<td>*</td>
</tr>
<tr>
<td>Boston-Milan</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Boston-Rome</td>
<td>-</td>
<td>*</td>
</tr>
<tr>
<td>Philadelphia-London</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Washington-London</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Chicago-London</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Chicago-Frankfurt</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Chicago-Milan</td>
<td>-</td>
<td>1</td>
</tr>
<tr>
<td>Los Angeles-London</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Los Angeles-Paris</td>
<td>-</td>
<td>*</td>
</tr>
</tbody>
</table>

* Less than four trips per week.
# TWA Transatlantic Pattern

**Average Day - Summer 1972**

<table>
<thead>
<tr>
<th>Route</th>
<th>Nonstop Daily Frequency</th>
</tr>
</thead>
<tbody>
<tr>
<td>New York-Shannon</td>
<td>1</td>
</tr>
<tr>
<td>New York-London</td>
<td>4</td>
</tr>
<tr>
<td>New York-Frankfurt</td>
<td>1</td>
</tr>
<tr>
<td>New York-Paris</td>
<td>2</td>
</tr>
<tr>
<td>New York-Geneva</td>
<td>1</td>
</tr>
<tr>
<td>New York-Zurich</td>
<td>1</td>
</tr>
<tr>
<td>New York-Milan</td>
<td>1</td>
</tr>
<tr>
<td>New York-Lisbon</td>
<td>1</td>
</tr>
<tr>
<td>New York-Madrid</td>
<td>1</td>
</tr>
<tr>
<td>New York-Rome</td>
<td>2</td>
</tr>
<tr>
<td>New York-Athens</td>
<td>1</td>
</tr>
<tr>
<td>Boston-London</td>
<td>1</td>
</tr>
<tr>
<td>Boston-Paris</td>
<td>1</td>
</tr>
<tr>
<td>Philadelphia-London</td>
<td>1</td>
</tr>
<tr>
<td>Washington-Paris</td>
<td>1</td>
</tr>
<tr>
<td>Chicago-London</td>
<td>1</td>
</tr>
<tr>
<td>Detroit-London</td>
<td>1</td>
</tr>
<tr>
<td>Los Angeles-London</td>
<td>1</td>
</tr>
</tbody>
</table>

**Total**: 23

**Note**: Excludes three segments which had less than four flights per week.
CHART 5
TWA VERSUS FOREIGN FLAG COMPETITION
IN B-747 SERVICE, SUMMER 1972

Routes Where TWA and Foreign Competitor Both Operate 747

New York-Frankfurt New York-Rome
New York-Paris    Chicago-London
New York-Lisbon

Route Where TWA Operates 747, but Not Foreign Competitor
Los Angeles-London

Routes Where Foreign Competitor Operates 747, but Not TWA

New York-Shannon   Boston-London
New York-Geneva    Boston-Milan
New York-Zurich    Boston-Rome
New York-Milan     Chicago-Frankfurt
New York-Tel Aviv  Los Angeles-Paris
Boston-Shannon


INTERNATIONAL AIR TRANSPORT AND FEDERAL POLICY

I am pleased to be a part of this afternoon's seminar on International Air Transport and Federal Policy. I see from the program that you will be hearing not only from the Executive Branch of the Federal Government but also from the Civil Aeronautics Board and from the U.S. side of the industry.

International air transportation is somewhat unique from a policy standpoint. A Statement of International Air Transportation Policy was approved by the President in 1970, replacing an earlier statement of several years prior vintage. This new Policy Statement is taken by the Executive Branch and other parts of the Federal Government as establishing policy guideposts for future U.S. participation in the international air transportation industry.
For our purposes this afternoon I think it would be useful to use the 1970 Policy Statement as the backdrop for my remarks. Given the two years since the Policy Statement was approved, it's appropriate to take a look at what has happened in the intervening years, whether the policy has been effectively implemented, and whether there are particular problems or developments which should now be taken into account. My staff in the Department of Transportation recently completed a preliminary review of the implementation of the Policy Statement during the last two years, and I have included this in the materials I have distributed today. You may find it a useful context for my remarks and a possible basis for your questions.

The 1970 Policy Statement covered a number of policy issues. I do not intend to touch on each of them in my opening remarks this afternoon, although I will be happy to try to respond to questions on any aspect of the Policy Statement.

Rather, I would like to concentrate this afternoon on the 4 or 5 issues that I think are of greatest current concern, and which may serve as the best focus for discussion during the next hour or so.

I. A policy issue of the highest priority for the Federal Government at this time is the question of aircraft hijackings, both domestic and international. In 1970, the Policy Statement noted that the purposes of the Policy Statement overall could not be realized until aircraft hijackings are stopped. It went on to say that by any standard air piracy is reprehensible, and that we support measures designed to end this terrible practice. It may be useful for you to have a tabular description of the pattern of international conventions which have been negotiated to deal with the threat of aircraft hijacking. I have had such a table prepared and it is included in the papers I have distributed. We are now actively seeking to add to this group of conventions further international agreement on sanctions to be applied to a nation that refuses to extradite or prosecute a hijacker, or otherwise flouts internationally standards of conduct.

President Nixon has assigned to the Secretary of Transportation the responsibility to coordinate the Government's overall program in this area, and to the Department of State the responsibility for coordinating the international aspects of it. Pursuing these responsibilities, Secretary Volpe proposed to the ICAO Council in December of 1971 that agreement be reached to apply a boycott to nations that refuse to extradite or prosecute a hijacker. Although the ICAO Council at that time adopted the proposed resolution, progress has not been satisfactory within ICAO, and the United States has called a meeting of the concerned nations in September of this year to make another strong effort to accomplish international agreement in this important area.
II. The relationship of scheduled services and charter services.

Perhaps the most contentious feature of the 1970 Policy Statement was its treatment of the competitive relationship between charter services and scheduled services. In the years preceding the 1970 Statement of Policy, charter services had begun to become an important feature of the international air transport market, largely brought on by the competitive pressures of the supplemental carriers who had been granted certificates by the CAB to engage solely in charter operations. It had always been true, you should understand, that scheduled operators were free to engage in charter operations both on the routes where they operate scheduled services and to some extent even off those routes. But these charter rights of the scheduled operators had not been exercised to any substantial degree until the supplemental carriers - charter specialists - began to aggressively develop the market for this type of air transportation.

