

MARKETING STRATEGY FOR COMMERCIAL AIRCRAFT
ENGINES; A CASE STUDY

by

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(1979)

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(1984)

Submitted to the Sloan School of Management
in Partial Fulfillment of
the Requirements for the Degree of
Master of Science in Management

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ABSTRACT

The commercial aircraft engine business is characterized by large financial investments with returns obtained through a limited number of high value sales. An engine design requires up to \$1 billion to develop and sells for between \$3 and \$7 million each. The total market value is estimated to be worth \$5 billion per year. This creates intense competition between manufacturers which is influenced by each manufacturer's effectiveness in implementing a marketing strategy.

The engine manufacturer has two customers; the aircraft manufacturers who generally have a number of engine supplier options for each of their aircraft, and the airlines who select an engine to power the aircraft they purchase. Each customer has a set of objectives it tries to achieve in purchasing aircraft engines. A successful marketing strategy is one that addresses the engine purchase objectives of each customer better than the competitors do. This thesis uses the customers' engine purchase objectives to identify an effective marketing strategy and studies the implementation of that strategy at a major aircraft engine manufacturer.

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Title: Senior Lecturer

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My special thanks go to the members of the General Electric Aircraft Engine Group's Commercial Engine Operation, American Airlines, Delta Air Lines, United Airlines, Boeing, and McDonnell-Douglas whose generous contributions of time and assistance helped provide an understanding of marketing in the complex, but exciting aircraft engine business. None of these individuals or organizations are responsible for the conclusions or errors that remain.

Lastly, I dedicate this thesis to my wife, Valerie, and children, Matthew, John, Michael, and Katherine who's patience and support helped to make this thesis exciting and rewarding.

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CHAPTER ONE
INTRODUCTION

The commercial aircraft engine business environment consists of a few manufacturers who produce the engines, a few aircraft manufacturers who produce commercial aircraft and need the engines to power their aircraft, and the many airlines who purchase the aircraft. The marketing focus of the engine manufacturers has changed substantially since the mid 1970's. Before the mid 1970's the commercial aircraft engine industry had a traditional supplier role with a marketing strategy that focused on the aircraft manufacturers. The aircraft manufacturers selected one engine manufacturer to supply engines for each aircraft program and then marketed the complete aircraft, with engines, to the airlines. The engine manufacturer's primary responsibility to the airlines was to sell spare parts and provide technical support in servicing the engines in operation. In the mid 1970's the sales and marketing role of the engine manufacturers changed and shifted engine competition from the aircraft manufacturer level to the airline level. The aircraft manufacturers shifted their role in engine selection to a more neutral one by obtaining multiple engine supplier options for each aircraft and letting the airlines make the selection. For the engine manufacturer this created dual customers; the airlines who make the engine selection and the aircraft manufacturers to whom the engines are supplied.

The motivation for the change came from all involved. The airlines wanted engine competition as a way to reduce overall aircraft purchase price and improve service from the engine manufacturers. The aircraft manufacturers wanted to make the aircraft more attractive to airlines by providing the desired engine competition. Each engine manufacturer wanted to increase its potential market share.

Today competition in the commercial aircraft engine business is intense as each manufacturer competes at each airline to supply a limited number of a high value product. The largest airlines can negotiate for the purchase of up to 100 aircraft at a time with an engine value that can exceed \$1 billion. Before any engine selection is made, the airlines go through an extensive evaluation and negotiation process with all of the engine manufacturers to make sure they are getting the best product at the best price. Such an evaluation can take many months. Marketing in this environment is critical as small differences in satisfying the airline's objectives can impact the engine selection.

Marketing strategy involves responding to a customer's needs and desired objectives more effectively

than the competitors do. This study develops and analyzes the marketing strategy of the commercial aircraft engine industry and its implementation within one engine manufacturer, General Electric. The strategy, which focuses on both the airlines and the aircraft manufacturers, is developed based on an evaluation of the needs and engine purchase objectives that the airlines and aircraft manufacturers have. The study is organized as follows:

Chapter 2 - Provides a broad overview of the commercial aircraft engine market and business characteristics.

Chapter 3 - Explains the contractual relationships and the resulting product and financial flows between the engine manufacturers, aircraft manufacturers, and airlines.

Chapter 4 - Identifies the airlines needs and engine purchase objectives.

Chapter 5 - Identifies the aircraft manufacturer's needs and engine purchase objectives.

Chapter 6 - Develops the commercial aircraft engine marketing strategy and uses it to explain engine sales results in the 1980's.

Chapter 7 - Examines the implementation of the marketing strategy in General Electric's Aircraft Engine Group.

Chapter 8 - Summarizes the results and considers implications for the future.

The appendices contain background on the engine manufacturers and the commercial engines they produce, the

aircraft manufacturers and the aircraft they produce, the General Electric Aircraft Engine Group, and the engine selection processes used at three major U.S. airlines; American Airlines, Delta Air Lines, and United Airlines.

CHAPTER TWO
COMMERCIAL AIRCRAFT AND ENGINE INDUSTRY

Aircraft engines are highly technical and complex products which utilize state-of-the-art technologies in many engineering and manufacturing disciplines. This causes development of a new engine to take four to five years and require an investment of between \$1 and \$1.5 billion in design, testing, and manufacturing tooling.^{1/} The engine manufacturers face a risk that, while the engine is being developed, changes in the market or the engine development strategy used by the competition may reduce the demand and profitability of the engine. Those manufacturers who are successful share in a business that has been projected to be worth \$74 billion through the year 2001 or \$6 billion per year.^{2/}

2.1 THE COMMERCIAL AIRCRAFT ENGINE MARKET

There are currently 225 airlines, centered in 94 countries, that make up the market for commercial aircraft engines.^{3/} The airlines range in size from American Airlines, that has a fleet of 475 aircraft and transports 55 million passengers per year, to the West German airline Germania that has a fleet of four aircraft and transports one half million passengers per year.^{4/} Figures 2.1 and 2.2 show the distribution of fleet size and aircraft

FIGURE 2.1

AIRLINE FLEET SIZE DISTRIBUTION

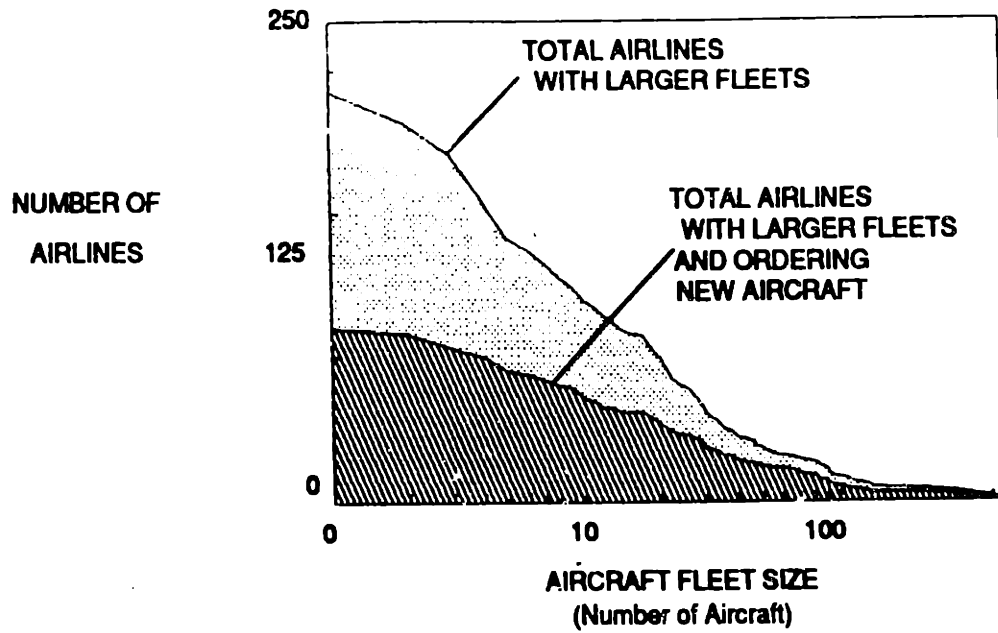
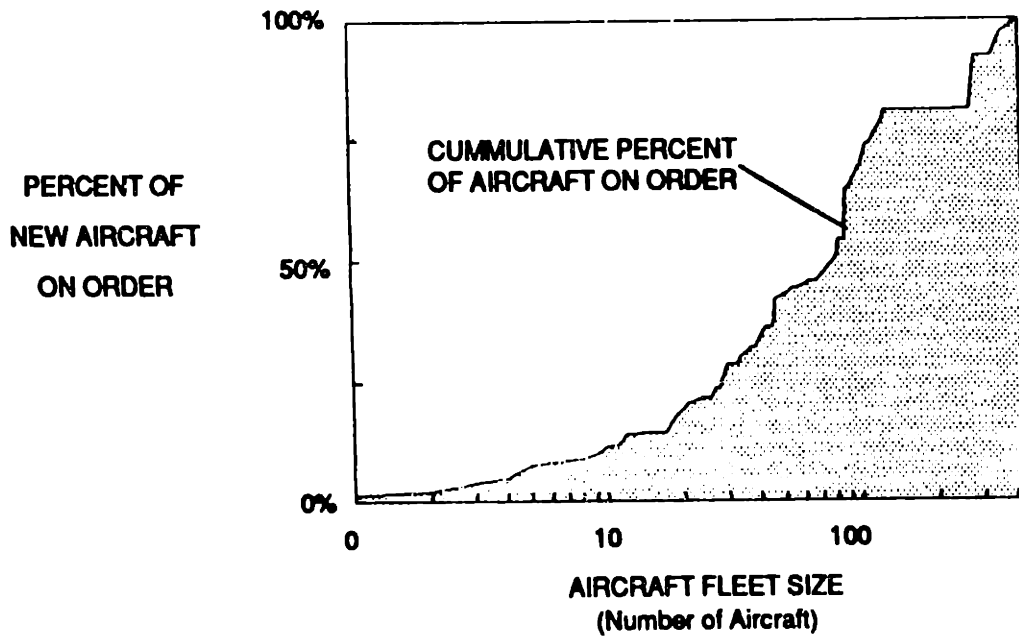


FIGURE 2.2

MOST AIRCRAFT ORDERS FROM LARGE AIRLINES



Source: Compiled from data obtained in *Interavia*, "The World's Major Airlines, October, 1988, 1017-1067.

purchases among the world's airlines. A majority of the airlines have aircraft fleets of less than 10 and the largest 20 airlines account for 50 percent of all new aircraft and engine orders.^{5/}

The market demand for commercial aircraft engines has been extremely cyclical with periods of boom and bust. As shown in Figure 2.3, since the introduction of jet powered aircraft in the late 1950's there have been four peaks in production which have tended to follow peaks in passenger traffic and the world economy. The industry is currently in the middle of a period of record orders. For example, John Hayhurst, Vice President of Marketing for Boeing said:^{6/}

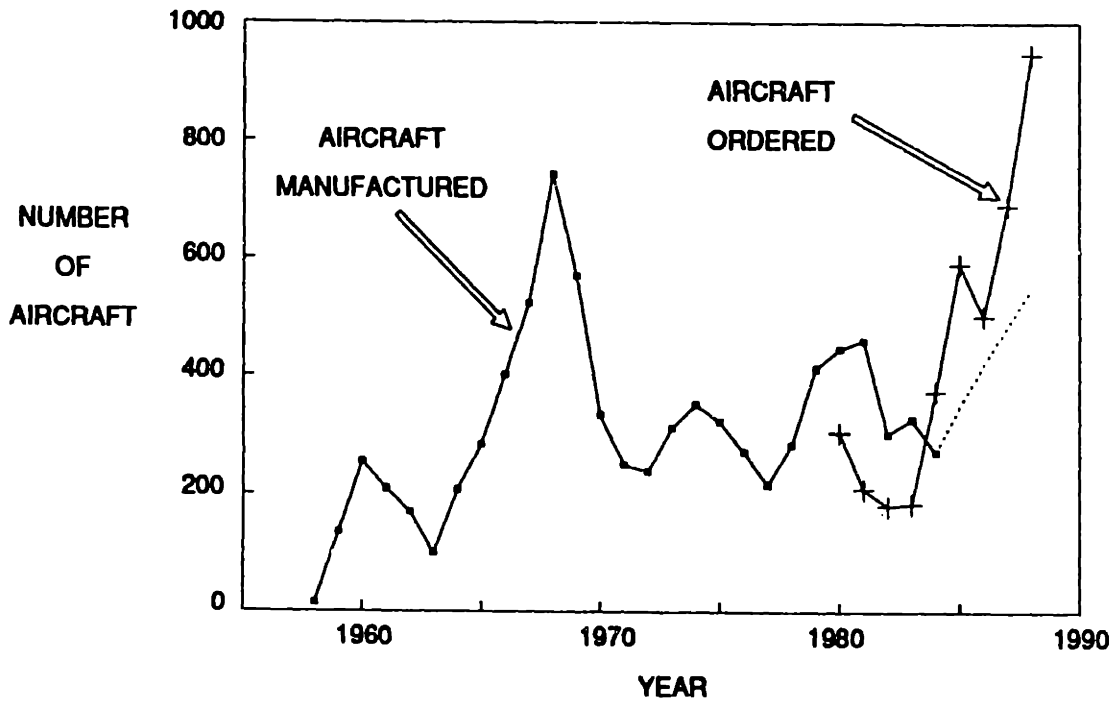
We have just completed our fourth consecutive record sales year at Boeing. It is also our fourth consecutive year of grossly exceeding our sales forecast.