A moment ago, I characterized this section of the Policy Statement as the "most contentious." This was because it was taken wholly accurately, to be an endorsement of charter services. And there is clear language in the Policy Statement which finds value in charter services - whether those charter services are operated by scheduled operators or by supplemental carriers or other charter specialists.

As the Policy Statement puts it "charter services by scheduled and supplemental carriers have been useful in holding down fare and rate levels and expanding passenger and cargo markets. They offer opportunities to exploit the inherent efficiency of planeload movement in the elasticity of demand for international air transport. They can provide low cost transportation of the sort fitted to the needs of the significant portion of the traveling public. Charter services are a most valuable component of the international air transportation system, and they should be encouraged."

This is not to say that there was not an even stronger endorsement of scheduled services in the Policy Statement. What was significant about the 1970 Policy Statement was that it gave as much recognition to charter services as it did, for this marked a departure from the prior policy statement that had been adopted under the Kennedy Administration. As far as scheduled services were concerned, the Policy Statement had quite a bit to say: "scheduled services are of vital importance to air transportation and offer services to the public which are not provided by charter services. Only scheduled services are expected to offer regular and dependably frequent schedules, and provide extensive
flexibility in length of stay, and maintain worldwide routes, including routes to areas of low traffic volume. Substantial impairment of scheduled services could result in travelers and shippers losing the ability to obtain these benefits."

Given this recognition that both types of services had value to the traveling public, the Policy Statement concluded that each type of service should receive appropriate government protection if the service was threatened with substantial impairment.

Another aspect of this part of the Policy Statement deserves note. It was quite explicit in the constraint that should be put upon government interference with the use and growth of charter services. As the Statement put it: "The widespread public acceptance of charters warrants care in taking any restrictive actions. A determination whether to impose restrictions upon charter services should consider principally the extent to which the ability to obtain frequent and regular travel would otherwise be prejudiced. If it is necessary to restrict charter services (because of their impact on scheduled services), the restrictions should be the minimum necessary to have the required effect."

I would not be overstating the case to say that the relationship between scheduled and charter services continues to be one of the key, if not the dominant competitive question in international air transportation today, certainly across the North Atlantic, and in other markets as well.

Before discussing these issues, it might be useful to do so in the context of some statistics which show how these markets have grown. A table which I have included in the materials that I have distributed traces the growth of the charter and scheduled markets from the years 1968 through 1971, and shows to what extent the charter growth is attributable to supplementals and to other charter operators whether they be IATA members or foreign charter specialists.

Let me say a word about this chart. It would be wrong to think that all of the so-called bulk transportation market travels on charter services. For some years now, the scheduled carriers have offered fares that are aimed at attracting groups of scheduled passengers, often at rates which are directly competitive with charter rates. Consequently a substantial part of the traffic on scheduled services as shown on this chart includes the kinds of passengers who would also be interested in flying on a charter flight, and indeed might well be flying on a charter flight but for the competitive aspects of the service and price offered by scheduled operators. Naturally, the converse is true: many charter passengers might well prefer scheduled service, given
an equivalently low price. And the Policy Statement recognizes these relationships, and states that: "Both scheduled carriers and supplemental carriers should be permitted a fair opportunity to compete in the bulk transportation market."

There is something striking about the growth of the charter markets. Notwithstanding the impressive upward slant over the past several years, it has taken place in the face of a tremendous variety of governmental restrictions, all designed to keep this growth under check.

We have recently had occasion in the Department to make a summary of the different ways that we and other governments have chosen to restrict the use of charter travel, and I have included that tabulation in your materials as well. They vary from outright prohibition on charter flights to explicit numerical quotas on the number of charter flights that may be operated into a country (generally these prohibitions and limitations are addressed at the charter specialist. As I indicated earlier, on-route charter operations by scheduled operators are generally allowed without restriction by governments). Other restrictions have to do with the quality of service that you can offer, or the number of stops you must make, or the price that you must charge, or the relationship between the passengers that must exist before they can travel as a group.

The differences between these existing restrictions, many of which predated the 1970 Policy Statement, and the teachings of that Policy Statement, are rather clear. That Policy Statement puts at issue the continuation of any such restrictions unless they can be justified and shown to be necessary to protect or preserve the convenience that only regular scheduled service can provide. Yet I am frank to say that virtually none of these restrictions have ever been justified in these terms, and indeed I would venture to predict that not many of them would survive such an exercise.

Since 1970, there have been a number of moves within the Federal Government to implement the teachings of this part of the Statement. On the international diplomatic front, the State Department has taken the fruits of an interagency drafting effort and attempted to interest countries in negotiation of bilateral charter agreements, agreements that would provide for the regular operation of charter services.
On another front, efforts have been made to identify what it is about the operation of scheduled services that is entitled to governmental protection, or that would serve as the justification for the restrictions on charter services that are now maintained by so many governments. This is the effort to identify what aspects of scheduled services, or what level of scheduled operations, should be protected from substantial impairment, consistent with the public interest, within the meaning of the President's Statement of Policy.

Our progress in this front has not been encouraging. The Department has proposed on several occasions to the Civil Aeronautics Board that an investigation be instituted that would address this issue, and upon which appropriate regulations might be based to apply whatever justifiable restrictions on charter services were found to be warranted. The Board has not instituted any such investigation. Indeed, before Congress recently, the General Counsel of the Board testified that he thought that such an investigation would be fruitless. I am not sure I fully understand that testimony. If he was suggesting that there is no way to identify what it is about scheduled service that the government should protect, I don't understand how we can justify any restrictions on charter services, at least in a priori sense. If the Board is saying that damage to scheduled service can only be measured on an ex post facto basis, then restrictions should be lifted until their reimposition is justified. Or experiments should be tried, where their impact could be measured.

As we see it, all restrictions on charter travel are tools to be applied to achieve an objective. Unfortunately, it's easy to become fascinated by the manipulating and sharpening of the tools. We believe we should first concentrate on exactly what it is we want to achieve, and then select the tools to do the job. Relevant to this issue, we do have the view of the Board on the issue of substantial impairment, at least as far as prior years are concerned. In the recently released decision of the Board concerning renewal of transatlantic supplemental certificates, the Board found that there was no substantial impairment of scheduled services for the years up to and through 1970. This conclusion of the Board appeared to be based upon findings that there had been no diversion of traffic or revenue from scheduled services, notwithstanding the strenuous arguments of the scheduled airlines in that case that substantial impairment had indeed taken place.

Apart from CAB proceedings, the Executive Branch is currently engaged in discussions with European countries in an effort to identify on a statistical basis what level of scheduled operations does represent the minimal desired level of scheduled service in the public interest,
and the relationship of various charter concepts and rules to such a minimal level. If this level can be identified and agreed upon, we believe it will serve as a benchmark for the application of appropriate restrictions on charter operations to the extent that those charter operations appear to threaten the maintenance of that level of scheduled operations.

Should this benchmark be identifiable, we would expect it to be of value in conjunction with the negotiation of bilateral agreements concerning charter operations. Indeed, it is my view that the identification of such a benchmark would facilitate negotiation of such charter agreements, because both sides would be able to understand that amount of characteristics of scheduled service they are concerned about protecting from substantial impairment.

I should mention another aspect of the regulatory scene which bears on all that I have said. Both on this side of the Atlantic and the other, there is a gradually awakening disaffection with the concept of affinity charter regulations. That is, requiring that the people traveling in a charter group bear some pre-existing relationship or affinity to one another, by reasons of their common membership in some group that was formed for purposes other than qualifying for air travel. This concept has proven very difficult to enforce, and to the extent it was developed to constrain charter travel, it obviously has not worked very well. Consequently our Civil Aeronautics Board has proposed and is now considering another way of regulating charter travel, which would not apply the affinity concept, but instead would apply certain restrictions to the charter traveler in terms of how long before the flight the ticket must be purchased, how much of a down payment must be made, how much of the down payment is forfeited if the traveler decides not to go on that flight, etc.

In Canada and Europe, too, there is disaffection with the affinity concept and a desire to move to some excursion travel charter regulation which also would deal with the advance purchase and down payment features and other elements of the trip. Other countries share our view that the affinity concept is inherently discriminatory, and unjustifiably denies to many the benefits of low-cost charter travel.

I think it's fair to say that our objective is that a non-discriminatory charter concept be developed which is open to widespread use. To the extent this concept becomes a substitute for the affinity rules, our regulations and the European regulations should be harmonious. I would
also say that in terms of our Policy Statement, the restrictions on the use of this type of charter - that is the advance purchase requirement, and the amount of the down payment, and other requirements all should be tailored in the light of whatever protection of scheduled service it is felt is necessary to be accomplished by such restrictions. Thus, these conversations that we're having with the European governments may have an additional potential application. They may serve as a basis upon which both the Europeans and ourselves can structure new charter regulations as to avoid undesirable impacts on scheduled service and yet allow the greatest feasible use of the new charter authority for the benefit of the traveling public.

Before leaving the question of charter and scheduled competition, let me say a word about a current problem which the members of IATA have before them now. This is the proposal that would allow scheduled carriers to fill their unused capacity with small groups of charter passengers. This is a proposal that has been made by Pan Am and by perhaps some other scheduled operators, and is the subject of an IATA meeting that has been ongoing in Europe for some time. We've been besieged with views pro and con about this proposal. From the scheduled carriers we've heard that it's a desperately needed financial boost to their revenue position, and makes economic sense because the space on their scheduled flights that is involved would otherwise be unused. From the charter specialists, the supplementals, we've heard that this type of charter operation by scheduled operators would have a disastrous impact on charter specialists because it would siphon away from planeload charter operations many groups of charter travelers that would otherwise be grouped in planeload lots by charter organizers. From the standpoint of the traveler, which we like to make our principal focus, the proposal can be defended. It does make available to the charter traveler the facilities and the quality of the service provided by scheduled operators, and so long as the fare is commensurately low, it appears to offer an advantage. But we have not been able to sort out the effect of the use of this device on the competition between the scheduled and charter operators. There is much to be said for letting the market work its will, but the supplementals contend quite vigorously that this is an unfair competitive device. Once used to put the supplementals out of business, they argue, the scheduled operators' interest in charter operations will cease, all to the eventual disadvantage of the traveling public. The Policy Statement does warn us that the government should not allow enjoyment of the right to perform both scheduled service and charter
service to result a decisive competitive advantages for scheduled carriers. Therefore we have to consider whether this would be a decisive competitive advantage, and we do not yet have the facts at hand that would give us the conclusive answers to these questions. We understand that the Board has told the scheduled carriers that any such fare in their new fare package would lead the Board to institute a thorough investigation of the pros and cons, and we tend to agree that the issues raised by such a proposal would warrant a thorough factual investigation.

III. Capacity problems. As the Policy Statement makes clear, our basic policy position is consistent with that which the U.S. maintained for many years. That is, there should be no pre-existing capacity constraints upon the capacity offered by ourselves or foreign airlines operating scheduled services to or from the U.S., and that any difficulties that may arise with respect to excess capacity in the market should be resolved on an ex post facto basis. This principle can be said to be the keystone of the so-called Bermuda principles, and indeed distinguishes the bilateral airline relationships that we have with other countries from that which most foreign countries have amongst themselves. The practice abroad is very much predeterminism, with each country agreeing or arranging with others in advance as to the amount of airline capacity to be operated in particular market pairs.