The predictions by some analysts and manufacturers that this is the beginning of an extended period of soaring demand led to the following speculation in a Wall Street Journal Article:^{7/}

If the analysts and industry planners are proven correct, it could mean two decades of prosperity for the commercial aircraft industry.

FIGURE 2.3

CYCLICAL COMMERCIAL AIRCRAFT
ORDERS AND DELIVERIES



Source: The Economist, June 1, 1985, 8 survey. and data provided by General Electric Company, January, 1989.

One airline consultant projects that the total value of commercial aircraft sales through the year 2000 will total \$353 billion.^{8/} The current optimism comes from the ongoing demand for new aircraft generated by deregulation, economic growth in the Pacific Rim, and the retirement of older aircraft.

Since the U.S. airline industry was deregulated in 1979 there has been extensive demand for new aircraft and, as a result, for new engines. The airlines have required new aircraft to handle the nearly doubling of passenger traffic from 240 million in 1978 to 455 million in 1988.^{9/} There has also been a consolidation of airlines, shown in Table 2.1, to a few large, financially strong airlines which can afford to purchase new aircraft. Since 1985, five of the major U.S. airlines have ordered 391 aircraft plus placed options for 558 additional aircraft. The orders are summarized in Table 2.2.

Deregulation has caused a change in the U.S. airline's route structure and optimum aircraft size. The airlines have found efficiencies in creating centers of flight activity called "hubs" where, as shown in Figure 2.4, passengers from cities throughout the airline system

Table 2.1

CONSOLIDATION OF THE U.S. AIRLINES

<u>AIRLINE</u>	<u>AIRLINE PURCHASED</u>	
Texas Air	Continental	1981
	Eastern	1986
	People Express	1986
	- Frontier	1985
United Airlines	Pan Am's Pacific Routes	1985
Delta Airlines	Western	1986
Northwest Airlines	Republic	1986
TWA	Osark	1986
US Air	Pacific Southwest	1987
	Piedmont	1987
American Airlines	AirCal	1987

Source: Business Week, "The Frenzied Skies",
December 19, 1988, 76

are funneled into the hub city for transfer to flights going to the passengers' final destination. The airline can thus transport the passengers the most economically as well as improve revenues by dominating passenger traffic originating or terminating in the hub city. This strategy has caused the airlines to offer more frequent flights with smaller aircraft which has in turn, increased the demand for aircraft with a passenger capacity of 150 or less.

Table 2.2

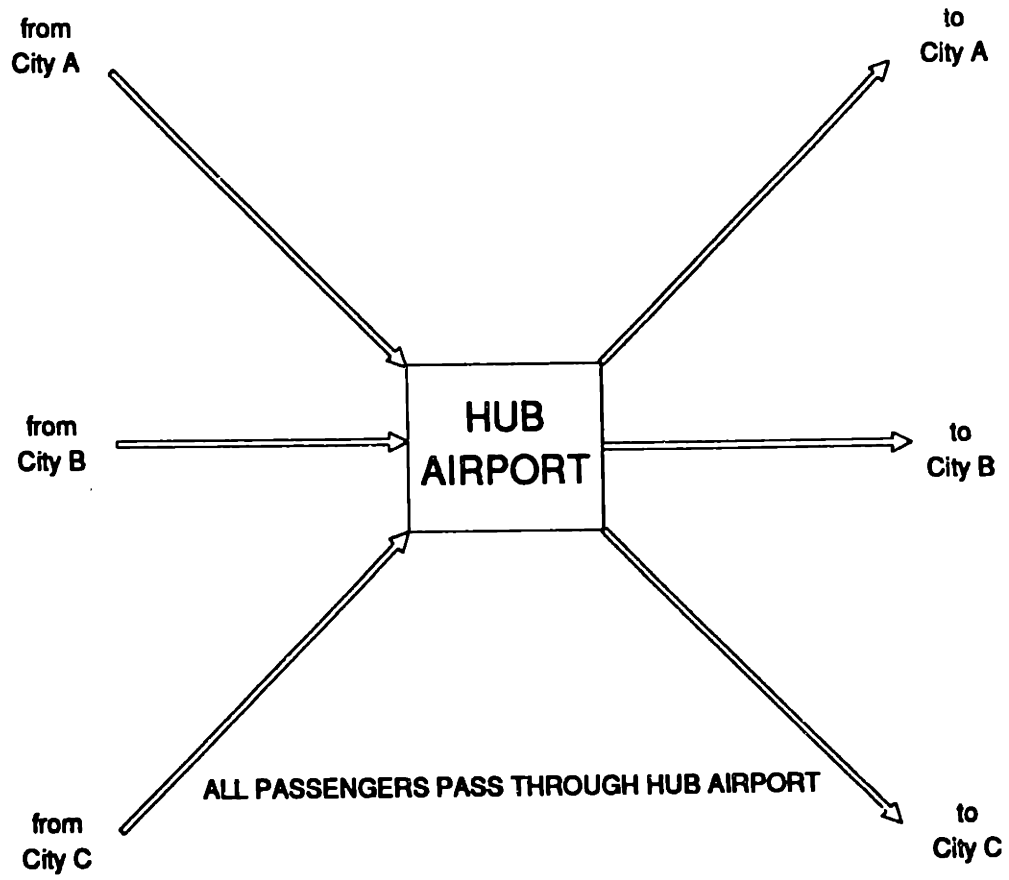
LARGE AIRCRAFT ORDERS BY MAJOR U.S. AIRLINES

<u>AIRLINE</u>	<u>DATE</u>	<u>AIRCRAFT</u>	<u>FIRM</u>	<u>OPTIONS</u>
American Airlines	1987	A300-600R	25	20
	1987/89	767-300ER	10	30
	1988/89	757-200	75	55
	1989	MD-11	8	42
	1989	Fokker	75	75
Northwest Airlines	1985	747-400	10	0
	1986	A320	10	90
	1986	A340	20	0
	1986	A330	0	10
Delta Air Lines	1985	MD-88	30	54
	1988	MD-11	9	31
	1988	MD-88	0	100
	1988	767-300ER	9	31
	1988	757-232	0	50
United Airlines	1985	737-300	110	0
	1985	747-200	2	0
	1986	747-400	15	0
	1987	757-222	30	30
US Air	1988	737-300	<u>50</u>	<u>30</u>
TOTAL			488	648

Source: Compiled from Interavia, "Airline Purchases",
October 1986, 1987, 1988.

FIGURE 2.4

AIRLINE HUB OPERATIONS



Effects similar to the U.S. deregulation are now occurring around the world. As reported in the Wall Street Journal:^{10/}

It [deregulation] has become a major trend around the world. It has spurred creation of new airlines and expanded routes in Canada, Japan, Australia, and in the Common Market countries, where even more growth is expected by 1992, when deregulation's full effect will be felt.

Passenger traffic to and from the Pacific Rim countries such as Japan, Korea, and Hong Kong has the highest yearly rate of growth in the world. This has fueled the demand for new aircraft, primarily the long-range, 500 passenger Boeing 747-400 aircraft. There are currently 89 747-400 aircraft on order from airlines that have service to the Pacific Rim including Japan Air Line, Northwest Airlines, United Airlines, All Nippon Airways, Cathay Pacific, Korean Air Lines, Singapore Airlines, Thai Airways International, and Qantas Airways.^{11/}

Replacement of older aircraft produced in the 1960's may provide a substantial source of continued new aircraft orders. Of the more than 8000 commercial aircraft currently in operation, over 2400 are more than 20 years old.^{12/} At some point in time, either due to government regulation or excessive cost of maintenance, those

aircraft will have to be replaced with new aircraft. Some of the current aircraft on order will probably be used to replace older aircraft, but even so, there will still have to be many more replacement aircraft built.

2.2 CHARACTERISTICS OF THE ENGINE BUSINESS

The aircraft engine business is made up of three major manufacturers who lead the industry and a number of smaller manufacturers who participate through sharing arrangements with the major manufacturers. The major manufacturers who are General Electric, Pratt and Whitney, and Rolls-Royce have found that sharing portions of their engine programs with smaller manufacturers enables them to spread their limited resources across more programs and, through diversity, reduce overall risk. For the smaller manufacturers, the sharing of engine programs provides an opportunity to participate in a business that they would not be able to enter into on their own.

Sharing of engine programs has taken the form of either joint ventures or production sharing. Joint ventures, of which there are two, are agreements in which two or more manufacturers share all aspects of an engine program including development, production, and product

support. General Electric and SNECMA, located in France, established a joint venture in the early 1970's called CFM International to develop the CFM56 engine. It has become the best selling commercial aircraft engine of the 1980's. Pratt and Whitney, Rolls-Royce, MTU located in West Germany, Fiat located in Italy, and JAEC a Japanese consortium established a joint venture in the early 1980's called International Aero Engine (IAE) to develop the V2500 engine, a competitor to the CFM56 engine.

Production sharing is an agreement in which a major manufacturer sells small sections of an engine program to a smaller engine manufacturer who, in return, receives specific part production responsibility and a share of the revenues. An example of production sharing on a Pratt and Whitney large thrust engine is shown in Table 2.3.

The development of aircraft engines usually involves the derivative concept. Each manufacturer periodically develops a new, higher performance engine to replace an older engine design. The older engine has usually established, through operational experience, a very good reliability and maintainability record. When developing the new engine, the manufacturer wants to capture the

Table 2.3

PRODUCTION SHARING ON THE PW4000

<u>PARTNER</u>	<u>PART RESPONSIBILITY</u>
Fiat (Italy) - 2%	Main Gearbox
Kongsberg Vapenfabrikk (Norway) - 3%	Casing, HPC & LPT parts
Fabrique Nationale (Belgium) - 3%	Casing, LPT parts, Bearing Housing
Sansung Precision Ind. (Japan) - 1%	Misc Turbine and Bearing Housing parts
Eldim B. V. (Netherlands) - 1%	Misc Turbine Parts

Source: Aviation Week and Space Technology,
September 1, 1986.

experience benefits gained on the older engine. This is done by making the new engine a derivative of the older engine with as many of the parts as possible are kept the same or minimally modified. The experience gained with the older engine is carried forward and the cost of new engine development is reduced.

The sale of aircraft engines is influenced by the inertia of the business. Inertia in the aircraft engine business, caused by spare part sales and commonality, tends to extend a manufacturer's market share advantage over a longer period of time than might normally be expected. Once sold, an engine remains in service for twenty or more years generating an ongoing source of spare part sales revenue that is equal to six to eight percent of the original engine purchase price each year.^{13/} In addition, the engine sale causes the airline to make a substantial investment in engine maintenance capability. In subsequent engine purchases, the airline has an incentive to maintain commonality and purchase more of the same engine. The net effect is that when an engine manufacturer achieves a market share advantage, that manufacturer has the potential to extend the length of time it has an advantage through follow-on orders from airlines trying to maintain commonality and on-going spare parts sales. The cycle can be broken by one manufacturer offering much better purchase conditions or when a new generation of engine is introduced and removes the commonality advantage

The high cost of engine development and the sales advantages gained from engine commonality have led the manufacturers into a strategy of maximizing the number of

aircraft applications on which the same engine can be used. On the large thrust class of engines most of the manufacturers have one engine that can be used on the 747, MD-11, 767-200, 767-200ER, 767-300, 767-300ER, A300, and A310 aircraft. It is not unusual for an airline to operate more than one of the above types of aircraft. The engine manufacturer that was selected on the first type aircraft purchased will, for commonality benefits, often also be selected on the second type aircraft.

FOOTNOTES

1. Andrew, J., "Eternal Triangles", The Economist, June 1, 1985, survey 6.
2. Nelms, D., "Engine Manufacturers Look For More Thrust", Airline Executive, October, 1988, 21.
3. Data compiled from Interavia, "The World's Major Airlines", October, 1988, 1017-1067.
4. Interavia, "The World's Major Airlines", October, 1988, 1022, 1052.
5. Data compiled from Interavia, "The World's Major Airlines", October, 1988, 1017-1067.
6. John Hayhurst, Vice President of Marketing for Boeing, interviewed by the author, Seattle, Washington, 13 January, 1989.
7. The Wall Street Journal, "Aircraft Boom May Be Only Beginning", September 26, 1988, 6.
8. Ibid.
9. Power, C., "The Frenzied Skies", Business Week, December 19, 1988, 70.
10. The Wall Street Journal, "Aircraft Boom May Be Only Beginning", September 26, 1988, 6.
11. Flight International, "World Airliner Census", December 17, 1988, p 58.
12. Andrew, op. cit.
13. Aircraft Investors, "Battle For Big Fan Market Share", October, 1988, 20.

CHAPTER THREE

THE CONTRACTS BETWEEN THE MANUFACTURERS AND THE AIRLINES

The engine manufacturer's dual role of supplying engines to aircraft manufacturers and marketing engines directly to the airlines creates contractual agreements linking the three companies. As a supplier, the engine manufacturer provides engines in response to a purchase order received from the aircraft manufacturer. The aircraft manufacturer makes the engine purchase based on the engine specified by an airline. The airline specifies an engine based on agreements made with the engine manufacturer through negotiation. For each interaction a separate contract is negotiated and signed.

The contract between the engine manufacturer and aircraft manufacturer is a long-term agreement which establishes the conditions for purchase and sale of aircraft engines in support of an aircraft program. The contract is written at the beginning of the aircraft or engine program and is specific to that aircraft/engine combination. The conditions include engine technical capabilities, delivery lead times, and sale price. Sometimes there can be one-time payments from the engine manufacturer to the aircraft manufacturer to help cover the costs associated with certifying the engine on the aircraft.

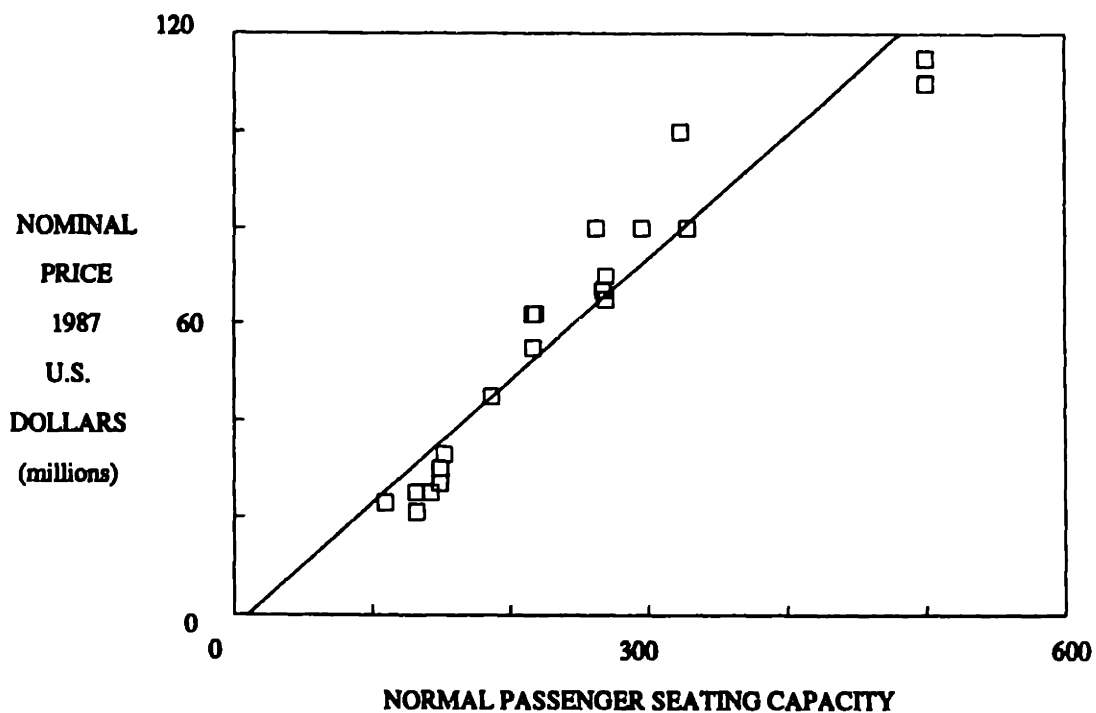
The aircraft manufacturer negotiates with the airline for the sale of aircraft. When a sale is made, a contract is negotiated and signed which includes technical specifications, purchase conditions, and the engine to be used to power the aircraft. Payment for the aircraft, including engines, is made by the airline to the aircraft manufacturer in installments specified in the contract. The total aircraft cost is dependent on the aircraft size and ranges from \$20 million to \$120 million as shown in Figure 3.1.

The engine manufacturer negotiates directly with the airlines concerning the selection of aircraft engines. However, since the engines are sold through the aircraft manufacturer, engine sale price can not be negotiated. Rather, allowances are made by the engine manufacturer to help reduce the airline's future costs associated with the operation of the engines. A common allowance is credits towards the purchase of spare parts and maintenance tooling. Some other types of allowances were described by John Hodson, Vice-President for Rolls-Royce as quoted in a 1983 Seattle Times article:^{1/}

We [Rolls-Royce] will either give, or sell at a very low price, the initial tooling needed to set up an overhaul shop . . . We provide engineers to help

FIGURE 3.1

AIRCRAFT PURCHASE COST BETWEEN
\$20 MILLION AND \$120 MILLION



Source: Compiled from Jane's All The World's Aircraft
1988-89, Jane's Information Group Limited, 1988.
plus Flight International, October 10, 1987, p 60.

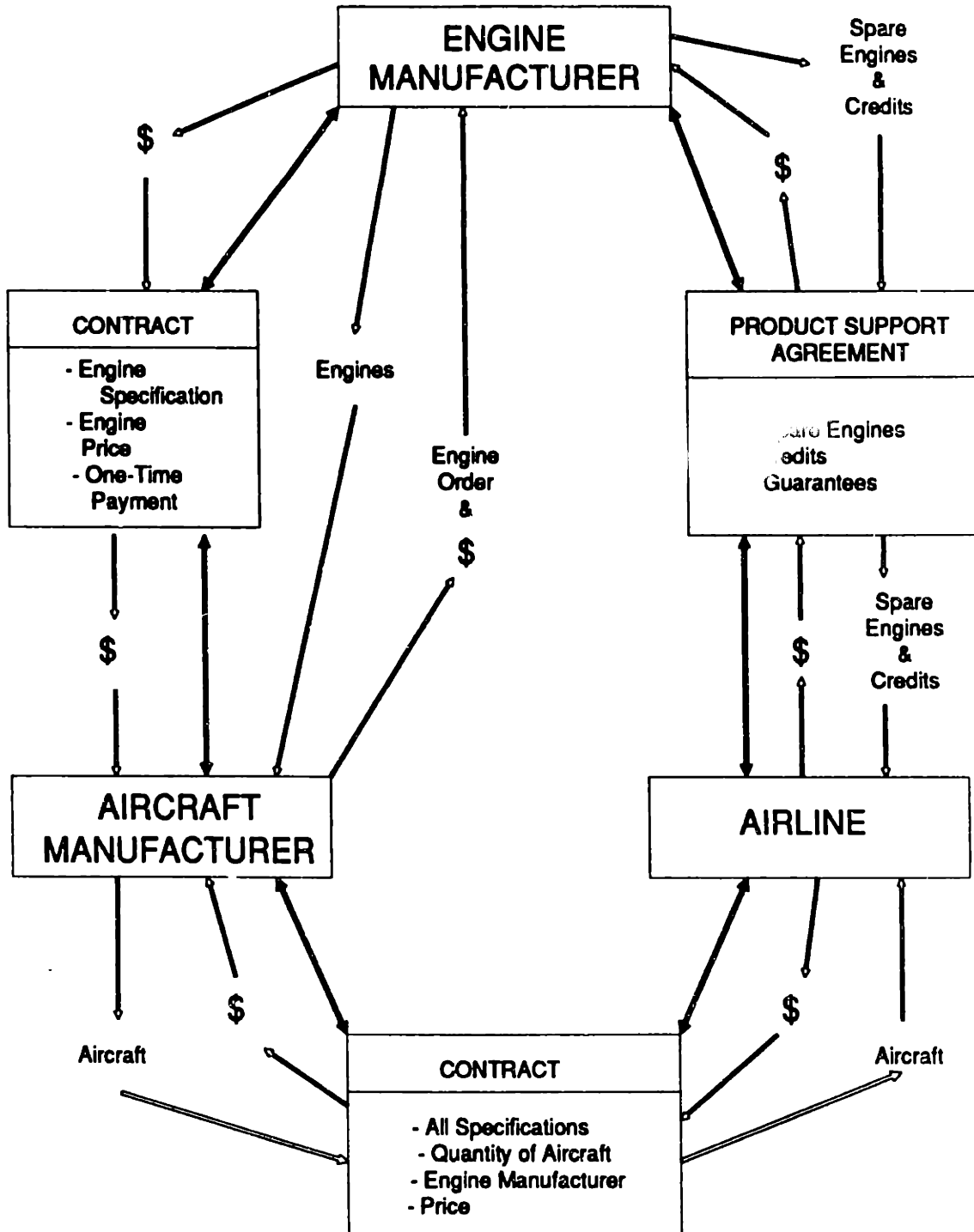
them in the introductory period. We provide those either free or for a very nominal sum... We will put a lease engine at their disposal so that they have to buy only the minimum number of spare engines until they've got their overhaul facility working.

The negotiated agreements between the engine manufacturer and the airline are placed in a contract called a "Product Support Agreement". It contains engine guarantees, defines the support to be provided by the engine manufacturer over the engine life, and sells the airline spare parts and spare engines. The credit allowances are placed in a side letter to the Product Support Agreement. The spare parts and spare engines are sold by the engine manufacturer directly to the airline.

The series of contracts between the engine manufacturer, aircraft manufacturer, and airlines forms the structure around which the sale and marketing of aircraft engines takes place. A summary of contracts and the flows of products and payments that they control are shown in Figure 3.2. Engines flow from the engine manufacturer to the aircraft manufacturer and on to the airline as part of an aircraft. Payments for the engines flow in the reverse direction. In addition, there is a flow of credits, spare parts, and spare engines from the

FIGURE 3.2

CONTRACTUAL INTERRELATIONS: ENGINE MANUFACTURERS, AIRCRAFT MANUFACTURERS, AND AIRLINES



engine manufacturer to the airline. The credits are applied against the spare part and spare engine payment flow.

FOOTNOTES

1. Rinearson, P., "Boeing Case: Making it Fly", Seattle Times, June 24, 1983.

CHAPTER FOUR

THE MARKET FOR AIRCRAFT ENGINES - THE AIRLINES

4.1 AIRLINES' PURCHASE OBJECTIVES

The factors that influence an airline's selection of commercial aircraft engines begin with the airline's operational environment. An airline's growth opportunity, or the economic advantages of replacing older aircraft, or the desire to improve its competitive position leads the airline to the purchase a new aircraft and results in the need to select an engine to power the aircraft. This, in turn, leads to an extensive evaluation and negotiation process with the engine manufacturers in which the airline tries to satisfy a number of objectives. These engine purchase objectives can be grouped into the categories of services, product features, and purchase conditions.

An airline establishes a long-term reliance on the engine manufacturer to provide services including engine technical support, spare parts supply, and solutions to technical problems that develop. Aircraft engines are a highly complex product that require periodic removal from the aircraft for maintenance. Usually the airline has a replacement engine available which can be placed on the aircraft overnight without interrupting the aircraft's availability. Unresponsiveness from the engine manufacturer in any of the service areas can cause an insufficient supply of usable engines which could leave

aircraft idle and disrupt the airline's entire operation.

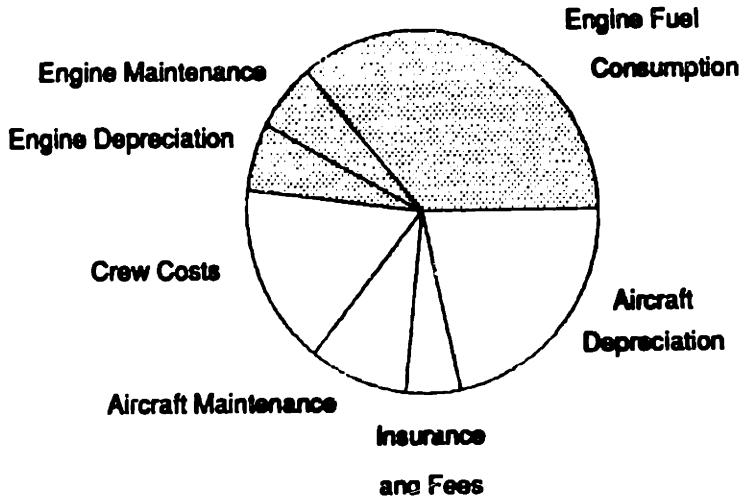
An airline wants an engine that will produce the thrust required to power the aircraft, have a minimum cost of operation, and have a minimum risk of developing service problems. Of these, the primary focus is usually cost of operation which includes fuel burn performance, maintenance cost, and reliability, a factor which contributes to the total maintenance cost. As shown in Figure 4.1, fuel consumption makes up approximately 30 percent and engine maintenance cost makes up approximately 10 percent of total aircraft related cost. Over the twenty year life of an engine small differences in either fuel consumption or maintenance cost can have a significant financial impact to the airline.

An airline has a strong interest in obtaining the best purchase conditions possible. Purchase conditions include allowances, financing, and purchase flexibility. Allowances reduce the airlines overall cost by reducing the cost of subsequent spare part purchases. Financing obtained and guaranteed by the engine manufacturer can sometimes provide the airline with a better interest rate than could be achieved in the open financial market.