Over the years the pressures on us from other countries to erode the Bermuda capacity principles have been continuous, and these pressures are as strong today as perhaps they ever have been. Perhaps in response to these pressures, the Policy Statement states, forthrightly, that "attempts to restrict U.S. carrier operations abroad should be vigorously opposed, and where required, the United States should take appropriate measures against the carriers of foreign countries restricting U.S. carrier operations." Consistent with this mandate, we have recently armed ourselves with a regulatory weapon to resist foreign restrictionism. After a number of years of debate as to the form of the appropriate regulation, the CAB has adopted Part 213 of its economic regulations which enables the Board to react to foreign restrictions by requiring that the foreign carrier file its own schedule of operations with the Board, subject to disapproval by the Board, which itself is subject to Presidential review and veto. A similar regulation has been proposed which would apply to restrictions of charter operations. I am pleased to say that this retaliatory authority is not a paper tiger. Some time ago, the Board exercised it in the case of Australia. More recently, the British Government's restriction of National Airlines' frequencies from Miami to London has led the CAB to call for the filing of BOAC's schedules under Part 213. The end of this particular story is not yet written, and perhaps Charlie Butler will want to comment upon it when he speaks to you later today.
The potential measures that this country might consider to further protect the Bermuda principles are worth some thought. Certainly, in a period of general excess capacity, the Department of Transportation would be interested in carrier proposals to agree upon some reduction of operating capacity. This is a principle which has already been found beneficial when applied to our domestic transcontinental operations, as well as operations from New York to Puerto Rico. Given adequate economic justification for such arrangements, we would be interested in at least examining a proposal for some comparable arrangement concerning international routes.

Another practice which has been found to be a useful adjunct to the maintenance of Bermuda principles, is called pre-screening. This involves the review by the United States Government of schedule changes by various American airlines, before the change is put into effect, to consider whether the changes might be the subject of some foreign protest on the ground of excessive capacity increase. Historically, the government has resisted putting itself in this posture with respect to our own airlines, but I think it's clear that on some occasions our own airlines have proposed capacity increases which cannot be defended in terms of economic projections, and which have led to unfortunate strains on the maintenance of our Bermuda principles. I wholly agree that management discretion should control, at least in the first instance, with respect to the type and quantity of service that is provided in a market. On the other hand, economic opportunity should carry with it certain responsibility, and when a carrier appears to disregard such responsibility, it's appropriate for the government to think of ways to encourage the exercise of it.

IV. Rate regulation. The President's Policy Statement generally calls for a continuation of our acceptance of IATA as the machinery for pricing scheduled services, and also recommends vesting the U.S. Government and the Board with authority to regulate rates and fares between the United States and foreign points, subject to executive review. Within the present Congress, such authority was granted to the CAB, and I have included a print of that public law in the papers which I have distributed. During the discussions before the Congress on the shape of this new legislative authority, Department of Transportation urged on behalf of the Administration that the Board's regulatory standards be constrained, narrowly defined, and cost-related. Congress agreed that the Board's powers be constrained, and specified that the Board could suspend and disapprove international rates, but not fix them. With respect to the regulatory standards, however, the Congress
rejected our approach, and chose instead to incorporate the Board's domestic regulatory standards, and also the principles that are found in standard bilateral agreements. Consequently, I believe it will be a considerable time before we see a pattern of the Board's regulatory rationale under this law, largely because the exercise of the power should be relatively rare.

We have on a number of occasions urged that air fares be related to costs. This was the thrust of the Department's testimony before the Board in the General Passenger Fare Investigation. It was also the basis of the Department's analysis last year of certain fares proposed by Lufthansa; that analysis was given to the Congress as part of my testimony on the air fare bill. And our interest in cost-related rates is not confined to air fares. It has served as one major rationale for the Administration's proposals to the Congress to amend the Interstate Commerce Act concerning the regulation of domestic surface transportation. A major unresolved issue concerning air fares that faces the international airline industry and governments today is the extent to which fares should be required to have a particular relationship to cost.

In the charter market, for example, fares are now set entirely by market competition; there is no existing industry group like IATA to set the fares, and there is no widespread governmental control of charter fares. One issue which we are considering now is whether there is a need for a cost floor under charter rates. The continuing increase of charter operations across the North Atlantic may be creating sufficient competitive pressures to drive the level of the rates below an economically sensible level. Given our general concern that transportation rates should not be allowed to be pushed by competitive or other forces below and appropriate cost level, we are giving some thought to identifying the current relationship between charter rates and costs, and considering ways in which an appropriate cost floor might be identified and applied to the level of charter prices. From the travelers' standpoint, this might prevent charter rates from sinking as low as the travelers might prefer. But we have never thought that the long-term interest of the traveler would be served by below-cost carrier operations. I might add that I do not view what I have just said as inconsistent with that part of the Policy Statement that states that "continued
support should ... be given to the establishment of IATA and non-IATA charter rates on a free competitive basis." I have not suggested that charter rates be fixed; only kept from sinking to undesirable levels.

V. In conclusion, let me summarize my impression of the implementation of aspects of the President's Statement on International Air Transportation Policy over the last two years.

In certain areas, where the Policy Statement took a new posture, there has been impressive implementation. I think particularly of the call in the Statement for additional CAB authority to regulate international air fares - that law has been passed and signed by the President. I think also of the call to this Government to react vigorously to foreign efforts to restrict our air carrier operations. And with respect to the adoption and application of Part 213 of the Board's regulations, as well as proposed action with respect to the service of Irish airlines to New York, this Government has shown that it is prepared to back that policy thrust.

With respect to other major elements of the 1970 Policy Statement, the record of implementation is not as bright. The Policy Statement urged us to vigorously seek intergovernmental agreements covering the operation of charter services. Without passing on the vigor of this effort, no such agreements have yet been reached. (But we are pressing forward, and such agreements may be reached soon.) The Policy Statement commanded us to prevent the substantial impairment of scheduled services and charter services. While I am prepared to agree that this impairment has not taken place in the last two years, we have not yet fully identified the criteria of such impairment, so that we will be able not only to recognize it after its taken place but also prevent its occurrence if it appears to be threatened. (Our talks with the ECAC countries may shed some light in this area.) And I am afraid to say that the injunctions in the Policy Statement concerning improvements in the structure of IATA fares have not yet borne immense fruit. (But the new law under which the CAB can regulate international fares may lead to such improvements).

So we have made substantial progress in the implementation of the 1970 Policy Statement. And we have more yet to do.

I would hope that all of you will consider it a responsibility to follow the course of this implementation, and let us know how you think it is progressing - particularly when you think it is not progressing fast or far enough.
Remarks of James E. Landry and Gabriel Phillips
Before the MIT/NASA Aviation Workshop
Waterville Valley, New Hampshire
Friday, July 21, 1972

United States International Air Transportation Policy --
The Promise and The Reality

(Landry) Ladies and gentlemen, I believe the program has already succeeded
in introducing the two of us to you and, for that reason, we can no doubt
dispense with the formalities of telling you who we are. Perhaps it would
be useful to explain briefly why we are here participating in this Workshop
and most particularly, on today's agenda. Clearly everyone on this after-
noon's program was brought here to discuss a single subject -- this country's
international air transportation policy. And obviously, the gentlemen who
spoke here this morning have in the past been most instrumental in formu-
lating the policy now in effect.

In short, you have heard today from those who by authorship or
assignment have a measure of allegiance to our government's international
air transport policy. We have come here as two representatives of the
scheduled airline industry whose work over the past several years has
entailed living with, or perhaps more accurately -- coping with that policy.
We are not here with an official statement of industry position on the subject,
although to be sure much of what we will say is consistent with publicly
espoused views of the scheduled airlines. We want to discuss some of the
things which from our experience we consider to be wrong about that policy. And, we would like to take advantage of the unique opportunity which this forum provides to raise some questions concerning a few of the sacred cows of U.S. international aviation policy down through the years. I hasten to say that we have not crept among you as iconoclasts in establishment clothing -- but an idyllic setting such as this and our placement on the program suggest that we have one last clear chance to catalyze thought toward resolution of what has seemed irresolvable.

The major departure in this Policy Statement from its predecessor is in its discussion of the relationship between scheduled and charter services. The previous statement, reflecting the absence of charter services as a significant element in international air transportation, made no mention of the proper role of such services. The new statement, in sharp contrast, carved out a whole new role for charter services and a new fertile field for controversy in international aviation relations. It was no doubt predestined to be controversial. First of all, it is a subject matter never before dealt with in any international policy statement. Secondly, it is a subject matter which was debated long and strenuously in the halls of Congress by representatives of the scheduled and supplemental carriers. Thirdly, it is a subject matter on which the representatives of the various agencies involved in the policy review held differing
and in some cases deep convictions. The product was of course a compromise or, as some critics have termed it, a waffle -- a waffle that says all things to all people. The end result is a shambles.

The pious and naive hopes of its drafters have produced a situation where international travel, particularly across the North Atlantic, has continued to expand rapidly. But, the expansion has not been a healthy one. Charter operators are going broke; scheduled operators are losing money and the legal regime which governs operations is more chaotic than ever.

I will address the capacity aspects of the charter policy, and Mr. Phillips will speak to the other competitive aspects -- entry and rates. Needless to say, in the real world they are all interrelated, although government administration mistakenly deals with them as separate items.

In discussing capacity, I would like to pinpoint one sentence from the charter section of the Policy Statement and the extraordinary proposals which have been built upon it. The sentence I refer to states "In any instances where a substantial impairment of scheduled services appears likely, it would be appropriate, where necessary to avoid prejudice to the public interest, to take steps to prevent such impairment." Mr. Binder has suggested that this constitutes a mandate upon the government to determine the level of scheduled service which is entitled to government protection. To arrive at this essential level of scheduled service, Bob
further suggested that the standard might take as its base the number of travelers using scheduled service at normal fares in a given base year, plus some proportion of the number of downward diverted discount fare passengers. More recently, Dr. Cherington built upon the proposal by Mr. Binder by suggesting that a route-by-route tabulation of the minimum scheduled service required was not a workable approach and proposed that a generalized rather than a detailed yardstick be utilized, such as setting as the minimum requirement the availability to individually-ticketed passengers of a number of seats equal to 160 per cent of the individually-ticketed passengers in the preceding year, handled by all scheduled carriers plus an allowance for growth of 10 per cent. The base number of passengers would exclude GIT and other low fare excursion passengers handled on scheduled aircraft.

Dr. Cherington added that further refinements might include some allowance for seasonality on the route. When constructive load factors for all carriers on a route drop below 50 or 55 per cent as related to the base requirements, Paul suggests that the Civil Aeronautics Board could unilaterally cut back on permitted charter flights by U.S. supplementals affecting that route and if the reciprocal country did not take similar action with respect to its charters, the Board could, perhaps after consultation, also curb foreign flag charters. Lastly, Paul suggested that,
if during a period of one or two years of study of the minimal scheduled capacity requirements, it appeared necessary to provide a greater measure of protection for scheduled service, the minimum standards could be tightened accordingly. And, as the frosting on the cake, Paul argued that uncontrolled carriage of GIT or low excursion fare passengers on scheduled flights might be used by the scheduled carriers to drive charter operations of any type from the market except in the peak season and the Board should therefore have the authority to limit or curtail the amount of capacity offered to low fare passengers on scheduled flights.

Let me tell you why we feel these proposals are dead wrong, both as a matter of law and as a matter of policy. Congress in 1938, after several years of strenuous debate and careful deliberation, enacted the Civil Aeronautics Act -- providing a statutory framework for the sound development of a national air transportation system built upon the concept of regulated competition. Down through the years, Congress cautiously reviewed and updated that Act on many occasions. But throughout the process, Congress prudently maintained a regulatory philosophy which embodied these basic principles: first, competition to the extent necessary in the public interest, secondly, controlled entry, and thirdly, no government regulation of scheduled frequency.

Yet, when the Administration issued its Policy Statement in June of 1970, it promoted a new and ambiguous standard for regulating competition in the public interest as it construed that philosophy, namely,
"substantial impairment." The Administration borrowed this concept from the capacity provisions of scheduled service bilateral agreements, which guard against an undue effect upon a competing carrier. I do want to say, parenthetically, a few words about Bob Binder's discussion earlier today of the letter exchange between the President and the Civil Aeronautics Board concerning the recent Transatlantic Supplemental Renewal Case decision. He suggested that it was improper for the Board to attempt to cut down the number of entrants from six to five without a finding of substantial impairment. I would suggest that the Board was looking to the consideration that there should be "competition to the extent necessary...," a key element of Section 102 -- the cornerstone provision of the Act. In other words, without presuming to declare who was right and who was wrong in the decision, it seems to me that the Board was attempting to follow the law, perhaps not necessarily the Policy Statement.