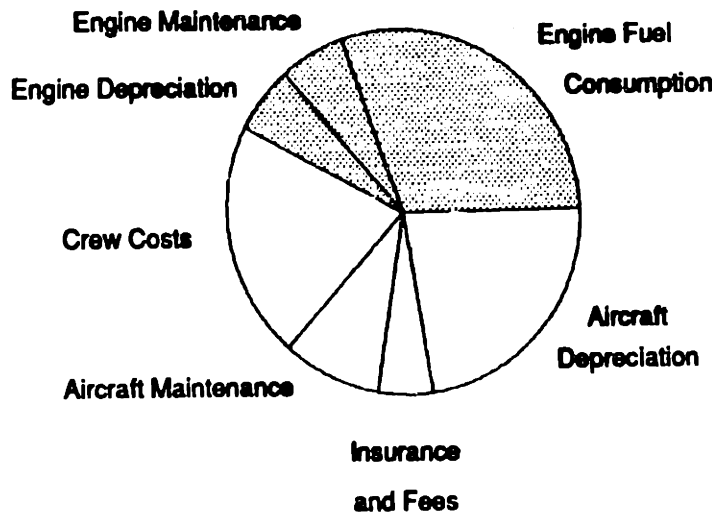
FIGURE 4.1

ENGINE RELATED COSTS ACCOUNT FOR 40% OF
TOTAL AIRCRAFT RELATED COSTS

TYPICAL 747-400



TYPICAL 767-300ER



Source: Data provided by General Electric Company,
January, 1989

Purchase flexibility involves techniques which reduce the airline's risk of aircraft ownership.

An airline faces the risk that a major reduction in passenger traffic or a change in the airline industry could cause the airline to have excess aircraft capacity. This often leads the airline to incorporate flexibility into its aircraft purchases to reduce and/or share some of the risks with the manufacturers. The most common methods used include purchase options and lease termination options.

Purchase options have long been used for the benefit of both the manufacturers and the airlines. They allow the airline to reserve future aircraft delivery positions at a predefined price without committing to purchase the aircraft. On predefined dates, which can be two or three years before scheduled delivery, the airline must decide if it will exercise the option and commit to purchasing the aircraft. This reduces airline risk by providing flexibility in the number of aircraft it eventually purchases. The manufacturers benefit from locking the airline into their products and better planning of long-range production.

The larger airlines with more negotiating power have been able to reduce risk by obtaining, from the aircraft and engine manufacturers, a lease with an option to terminate. The airline does not own the aircraft, but rather pays a monthly leasing fee to a third party owner who has been arranged for by the manufacturers. If the airline's business conditions change, it may have the option to return the aircraft. This transfers all of the aircraft ownership risk directly from the airline to the manufacturers.

The airline's engine purchase objectives, shown in Figure 4.2, have different priorities within each airline. However, in general there has been a shift in priority within the product features from technical risk to operational cost. In the regulated U.S. environment prior to 1979 an airline's costs were important but not critical. The airlines could afford to maintain strong engineering departments for technical support of the aircraft and engines in service. The engineering departments were the center of engine evaluation and focused on performing an independent assessment of the technical capabilities and risks of the available engines.

FIGURE 4.2
 AIRLINES' ENGINE PURCHASE OBJECTIVES

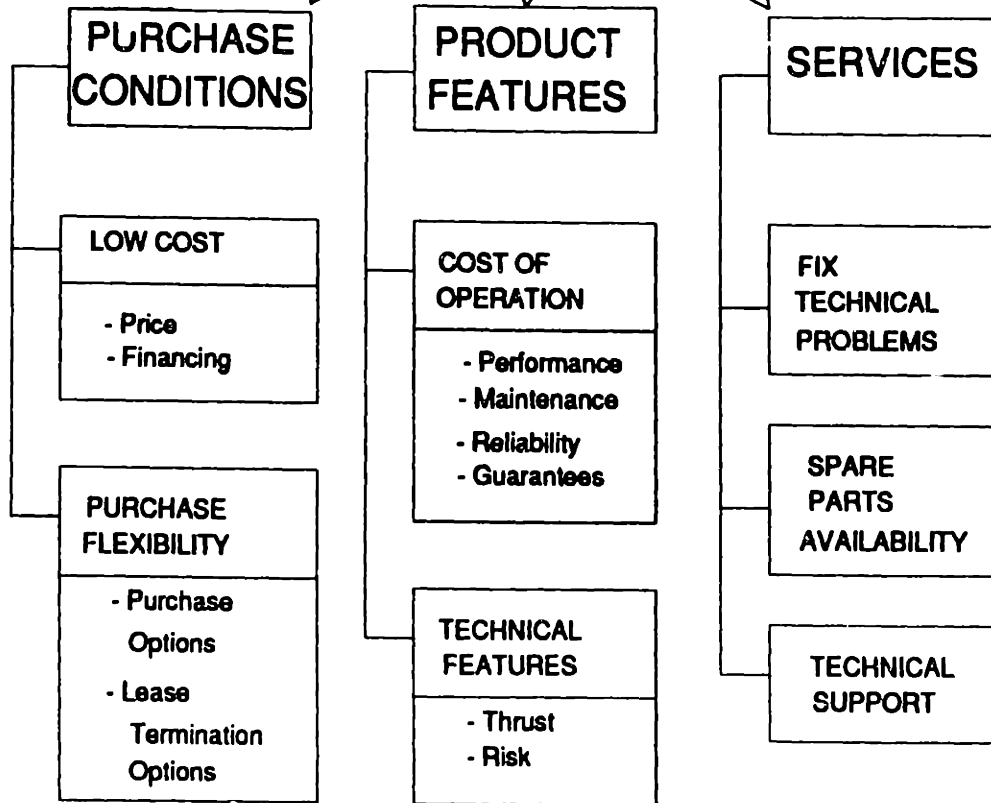
Environment:



Needs:



Engine Purchase Objectives:



Since deregulation cost minimization has become critical. It has forced reductions in the airline's engineering staffs which has limited the amount of detailed technical evaluation that can be performed. Instead, the airlines have tended to rely on the engine manufacturers and made them back up their promises of performance, reliability, and maintenance cost with guarantees. At the same time responsibility within the airline for engine evaluation and selection shifted to the financial organization with increased emphasis on cost of operation.

Engine technology has remained relatively constant which has allowed the airlines to be comfortable with a reduced involvement in evaluating the engine technical details because . They feel that any of the manufacturer's engines will work in their fleet of aircraft. As Dan Garton, Managing Director of Financial Analysis for American Airlines said:!

Engine technology has not changed too much recently. We are relatively familiar with the technology and the competing engines are similar. There may be a two percent difference between competitors, which is important, but it is not a question of whether an engine works. Before it was very much of a question of whether an engine would perform anywhere as near as well as they [the manufacturers] were saying it would.

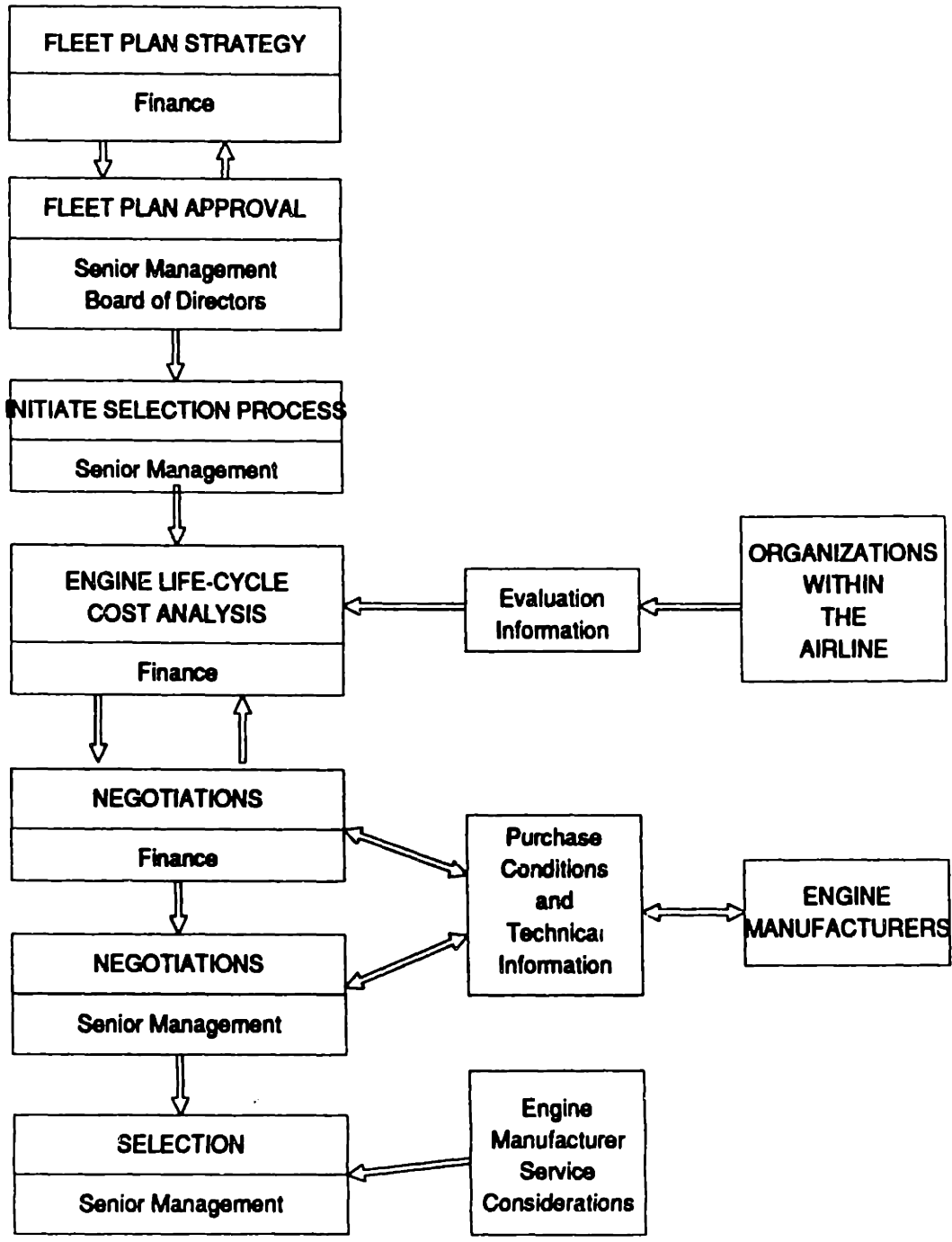
4.2 ENGINE SELECTION PROCESS AT THE AIRLINES

The high cost and more than twenty year life of commercial aircraft engines causes the airlines to take the selection of an engine extremely seriously. As a manager at American Airlines said:^{2/}

Nothing else at American Airlines has such a high level of attention. Bob Crandall [Chief Executive Officer] is very involved in the negotiation and key aspects of the purchase.

Each airline has set up its own evaluation and selection process which allows maximization of its purchase objectives. In the appendix, the selection processes of three major U.S. airlines; American Airlines, Delta Air Lines, and United Airlines are described. While differences in details exist, the processes are generally the same and are used for both aircraft and engine selection. As summarized in Figure 4.3, the selection process starts with a fleet plan strategy that is generated within the financial portion of the airline and approved by the airline's senior management and Board of Directors. Based on the schedule established by the fleet plan, senior management directs an aircraft and engine selection process to commence.

FIGURE 4.3
ENGINE SELECTION PROCESS USED
BY THE AIRLINES



Source: Interviews conducted by the author with management at American Airlines, Delta Air Lines, and United Airlines, January, 1989.

Evaluation of competing aircraft and engines is generally centered in the financial portion of the airlines. Delta is the exception with evaluation centered in a Technical Operations group. Information received from the manufacturers on purchase conditions and costs of operation is combined with evaluations performed by other portions of the airline to determine the products' life-cycle cost. At the same time, the finance group negotiates with the manufacturer over purchase conditions and costs of operation.

Competition is one of the strongest tools the airline has for achieving its purchase objectives. Negotiation is performed with each manufacturer over a period of time that can extend to more than a month. Initial negotiations are performed by the airline's lower level finance personnel. As negotiations proceed, added pressure is applied to the manufacturers as higher levels of airline management become involved.

The evaluation process is concluded when the airline feels it has negotiated as much as possible from each engine manufacturer. The finance group passes on to senior management the evaluation data, life-cycle cost estimates, and purchase terms being offered. Senior Management adds their own personal feelings and may make a

final push for further concessions before they make their selection.

The airline's objectives for service reliability are added to the evaluation process by the senior management who make the final selection decision. Before a manufacturer's engine can be selected, the senior management has to have confidence in the manufacturer's service ability and commitment to the airline. According to Bob Baker, Senior Vice President of Operations at American Airlines:^{3/}

Individual relationships and manufacturer reputations are the difference between a player and a winner in the business. All three manufacturers build good engines, the key is how quickly, openly, and objectively are the problems that develop fixed.

In addition another airline executive said:^{4/}

With purchase decisions of this magnitude, the senior people of the airline must be comfortable with the manufacturer's keeping their word and their integrity. . . . We are far more concerned with the manufacturer being responsive and listening to our most pressing needs.