In proposing a determination of the minimum level of scheduled service required, Mr. Binder and Dr. Cherington were suggesting that the rest of our air transportation needs could be taken care of by obligation-free, hit-and-miss, so-called "bulk air transportation" operations. The irony is that the clear Congressional intent was to build an air transportation system upon a firm foundation of scheduled service, and supplement it with such charter operations as required. Implicit in the Congressional purpose was a mandate to the Civil Aeronautics Board to assess the maximum
need for supplemental service, not the minimal need for scheduled service. Indeed, the Congress very purposefully forbade the Board from controlling the frequencies of a scheduled airline, or its selection of equipment. However, in order to insure that supplemental air transportation remained just that, the Congress specifically empowered the Board to exercise those controls over the supplemental airlines. Not only has the government never implemented this power, but the Cherington and Binder proposals would move in the opposite direction.

Again if I may digress for a moment, I was interested in the comment of one of your gentlemen a few minutes ago suggesting an analogy between the establishment of a minimum level of scheduled service and the Board’s stand on the specific level of service required to small communities. It seems to me that what Congress did was ordain for the latter area substantial governmental intrusion into the areas of managerial prerogative which are so fundamental to our free enterprise system. Congress did this because of the federal subsidy supporting this service. The rationale was that Congress should control, through its arm -- the Civil Aeronautics Board, the expenditure of public funds. There is no federal subsidy involved in the trunkline service for which the Department of Transportation seeks to find a minimum essential level, and that is a critical distinction.
Now if I may go back to the basic train of our presentation.

I have talked up to this point about what the law presently provides. But obviously, and I am sure Bob Binder would be among the first to point this out, the law will not serve society if it will not change to accommodate society's changing needs. Let us examine then whether the law should be changed as a matter of policy. As I mentioned, Bob first proposed in somewhat vague terms that some proportion of the number of discount fare passengers carried on scheduled service be included in the essential service base. Dr. Cherington, testifying on behalf of the supplementals in a Congressional hearing, suggested a total exclusion of this volume of passengers in the measurement. In short, both proposed that inevitably the amount of low fare service offered on schedules would be restricted, forcing those passengers into charter movements by either class of carriers.

The question is what part of the public could possibly benefit from such a policy. Not low fare passengers, for they would be limited as to the amount of scheduled service opportunities they would now find available. Some would find themselves forced into charters, whether they wanted that form of travel or not -- with the inherently greater restrictions on when and how they could travel, assuming they could establish charter eligibility in order to find any low fare outlet whatsoever. I am not talking about a handful of passengers -- in 1972 across the Atlantic alone, the scheduled carriers will be carrying some 6.5 million passengers meeting
this low fare description. In a predictable competitive response, the charter proponents now propose to shut out flexible low fare opportunities for a substantial portion of the market.

It would follow, perhaps, that if the discount fare passengers would not stand to benefit from the proposals of Messrs. Binder and Cherington then at least the full fare passengers might. They would not, and could not. If I could leave no other impression here, I would be satisfied if there could be a better understanding that the scheduled industry has been successful in developing an integrated, full service scheduled system since World War II because all sectors of the traveling public mutually reinforce the economic viability of this system as a whole, and therefore each part of the market benefits from the existence and support provided by the other parts. In other words, the ability to carry the business traveler, the government traveler, the military passenger, the vacationer, the youth passenger -- all on the same scheduled flight enables the industry to provide better service, better equipment, and a lower average fare to the entire public, than would be possible if major parts of these markets were segmented away from the scheduled system.

The supplementals, borrowing from economic purists, argue that the full fare passenger subsidizes the discount fare passenger. To the contrary, discount fare passengers fill the seats and produce the revenues which enable the carriers to offer the range and volume of services which
everyone including the full fare passenger enjoys. Without them, our industry could never have moved successfully into the first jet era, nor could we now support the large capacity jets of this generation of equipment.

Without the revenues from discount fare passengers, we would have to charge full fare passengers higher fares. Despite the contention that premium fare passengers are price-inelastic, experience demonstrates that when a substantially higher fare is introduced, the fewer the passengers willing to pay it. The formula partially adopted by Mr. Binder and fully advocated by Dr. Cherington would thus lead to constantly decreasing levels of "protected" scheduled service. As the ability to carry both business and pleasure travelers on scheduled flights was restricted, the number of those scheduled flights would be reduced and many transatlantic markets, for example, could no longer support even daily service with conventional jets and might be forced to once-a-week service or less with 747's.

I understand that Mel Brenner offered you an analysis the other day of what could happen to the New York-Paris market, for example, applying the Cherington formula, finding that the so-called "essential" level of service would be one 707 every two or three days or one 747 every five days for most of the year. The Bermuda-type agreements, which we have long fought to preserve with our foreign partners, would
not permit us to unilaterally restrict the service offerings of our foreign flag competitors. You can imagine then what Air France would do to our carriers' market participation with their twice daily 747 offering.

Before leaving the subject, I might mention that the Cherington proposal in particular gives no weight whatsoever to the value of scheduled service to the movement of freight and to the postal service -- key considerations in the determination of the public interest called for under the cornerstone of the Federal Aviation Act, Section 102. The fact that only the scheduled industry has the legal authority, the facilities and the total system to meet the needs of all parts of the air travel and air freight markets -- the fact that only the scheduled industry is equipped to provide the full service required in the national interest is not to be taken lightly. The proposals of Mr. Binder and Dr. Cherington would leave large parts of the public with less good service, or higher cost service, or both. They should be summarily rejected.

As I said at the outset, Gabe is going to address the other competitive aspects, dealing with entry and rates.
Mr. Landry cited only one relevant sentence from the charter section of the Statement. There are several other pertinent provisions which are appropriate in this context. Let me quote a few:

"While the roles of scheduled and supplemental carriers are different as described in this Statement, there has nonetheless developed in certain areas competition between them. This may, indeed, increase."