Similarly, EH Boullioun, former President of Pan Am, was

quoted as saying:^{5/}

The company that is buying is putting up a third of their money . . . for something that is not going to be delivered for two to four years. . . . They have to have faith in the people making the aircraft . . . They're going to buy on the integrity of the people they're talking to, and their past performance.

4.3 ENGINE SELECTION AT THE LEASING COMPANIES

Leasing companies are another source of aircraft engine purchases. They specialize in purchasing aircraft which they then lease to airlines for time spans that vary from a few months to ten years. They finance the aircraft by borrowing on the international capital markets and repay the bonds from the lease payments. Airlines, mostly those that are smaller or less financially sound, use the leasing companies to provide flexibility in aircraft fleet size and off balance sheet financing. The two major leasing companies are International Lease Finance Corporation (ILFC), founded fifteen years ago, and Guinness Peat Aviation (GPA), founded twelve years ago.^{6/}

Until 1988 the leasing companies generally did not order aircraft until lessees had been located.^{7/} ILFC discovered that the frequency of its aircraft purchases

was increasing and the number of aircraft in each purchase was getting larger. Its view of the market was described in Interavia by Steven Udvar-Hazy, president of ILFC as follows:^{8/}

Over the last 15 months, the rate at which we have been placing aircraft on new leases has been much faster than the rate at which we have been buying. Demand is outrunning manufacturer's capabilities and lead times are being stretched. . . . We were faced with a choice of continuing our ordering policy or making a bulk buy with deliveries spread out to 1995 and the flexibility to change delivery schedules or aircraft type.

In 1988, without airline lease commitments, ILFC ordered 130 firm aircraft with 40 options.^{9/} As a result of that and other leasing company orders, leasing companies now account for approximately 25% of current aircraft/engine orders.^{10/}

The leasing companies are financially, not technically focused. They have small staffs who are all working toward minimizing the costs of purchase and maximizing the revenues from leasing. Their purchase objectives are strictly financial consisting of purchase conditions and lease value. Like the airlines, the lease companies use competition between manufacturers and negotiation to minimize the cost of purchase.

At present there is a mixed view of the place leasing companies will occupy in the future. One financing expert sees a time ten to fifteen years from now when airlines will not own their aircraft, but rather lease them and concentrate on the business of flying aircraft. By contrast, an airline executive sees a time when the world will be dominated by large, financially strong airlines that will not need leasing companies.

FOOTNOTES

1. Dan Garton, Managing Director of Financial Analysis for American Airlines, Interviewed by the Author, Dallas, Texas, 31 January, 1989.
2. Managers for American Airlines, Interviewed by the Author, Dallas, Texas, 31 January, 1989.
3. Bob Baker, Senior Vice President of Operation for American Airlines, Interviewed by the Author, Dallas, Texas, 31 January, 1989.
4. Airline executive interviewed by the Author, January, 1989.
5. Rinearson, P., "Boeing Case: An Act of Faith", Seattle Times, June 24, 1983.
6. The Economist, "Aircraft Leasing: Rent-A-Jet", May 21, 1988, 77.
7. Rek, B., "Why Does ILFC Want All Those Jets?", Interavia, October, 1988, 1007-1009.
8. Ibid.
9. Ibid.
10. The Economist, "Aircraft Leasing: Rent-A-Jet", May 21, 1988, 77.

CHAPTER FIVE
THE AIRCRAFT MANUFACTURERS

5.1 AIRCRAFT MANUFACTURERS' ENGINE PURCHASE OBJECTIVES

Commercial aircraft manufacturers provide a complete aircraft to the airlines and rely on the engine manufacturers to be suppliers of the engines for that aircraft. The aircraft manufacturer's engine supplier decisions are influenced by its purchase objectives which can be grouped, as shown in Figure 5.1, into the categories of airline satisfaction and aircraft salability.

An airline's satisfaction with the aircraft it operates is a function of the aircraft's reliability and the service the airline receives. Since the level of satisfaction influences the airline's future aircraft purchase decisions, the aircraft manufacturers are very sensitive to the reliability and service provided on the complete aircraft, including engines. The aircraft manufacturer wants the engine manufacturer's product reliability and service to enhance the airline's satisfaction with the complete aircraft.

FIGURE 5.1

AIRCRAFT MANUFACTURERS' ENGINE
PURCHASE OBJECTIVES

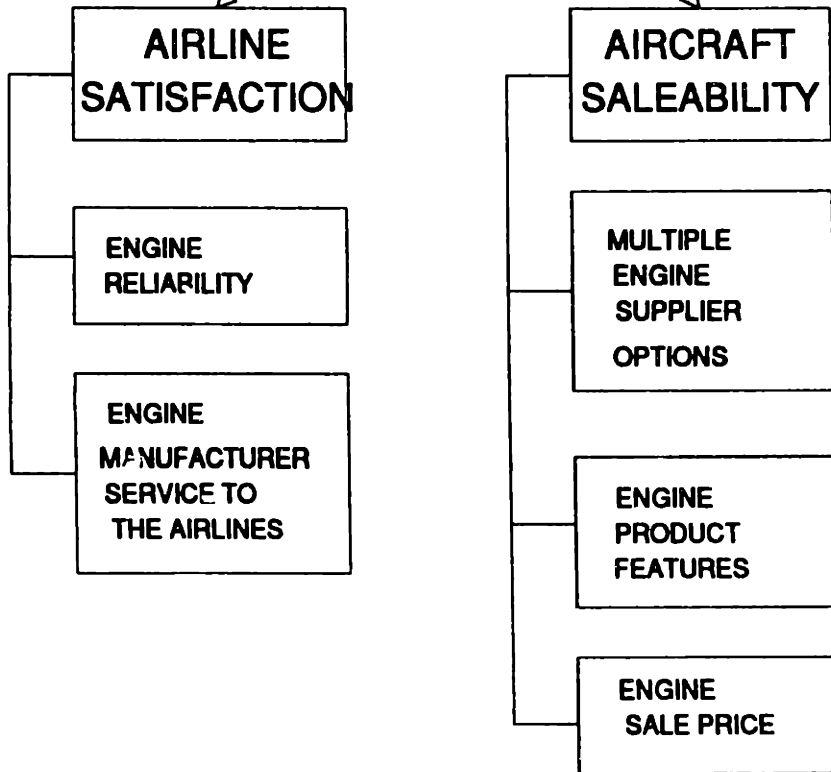
Environment:

SELL AIRCRAFT

Needs:

ENGINES FOR THEIR
AIRCRAFT

Engine Purchase
Objectives:



The aircraft manufacturer's engine supplier decisions are also driven by an overall objective of maximizing aircraft salability. The primary engine factor that influences the aircraft's salability is the number of engine supplier options offered. Since the mid 1970's the aircraft manufacturers have offered multiple engine supplier options on most aircraft. This gives the airlines the opportunity to standardize engines across aircraft types and to receive, through competition, better purchase conditions from the engine manufacturers.

Secondary factors that influence an aircraft's salability are product features and sale price. Engine product features such as fuel consumption and thrust have a significant impact on an aircraft's performance characteristics. However, any aircraft salability advantages arising from the engine product features are nullified by the same engine being offered on the competitor's aircraft. In the future, there may be special cases where an aircraft is designed to take advantage of a new technology engine. That aircraft may achieve a salability advantage if the competition does not have an aircraft capable of using that engine. Engine sale price is generally not a major concern for the aircraft manufacturer since competing aircraft offer the same engines and the airlines negotiate directly with the

engine manufacturers. For the aircraft with a single engine supplier, the aircraft manufacturer tends to be more sensitive to price.

There are only two aircraft today that have a single engine supplier; McDonnell-Douglas's MD-80 series aircraft and Boeing's 737 series aircraft. In the engine selection phase, the engines available for use did not permit multiple engine supplier options. Each aircraft was designed initially in the 1960's and was updated in the late 1970's. At the time of the update, there were two engines available to power the aircraft; Pratt and Whitney's turbojet engine that used to power both aircraft in the 1960's and 1970's, and the CFM International's (General Electric and SNECMA) modern turbofan engine. The two engines were sufficiently different to require aircraft structural interfaces which prevented both engines from being offered on the same aircraft. McDonnell-Douglas decided not to change its engine support structure and kept Pratt and Whitney as the sole engine supplier. Boeing chose to use the more efficient engine with CFM International as the sole supplier. Both aircraft have sold well with more than 800 MD-80 aircraft sales and more than 1100 737 aircraft sales since 1980.^{1/}

Today there is a newer International Aero Engine [IAE] engine available which could be offered on either aircraft. The MD-80 aircraft would still require structural changes to be compatible with a modern turbo fan engine. The 737 aircraft has sold so extensively that there are few airlines left that do not already operate the existing aircraft/engine combination. There is no improved salability advantage for Boeing to offer IAE as a second engine supplier option.

5.2 ENGINE MANUFACTURER INTERFACE PROCESS AT BOEING

The aircraft manufacturer's primary purchase objective is to improve aircraft salability by having multiple engine supplier options on all new aircraft. The aircraft manufacturer accomplishes this through extensive communication and coordination of aircraft development plans with the engine manufacturers so that each will be convinced that the potential market justifies the adaption or development of an engine.

Boeing utilizes an Engine Management Office and quarterly management reviews with each of the engine manufacturers to aid communication and coordination on new aircraft and engine development. The Engine Management

Office administers the purchase and delivery of all engines plus coordinates all technical communication. It provides a degree of continuity to the many different projects that the various organizations within Boeing are working on.

There are three different product development groups at Boeing looking at new and derivative aircraft that Boeing could develop for future production. As their ideas evolve and change, they look to the engine manufacturers for engine capabilities that would be compatible with their aircraft ideas. This communication goes through the Engine Management Office which coordinates the various requests from inside Boeing and, for the engine manufacturer's benefit, assign relative importance.

Even with the Engine Management Office as a central Boeing voice to the engine manufacturers, Phil Condit, Executive Vice President for Boeing is concerned that the engine manufacturers will get mixed signals about Boeing's product development plans.^{2/}

The engine manufacturers get a whole range of signals of varying strength. . . It is a very dynamic market place, competitors are changing, and airline inputs are coming in. What may have been true six months ago may not be true now.

The solution implemented by Boeing has been a series of quarterly management review meetings with each of the engine manufacturers. It provides Boeing an opportunity to explain its product development strategy and possibly influence the engine manufacturer's engine development strategy in its favor. These meetings are also an opportunity to share feedback from the airlines concerning product needs.

The engine manufacturers generally try to have engines available to power the new aircraft developed by the airlines. Boeing's extensive engine communication and coordination efforts is helping to assure that each of the manufacturers will be successful in having the correct engine available for future Boeing aircraft.

Boeing maintains strict neutrality through all of its dealings with the engine manufacturers. As John Hayhurst, Vice President of Marketing for Boeing said:^{3/}

We bend over backwards not to give one engine manufacturer an advantage over the other.

Also, as Joe Masterson, Manager of Engine Management for

Boeing said:^{4/}

With multiple engines you have to keep everyone [the engine manufacturers] at arms length. We can not actively or passively favor one engine.

Boeing is also forced to place a high degree of trust in the engine manufacturer's being neutral between aircraft manufacturers. Phil Condit described his approach to the quarterly management review meetings as follows:^{5/}

If I am too clandestine, holding my cards too close to my vest because I am afraid you [the engine manufacturer] might tell Airbus, then you [the engine manufacturer] are not sure what I am doing and can not be responsive. Instead I am open and tell each company what I am thinking.

FOOTNOTES

1. Data compiled from data provided by General Electric, January, 1989.
2. Phil Condit, Executive Vice President for Boeing, Interviewed by the author, Seattle, Washington, 13 January, 1989.
- 3. John Hayhurst, Vice President of Marketing for Boeing, Interviewed by the author, Seattle, Washington, 13 January, 1989.
4. Joe Masterson, Manager of Engine Management for Boeing, Interviewed by the author, Seattle, Washington, 13 January, 1989.
5. Phil Condit, Executive Vice President for Boeing, Interviewed by the author, Seattle, Washington, 13 January, 1989.

CHAPTER SIX

MARKETING STRATEGY FOR COMMERCIAL AIRCRAFT ENGINES

A successful marketing strategy is based on meeting the customer's purchase objectives better than the competition. In previous chapters the engine purchase objectives of the airline customers and aircraft manufacturer customers were identified. This chapter will use those purchase objectives to define the marketing strategies used by the engine manufacturers and explain the sales results in each of the engine size categories.

6.1 MARKETING STRATEGY FOR SELLING TO THE AIRLINES

The airline's engine purchase objectives were identified in chapter 4 and grouped, as shown in Figure 6.1, into the categories of services, product features, and purchase conditions. A successful marketing strategy is to be the industry leader in meeting the airline's engine services and product feature objectives. Leadership in services includes timely delivery of spare parts, prompt implementation of solutions to engine technical problems, and continual technical support to the airline's technical and maintenance organizations. Leadership in product features includes superior technical capability, low cost of operation, and low technical risk.