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"Charter services by scheduled and supplemental carriers have been useful in holding down fare and rate levels and expanding passenger and cargo markets. They offer opportunities to exploit the inherent efficiency of planeload movement and the elasticity of demand for international air transport. They can provide low-cost transportation of a sort fitted to the needs of a significant portion of the traveling public."

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"Additional uniformity and simplification of charter rules is desirable, and an effective charter enforcement program should be maintained."

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"Both scheduled carriers and supplemental carriers should be permitted a fair opportunity to compete in the bulk transportation market."

* * *

"Licensing tools (geographic limitations, charter definitions, volume restrictions, etc.) can be utilized to adjust the competition between scheduled services and charter services."

* * *

"The foreign landing rights for charter services should be regularized, as free as possible from substantial restriction. To accomplish this, intergovernmental agreements covering the operation of charter services should be vigorously sought, distinct, however, from agreements covering scheduled services."

* * *

This is a recital of the promise of the Policy Statement. Let's look at the realities. One place where the promise ignores reality is in failure to recognize that the international air transport passenger market is one market. Today, over the North Atlantic -- the world's preeminent international passenger route, only 30 per cent of scheduled service passengers
move at first class and regular economy fares. The remainder move at promotional fares of one kind or another. Just five years ago, nearly 55 per cent of scheduled carrier passengers moved at first class and regular economy fares. Clearly the proportion of premium fare passengers is dwindling.

Yet the Policy Statement attempts to assign as the preserve of charter services the bulk transportation market. This can represent as much as 70 per cent of the current scheduled carrier traffic across the North Atlantic and of course all of the charter traffic across the North Atlantic, or roughly eight out of every ten passengers.

Who would be entitled to operate charter services for this bulk transportation market? Today, there are seventeen foreign and three U.S. scheduled operators. Additionally, there are six U.S. supplementals and twenty-three foreign charter specialists so authorized.

Now the Policy Statement calls for regularization of charter services through the establishment of intergovernmental agreements. Additionally, the Statement calls for uniformity and simplification of charter rules and an effective charter enforcement program. It also states that licensing tools can be utilized to adjust competition between scheduled services and charter services. But there simply will not be an international legal regime for charter services under present circumstances. Why?
There are too many operators.

The competitive structure is too irrational.

Neither the United States nor its prospective bilateral partners have come to grips with the rules of the game.

Let's look at these problem areas. The pattern of scheduled services is built on a foundation where U.S. operators obtain certificates of public convenience and necessity which specify the permissible scope of operations by means of linear routes with specified terminals in the United States and abroad. The certificates are granted in complex licensing proceedings where careful consideration is given to the needs of the traveling public in specified markets, traffic flow projections, likelihood of profitable operations, competitive impact. This operating permission is then implemented through a series of bilateral agreements which also carefully define the routes being exchanged specifying the terminal and intermediate points. A careful balance is drawn between the economic opportunities available to the one side and the other. Reciprocity is thus formally and rationally established. Of course, in order to obtain access for U.S. carriers to Ireland and the United Kingdom, France, Germany, Italy and all the countries in Europe, access to the United States is given to airlines of each of those countries. Thus, the seventeen foreign scheduled operators and three scheduled U.S. operators across the North Atlantic.
In the charter service area, there are as yet no bilateral agreements. The United States seeks to obtain landing rights for its charter specialists by granting foreign operators permits willy-nilly in the hope that the foreign government will reciprocate. Needless to say, the system doesn't work very well.

The reality is that the same pattern for charter service bilaterals is neither necessary nor desirable, but the United States Government has failed to recognize this. The six U.S. supplemental carriers were given blanket authority to serve any points in the United States and any point in Europe. No single European country is going to allow six U.S. carriers with identically broad authority to serve from any point in the United States and at the same time be faced with U.S. scheduled operators--three in the case of the United Kingdom and two in other major European countries. They, unlike the United States Government, have some concern for not only the impact on scheduled services but the overall competitive impact on their national carrier.

The way to bring order out of this arrangement is for the United States first to recognize that it need not have six U.S. charter specialists operating in the same market even if charter services are to become the dominant mode of travel in the future. If the United States were to reduce the number of charter specialists through a more careful definition of the countries in Europe or of the geographical area in the United States which
each could serve or a combination of both, foreign governments would be faced with a more acceptable competitive environment. Secondly, the United States ought to recognize that the European market is a homogenous one, and its requirements are more than adequately served if entry is secured at three or four key gateways in Europe. With this recognition, the United States can seek to limit the number of European operators to that number necessary to secure entry at such gateways.

As an alternative, foreign governments might also be more amenable to a charter services agreement if there were imposed some sort of frequency or capacity limitation on charter operations as the Federal Aviation Act and the Policy Statement recognize.

Turning to the rules of the game problem, this has been the greatest impediment to any intergovernmental charter understanding thus far. The United States has one set of rules; each of the other countries has its own set of rules. To be sure, European governments have brought a certain harmony into their charter rules through ECAC's efforts -- in further recognition of the homogeneity of that market. The difficulty is twofold. The rules have constantly changed and expanded over the years and have constituted a more significant grant of authority than the basic licenses themselves. The second difficulty is the insistence by the United States that charter service arrangements be bilateral when the Europeans insist on a common approach or at least uniformity in rules.
To illustrate the changing nature of the rules, charter services were by definition originally confined to single entity or own-use charters and affinity charters. The respective definitions are by now well known to most of you. Then a new kind of charter was established -- an inclusive tour charter which is not a charter in the historic sense at all since the members of the group have no affinity.

As more and more people desired to take advantage of the lower fares of charter services, violations of the rules became rampant. Governments were unable to bring themselves to enforce such rules although the rules were and are enforceable. Instead they groped for a new kind of charter which would not have the enforcement problems and so-called discriminatory features of affinity charters and have come up with a travel group charter concept. This proposal is still in the developmental stage on both sides of the Atlantic.