FIGURE 6.1
AIRLINES' ENGINE PURCHASE OBJECTIVES

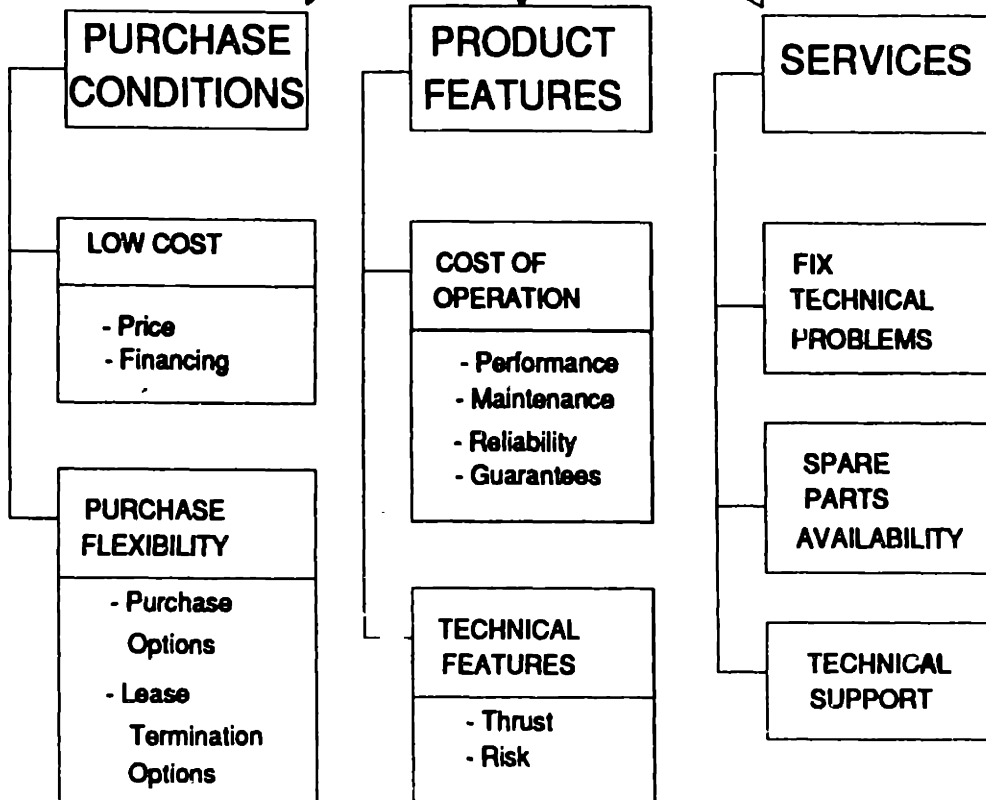
Environment:



Needs:



Engine Purchase Objectives:



The success a manufacturer has in being the industry leader in services and product features will likely influence the strategy used to address the airline's purchase condition objectives. If a manufacturer is the market leader in services and product features, its engine will have a higher value to the airlines than the competitor's engine. The purchase condition strategy will likely be to sell the engines for fewer price concessions than the competitor. The manufacturers who are behind in services and product features must be sure to achieve a minimum acceptable market share to keep their engine's production at an efficient level. Their purchase condition strategy will likely be to increase price concessions to maintain a minimum acceptable market share. With sufficient concessions the manufacturer should be able offset the competitor's higher service and product feature value.

The sales results in each of the three commercial aircraft engine thrust classes can be used to evaluate the impact each manufacturer's ability to meet the airlines' purchase objectives has on its market share. The large thrust class appears to be dominated by leadership in product features, the medium thrust class appears to be dominated by leadership in purchase conditions, and the small thrust class appears to be dominated by the product

features of aircraft with single engine suppliers.

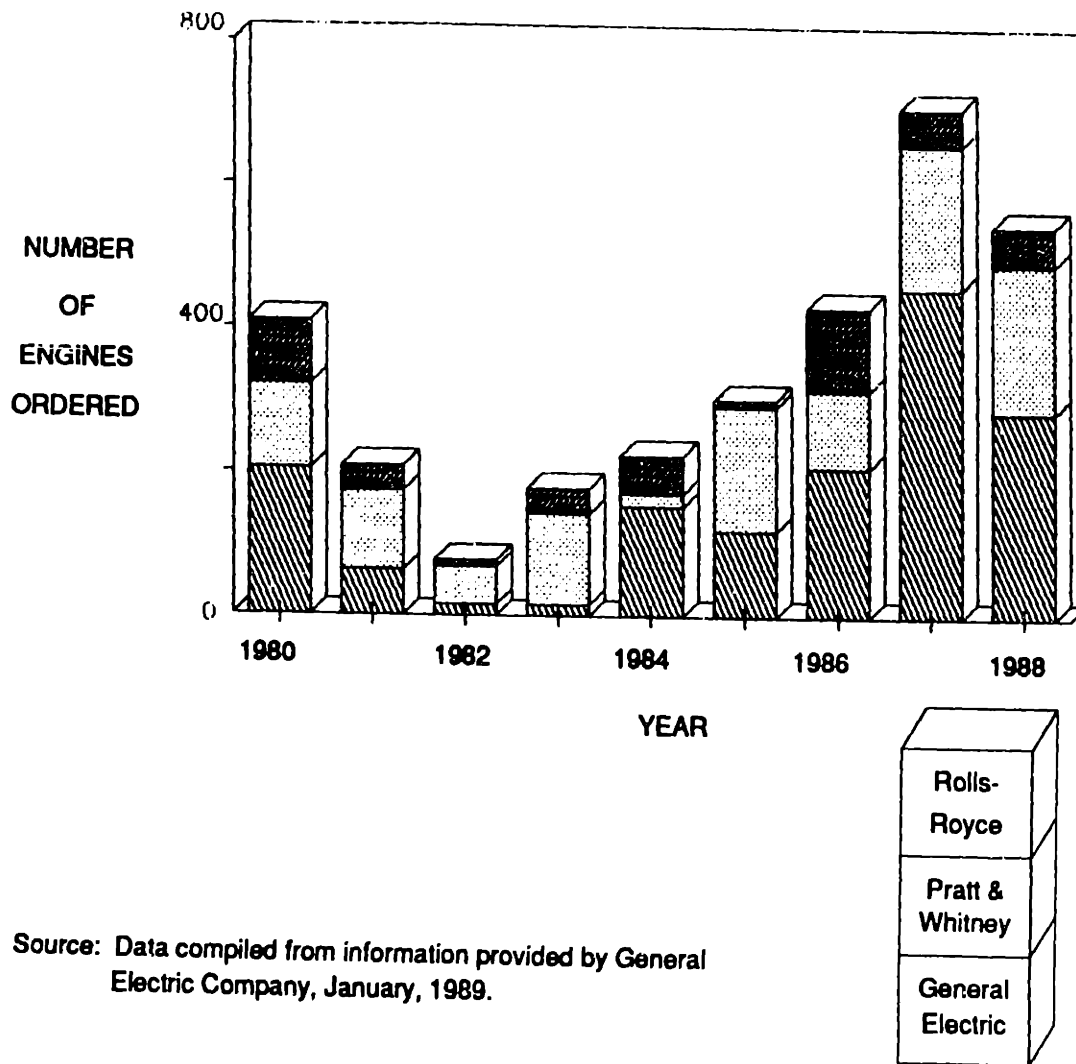
6.2 MARKETING RESULTS FOR THE LARGE THRUST ENGINES

The large commercial aircraft engine thrust class has provided the airlines the largest number of engine choices on the largest number of aircraft models. There are four aircraft models that offer the airlines a choice between engines manufactured by General Electric and Pratt and Whitney plus two other aircraft models that offer the airlines a choice between engines manufactured by General Electric, Pratt and Whitney, and Rolls-Royce. This creates extensive competition and makes marketing a key aspect of success in this thrust class.

Since 1980, as shown in Figure 6.2, Rolls-Royce has maintained a relatively stable 10 to 20 percent market share while General Electric and Pratt and Whitney have had substantial changes in market share position. General Electric had a market share advantage in 1980 that quickly declined to less than ten percent by 1983 while Pratt and Whitney's market share rose to over 70 percent. Unfortunately for Pratt and Whitney, this was a time of weak market demand with total 1982 engine orders of less

FIGURE 6.2

COMMERCIAL AIRCRAFT ENGINE ORDERS:
LARGE THRUST CLASS



Source: Data compiled from information provided by General Electric Company, January, 1989.

than 100. General Electric regained the market share lead in 1984 at the expense of Pratt and Whitney and has held that position during a period of record industry sales. In 1987 over 700 engines were ordered. Even Pratt and Whitney had its best year of the 1980's with over 200 engine orders.

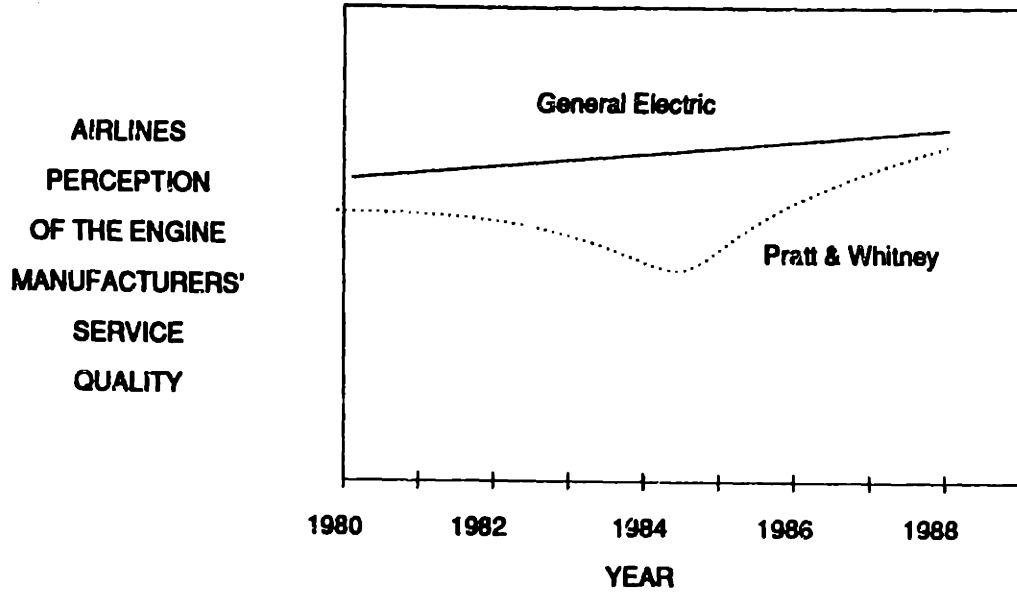
The variations in General Electric's and Pratt and Whitney's market shares can be explained by the effectiveness of each manufacturer in implementing the marketing strategy of meeting the airlines' engine product feature and feature objectives. Figure 6.3 shows the author's estimation of their relative position in services and product features. General Electric's advantage in meeting the airlines' service objectives is based on its strong reputation and Pratt and Whitney's poor reputation for product support. A key strategy of General Electric when it entered the commercial engine business in the late 1960's was commitment to the airlines. General Electric implanted throughout the company a commitment to the customer which continues today. As Ray Grismer, Manager - Airline Sales for General Electric said:^{1/}

We are a partner with the airline. Ideally we prefer to never have to look at the contract once it is signed because making the engine a total success for the airline is our real concern.

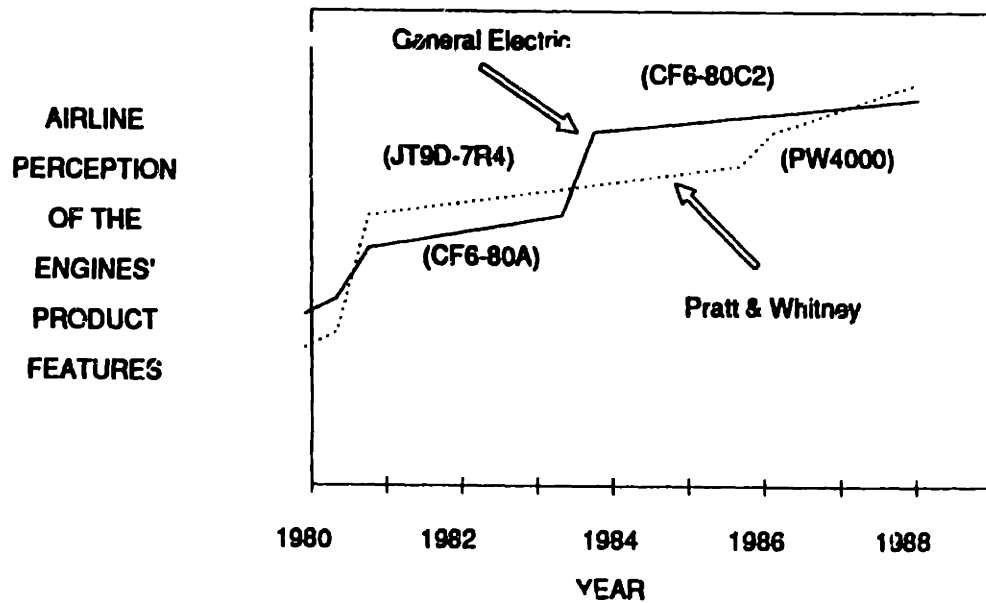
FIGURE 6.3

ESTIMATION OF RELATIVE POSITION IN MEETING AIRLINES' ENGINE PURCHASE OBJECTIVES

A) SERVICES



B) PRODUCT FEATURES



Also, as Gil Eckler, Director - Airline Sales for General Electric said:^{2/}

When you buy an engine from General Electric, you are buying a part of the General Electric company.

In discussing the reasons behind General Electric's success Tom Wilson, Manager of CEO Business Requirements for General Electric, said:^{3/}

There are no spectacular moves . . . it is being reasonably innovative and aggressive, and doing what we told people we would do. We have been relentless in fixing problems. There is no debating whose problem it is. If it does not work to General Electric standards it needs to be fixed. General Electric needs to continue to do those things, continue to play to the customer.

While General Electric was being successful in meeting the airline's Service objectives Pratt and Whitney was having difficulties as summarized in the Wall Street Journal:^{4/}

Making matters worse for Pratt and Whitney was a growing reputation for poor service and tardy spare parts deliveries to customers. Bob Doll, head of maintenance operations at United Airlines, recalls having so many problems with Pratt's service that "I knew the first names of all their VPs and had their telephone numbers in my head because I was always calling to expedite things".

Stimulated by the loss of a key customer, Japan Air Lines, in the mid 1980's Pratt and Whitney overhauled its product support and is reestablishing its reputation.

Increases in the manufacturers' ability to meet the airlines' product feature objectives has been gradual within an engine generation but sudden between engine generations. In 1980 General Electric had a product that met the airlines product feature needs better than Pratt and Whitney. However, in the next generation, Pratt and Whitney's product development strategy enabled its JT9D-7R4 engine to take an advantage in product features. The engine had higher thrust capability than General Electric's engine and was interchangeable on all the wide-body aircraft of that time including the 747, 767, A300, and A310 aircraft. General Electric used a two engine strategy with the older CF6-50 engine being used on the existing 747, A300, and DC-10 aircraft, and the new CF6-80A engine being used on the new 767 and A310 aircraft. As described in Interavia:^{5/}

Pratt and Whitney had fitted a bigger fan and low-pressure system to its engine. General Electric had no rival to the high-thrust JT9D-7R4, which took an increasing share of the 747 and A300 market.

General Electric's CF6-80A engine did have some product feature advantages including better reliability, maintenance cost (by \$30/hour),^{4/} and weight (by 400 pounds).^{5/} However, it was insufficient to overcome the commonality and thrust advantages of Pratt and Whitney's engine.

General Electric's poor position in product features and declining market share led to the development of the CF6-80C2 engine, a derivative of the CF6-80A engine. Started in 1980, it maintained the CF6-80A engine's reliability, maintenance cost, and weight advantages and added higher thrust capability, improved performance, and commonality across aircraft applications. The CF6-80C2 engine put General Electric ahead of Pratt and Whitney in product features.

Pratt and Whitney was slow to respond to General Electric's new engine and was behind in product features for a few years. The ultimate response, the PW4000 engine, was designed to retake the lead in product features. They chose not to develop a derivative engine, but rather redesign every part of the engine to best optimize performance, reliability, maintenance cost, and weight. Initially, without service experience to prove the engine's capabilities, technical risk concerns offset

some of the advantages achieved in cost of operation. When the engine entered service its overall position in product features was probably still behind General Electric's engine. Today Pratt and Whitney's engine is in service, the technical risk concerns are being eliminated, and the product features are being demonstrated. This is improving their position in product features to the point that they are either equal to or ahead of General Electric's engine

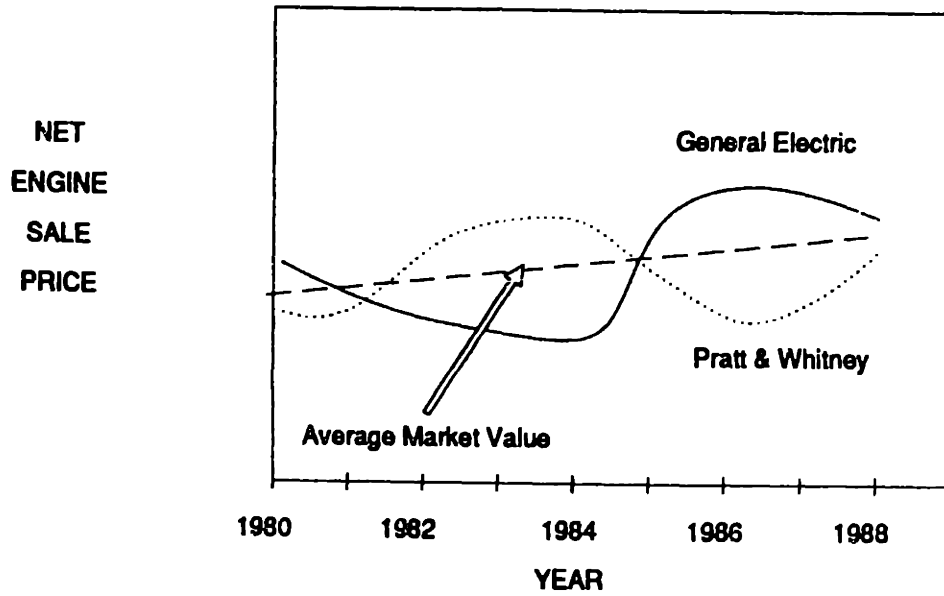
In the large thrust class product features have been a key to changes in market share including Pratt and Whitney's leading share in 1981-83, General Electric's leading share in 1984-88, and Pratt and Whitney's recovery in 1987-88. Services played a secondary role which probably contributed to the rapid growth in General Electric's market share during 1984-85. One of the reasons given for Japan Air Lines, a long time Pratt and Whitney customer, selecting General Electric was service quality.

The net sales price, list price less concessions, is proprietary to the manufacturers and the airlines. The author's speculation on relative net sales price since 1980 for both General Electric and Pratt and Whitney is shown in Figure 6.4. In 1980 both Pratt and Whitney and

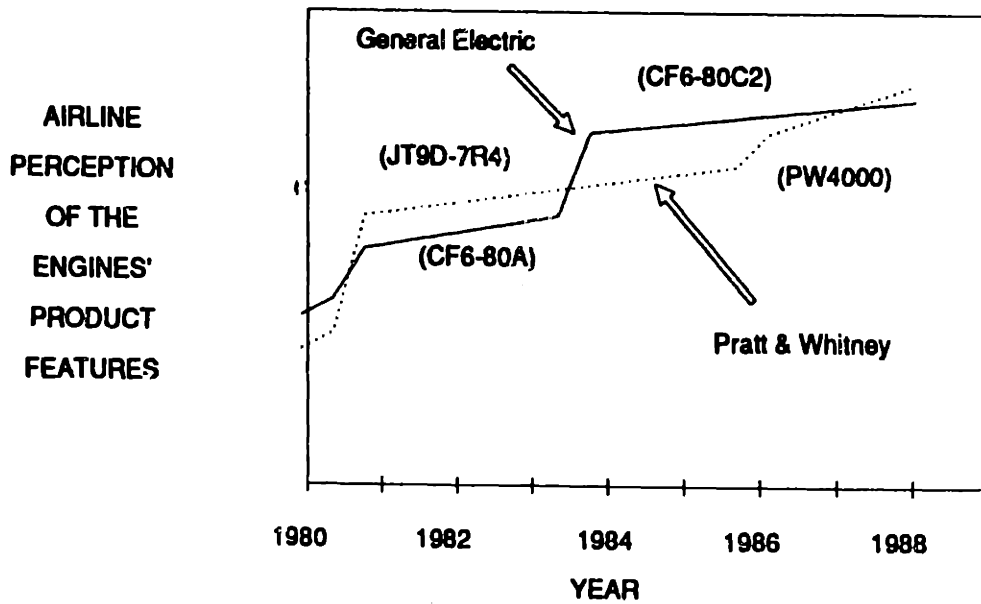
FIGURE 6.4

ESTIMATION OF RELATIVE ENGINE SALE PRICE

A) NET ENGINE SALE PRICE



B) PRODUCT FEATURES



General Electric were launching new engines and were likely in a price competition for new orders. With better product features, Pratt and Whitney gained market share and may have been able to obtain sales with fewer concessions. As General Electric's market share fell, it probably had to give larger concessions to make the few sales it did. With the introduction of the CF6-80C2 engine, General Electric regained the product features advantage. As the engine became accepted and began to be demanded General Electric may have been able to obtain a price premium relative to Pratt and Whitney. With Pratt and Whitney now catching up in both product features and services, it is likely that General Electric is coming under increasing pressure to reduce its price premium to make sales. Pratt and Whitney may still be discounting price to recover market share and win those airlines that have not selected the General Electric's engine.

The question now is when will the next change in engine generations occur and what will each competitor do? It appears that Pratt and Whitney, General Electric, and Rolls-Royce are working on the next generation of large engines which will have higher thrust capabilities. These engines will be available in 1992 or 1993 for use on the A330 aircraft and possibly new or stretched versions of the 767 and MD-11 aircraft. This will be the

next opportunity for the manufacturers to change their positions in product features. If one comes out ahead of the others it would start another cycle of one manufacturer having a dominant market share and receiving a premium price. If the manufacturers come out equal, it could start a price war in which none of the manufacturers will be able to obtain a price premium.

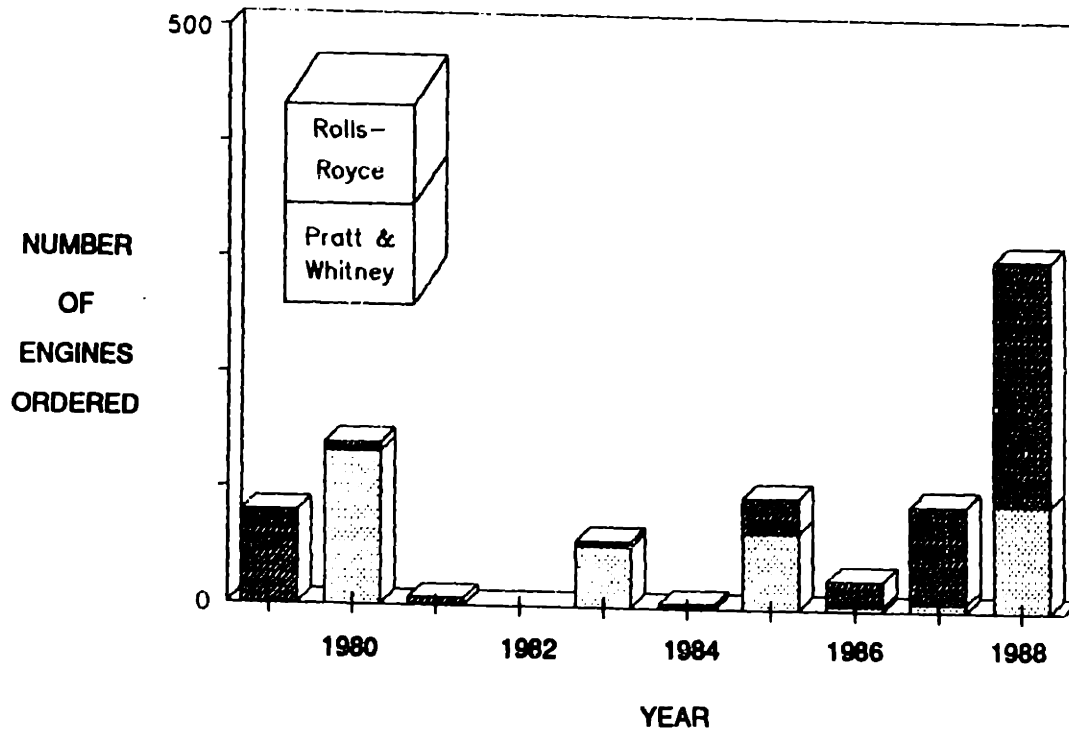
6.3 MARKETING RESULTS FOR THE MEDIUM ENGINES

The medium commercial aircraft engine thrust class has two competitors; Pratt and Whitney and Rolls-Royce. Both of these engine manufacturers developed an engine in the late 1970's and early 1980's to meet an anticipated need which has not developed as expected. The 200 passenger Boeing 757 aircraft is the only aircraft that uses medium thrust engines. Potential sales of both aircraft and engines were reduced by the shift toward smaller 150 passenger aircraft that occurred after deregulation of the U.S. airline industry in 1979.

Total engine sales, shown in Figure 6.5, for both Pratt and Whitney and Rolls-Royce were less than 100 per year from 1981 through 1987 and zero in 1982. Both manufacturers are receiving too few orders to obtain any

FIGURE 6.5

COMMERCIAL AIRCRAFT ENGINE ORDERS:
MEDIUM THRUST CLASS



Source: Data compiled from information provided by General Electric Company, January, 1989.

economies of scale in production. This has likely forced both manufacturers into a marketing strategy that is purchase condition focused and uses whatever price concessions are necessary to obtain sales. This would explain the fluctuations in market share during the first half of the 1980's. The manufacturers' relative position in product features and services could not change that rapidly. Since 1986 it appears that Rolls-Royce has been able to maintain a leadership market share. This may be an indication that Rolls-Royce has achieved an advantage in either product features or services, and the competitions are not just being decided on price.