In its attempts to reach formal charter service agreements, the United States has sought to overcome the diversity of rules by suggesting that the rules of the country of origin of the charter apply. Foreign governments have wisely recognized, however, that the rules of the game must be mutually agreed upon and have rejected the U.S. suggestion. They are currently seeking, through the ECAC/US/Canadian discussions, to arrive at a common travel group charter concept.
Now the second place where the promise ignores reality is in the wishful allegation that charter services hold down fare levels and expand markets, offer opportunities to exploit the inherent efficiency of planeload movements, and provide low-cost transportation of a sort fitted to the needs of a significant portion of the traveling public. It is of course true that charter services operated in full planeload lots can be priced lower than scheduled services operated at less than full plane lots. And they have indeed exerted a downward pressure on transatlantic fares, at least in the last five years, although the importance of that impact is somewhat overexaggerated.

To quote from a recent IATA study,

"The scheduled operators' awareness of the demand for low price travel is not recent but has extended throughout the years. In their endeavours to cater for this traffic they have maintained a constant review of fare levels, introduced new types of fares, amended and improved existing fare types. "From an original position of one class of travel with one fare level a structure has been developed which provides a wide range of promotional fares. Highlights over the years were the introduction of -

- a new lower class of service - tourist class. (1952)
- a family fare (1955)
a short limit validity Winter excursion fare (1956)
a third class of service - economy class (1958) -
tourist class service was abandoned in 1960
different fares for jet and propeller services (1960)
group fares (1962)
a progressive extension of the short limit validity
tourist class service was abandoned in 1960
excursion fare beyond the Winter period until in
1966 it was available year round
inclusive tour fares (1966)
group inclusive tour fares (1967)
contract bulk inclusive tour fares (1969)
longer limit excursion fares (1970)
lower level longer limit excursion fares; youth fares
(1972)."

International scheduled service fares are highly regulated. Charter
service fares are hardly regulated at all. Until both classes of service
are brought within the same price regulation mechanism, the passengers
to be sure will benefit over the short term from low fares, but the operators
will go broke.

Let's look at what is happening. The situation for the supplementals
as a group is grim. From 1970 to 1971 seven of the thirteen supplemental
carriers' financial condition worsened. At the same time, the supplemental carrier industry moved from a $240,000 net profit to a loss of $3.9 million. In the first quarter of 1971 the supplementals lost approximately $900,000. In the first quarter of 1972 they lost $2.5 million. Their financial condition appears to be worsening in 1972; only three show a profit in the first quarter. One of the supplemental transatlantic operators has ceased operations this year. The European experience is similar.

As for scheduled carriers, transatlantic operations in 1971 were a loss for all but two -- TWA and El Al. One analyst has estimated the loss by IATA carriers on the North Atlantic at about $300 million in 1971, and projects a $400 million loss in 1972.

And, let's take a look for a minute at the alleged inherent efficiency of charter services in the context of the North Atlantic market. The market has always been known for its high seasonal peak in the summer months. Today, in fact, about one-half of the total market moves in the months of June, July, August and September. The continually lower fares and the more intense supplemental competition have only served to intensify that peaking. A second feature about that peaking is that the preponderant traffic movement is eastbound in June and July and westbound in August and September. For scheduled services, operations are nearly at 100 per cent loads eastbound in June and July and only 50 per cent westbound. In
August and September there are 100 per cent loads westbound and 50 per cent eastbound providing a maximum average load factor for the four months of about 75 per cent. Even with sharply reduced capacity in the shoulder and off-peak months, average loads over the entire year can never exceed more than 60 per cent. Obviously, over the long run, prices for North Atlantic travel must reflect that kind of optimum load.

Now, how are charter services any different? I submit that they are not all that different since it is the same market with the same peaking and the same directional flow problems. Consequently, large-scale charter operations will not have the benefit of back-to-back operations at full plancloads and thus a certain amount of ferry milage has to be built into charter pricing. Charter services will also need substantial fleet sizes to accommodate peak summer season travel should that become the prevalent type of service. What happens with the aircraft in the off-season. Heretofore, the U.S. supplementals have had the luxury of substantial military charter business available to take up the slack. This military business is rapidly disappearing. Charter specialists will invariably be faced with low utilization which will add another cost item to be recovered in the price structure. Thus the economies of the two types of operation will move closer and closer together and so ultimately will their price structures.
In summary, the Policy Statement attempted by Executive fiat to equate the roles of supplemental and scheduled airlines in the so-called bulk air transportation business. Back in 1962 when Congress established the legislative authority for supplemental air carrier operations, Mr. Staggers who is now Chairman of the House Interstate and Foreign Commerce Committee stated: "The House is also convinced that the existing volume of charter business is adequate to support the supplemental air carrier industry and that the potential in this field is very promising, provided that the CAB adopts a realistic approach as to the number of carriers required by the public convenience and necessity."

Unfortunately, the CAB did just the opposite. It certificated twelve carriers, some of which have since failed. It put six U.S. flag supplemental carriers across the Atlantic, thereby inviting reciprocal action by their foreign governmental counterparts and thus sowed the seed for the nearly disastrous economic situation for all participants in the market today. There is just not that much room in the inn.

We would suggest that charter specialists ought to be tailored in number as have U.S. scheduled operators, with perhaps one charter specialist in each ocean, perhaps a maximum of two in the thicker Atlantic market. Or, if full decertification is too harsh a remedy, limited rather than broad geographic licenses should be the rule.
As a parting shot, we would suggest that the government would be mistaken to preserve the artificial role of the charter specialists at any and all cost, for their main value is the alleged competitive spur in pricing. The need for a competitive spur is only a sometime thing. The introduction of new types of equipment and the very basic need to fill seats are a more continuing spur. Let's face it -- the public by and large doesn't give a hoot about charter services. The public wants low fare services with as much convenience and flexibility as it can obtain at such fares.

We sincerely believe that a group of full service carriers can meet the full spectrum of the demands for air transportation more efficiently than two or more groups. The best public service for all elements of the traveling public can be provided by full service carriers. They meet the emergency and short-term demand requirements. They provide appropriate discount fares on scheduled flights for individual travelers who are more flexible. They offer special fares on scheduled flights for groups not requiring full aircraft charters. And, they provide full airplane charters for qualified groups. That whole array of services is available regularly and dependably at every city on the system.

But let there be no mistake—-if charter services are ordained as the sole vehicle for the mass market, we will devote our energies and resources in full measure to that service. The public and the economy which depend upon regularly scheduled service will be the losers.
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