General Electric initially started to develop a medium thrust class engine by modifying its large thrust class engine. The engine was cancelled when Pratt and Whitney followed Rolls-Royce's strategy of developing a new, non-derivative engine which was optimally sized for the medium thrust class. By either plan or luck, General Electric appears to have made the correct decision and not invested in a medium thrust class engine in the early 1980's. In the mid 1980's they attempted to gain a piece of the medium thrust market through a partnership with Rolls-Royce. General Electric was to share its large thrust engine, the CF6-80C2 in exchange for Rolls-Royce sharing its medium thrust engine and not increasing the

thrust on its large engine. The partnership fell apart when Rolls-Royce opted to increase the thrust on its large thrust class engine and continue competing with General Electric.

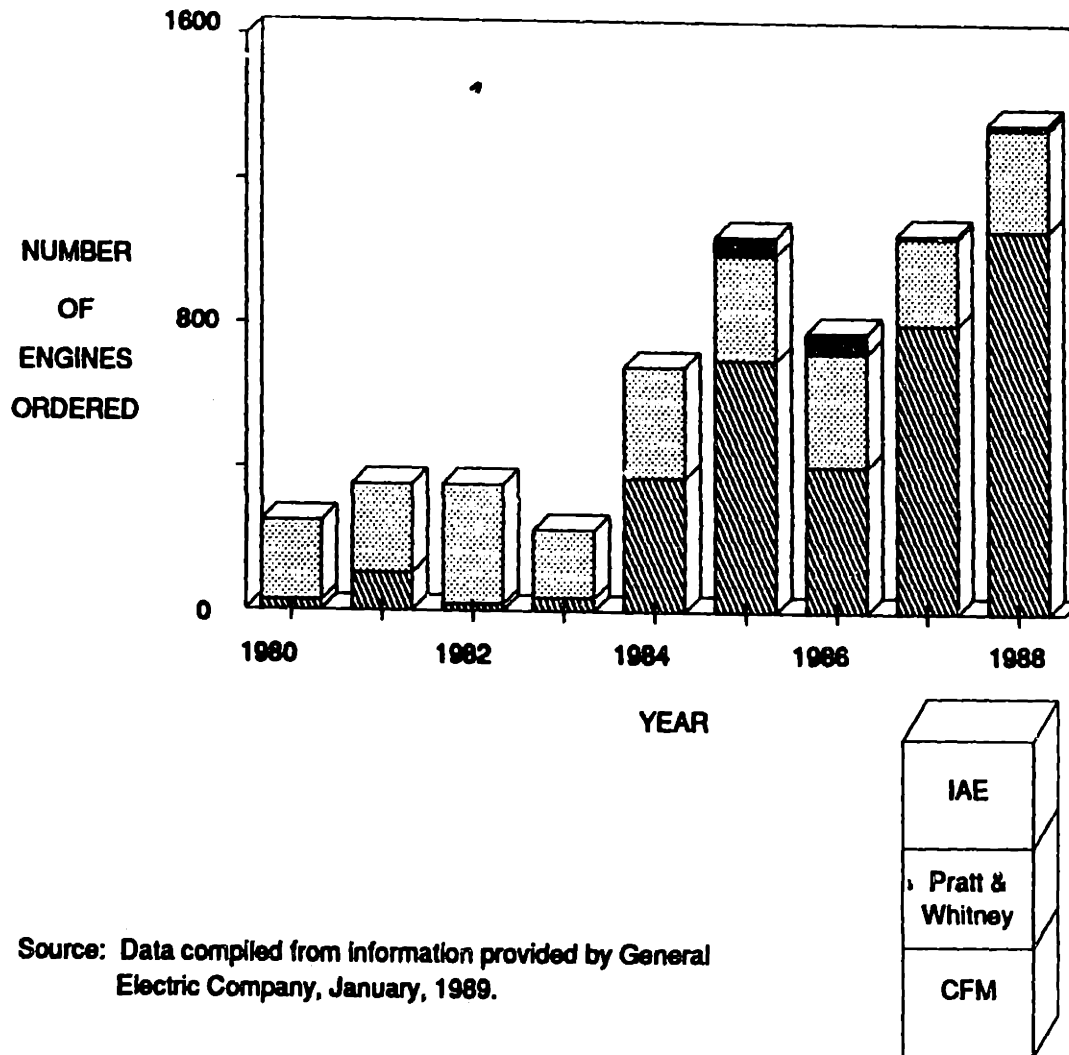
6.4 MARKETING RESULTS FOR THE SMALL THRUST ENGINES

Marketing in the small thrust class engines is different from the two larger thrust classes since most of the competition is between aircraft, not engines. The McDonnell-Douglas MD-80 aircraft has engines supplied solely by Pratt and Whitney, the Boeing 737 aircraft has engines supplied solely by CFM International (General Electric and SNECMA), and the new Airbus A340 aircraft, for the present has engines supplied solely by CFM International. Only the Airbus A320 offers an option in engine manufacturers with CFM International and IAE (Rolls-Royce, Pratt and Whitney, MTU, Fiat, and JAEC).

Dating back to the 1960's, Pratt and Whitney was the sole engine supplier in this thrust class with its engines used on Boeing's 727 and 737 aircraft and McDonnell-Douglas's DC-8 and DC-9 aircraft. Even in the early 1980's, as shown in Figure 6.6, Pratt and Whitney dominated the market with only a small number of CFM

FIGURE 6.6

COMMERCIAL AIRCRAFT ENGINE ORDERS:
SMALL THRUST CLASS



Source: Data compiled from information provided by General Electric Company, January, 1989.

International engine sales for re-engining DC-8 aircraft. In 1983 the market share began to shift with Boeing's phase out of the Pratt and Whitney powered 737 in favor of the CFM International powered 737. The CFM International powered 737 has been the largest source of small thrust class engine sales since 1984. While Pratt and Whitney has continued to receive 200 to 300 engine orders per year, its market share has dropped substantially due to the tremendous growth in this market segment supplied by the CFM International engine.

The A320 aircraft entered service in 1987 and offers both the CFM International and the IAE engines. The IAE is a new engine whose early image was hurt by compressor problems during development. In the future it could be a major competitor to CFM International, but needs to be legitimized by orders from some key airlines.

The success of the CFM International engine has been based on product features. On the 737 aircraft, the aircraft/engine combination meets the product feature needs of the airline and, as a result, is in high demand. On the A320 aircraft CFM International engine has a product feature advantage and has been sold on more of the aircraft than the IAE engine. The advantage comes from high reliability and low technical risk. While the IAE

engine is a newer design with better performance, its position in product features has been hurt by the technical risk arising from a new engine and compressor problems during development.

With the current generation of products, the inertia of the business will probably keep the CFM56 in a market leadership position. The window of opportunity for IAE, or another company will come with the next generation of engines. This may be a new engine concept like General Electric's Unducted Fan (UDF) or growth versions of the existing CFM International and IAE engines.

There has been some discussion recently of IAE trying to sell its engine on the MD-80 aircraft. That would give IAE the base from which to establish a reputation and start to develop its market share. For the CFM International engine, the opportunity for expanded market position may be in thrust growth. If the market shifts toward larger aircraft to compensate for airport congestion, a stretched A320 or 737 aircraft powered by growth CFM International engines might be able to steal some of the market from the medium thrust class engines.

6.5 MARKETING STRATEGY FOR SELLING TO THE AIRCRAFT MANUFACTURERS

The engine manufacturer's sales strategy directed toward the aircraft manufacturers is to have their engine offered as options on all aircraft. The aircraft manufacturer's purchase objectives were identified in chapter 4 and grouped, as shown in Figure 6.7, into the categories of airline satisfaction and enhanced aircraft salability. Their primary objective, to have multiple engine supplier options on all new aircraft, is essentially the same as the engine manufacturer's strategy. The implementation strategy for the engine manufacturers becomes one of understanding the aircraft manufacturer's aircraft development plans so that a suitable engine can be developed. If that is done successfully, it is likely that the aircraft manufacturer will offer the engine as an option to the airlines.

The success of the marketing strategy directed toward the aircraft manufacturers assumes that the engine manufacturer will be successful in generating sales of the engine at the airlines. This has always been the case with General Electric and Pratt and Whitney, but not with Rolls-Royce. A number of aircraft programs such as the MD-11, 767, A300, A310, and A330 started by offering just

General Electric and Pratt and Whitney engines as airlines that bought those aircraft were not interested in a Rolls-Royce engine. Rolls-Royce's strategy for having its engine offered on those aircraft has been to generate the interest in an airline for the Rolls-Royce engine on one of those aircraft. Once that happens the aircraft manufacturer, to obtain the aircraft sale, usually offers the Rolls-Royce engine as a third option. This has happened on the MD-11 and 767-300 aircraft.

As discussed in Chapter 5, there are a few aircraft that have a sole engine supplier which is an ideal situation for that engine manufacturer. The sole supplier status has continued because the aircraft manufacturers have not viewed a second engine supplier as increasing the aircraft's salability. While the aircraft salability continues to favor a single engine manufacturer, the engine manufacturer's risk is that the aircraft manufacturer will become dissatisfied with the engine manufacturer's service or product features and bring in a second source to apply competitive pressure. To prevent this the engine manufacturer's marketing strategy must focus on keeping the aircraft manufacturer completely satisfied with the engine manufacturer's service and the advancement in engine product features.

FOOTNOTES

1. Ray Grismer, Manager - Airline Sales for General Electric Company, Interviewed by the author, Cincinnati, Ohio, 4 January, 1989.
2. Gil Eckler, Director - Airline Sales for General Electric Company, Interviewed by the author, Cincinnati, Ohio, 3 January, 1989.
3. Tom Wilson, Manager of CEO Business Requirements for General Electric Company, Interviewed by the author, 4 January, 1989.
4. Stevens, C., "Delta's Order Boosts Pratt and Whitney", Wall Street Journal, September 26, 1989, 6.
5. Sweetman, B., "The Civil Big-Fan Battle", Interavia, December, 1983, 1267.

CHAPTER SEVEN
MARKETING OF GENERAL ELECTRIC AIRCRAFT ENGINES

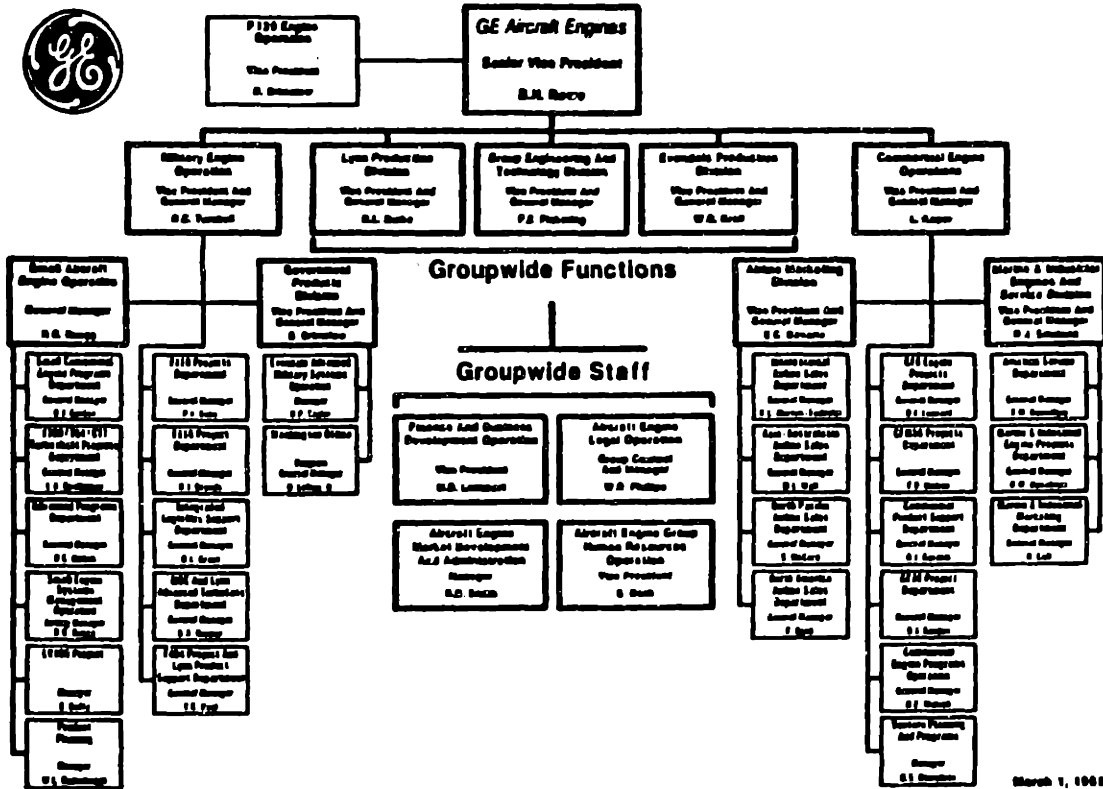
In the last chapter marketing strategies used in the commercial aircraft engine business were identified. The strategy directed at the aircraft manufacturers is to understand the aircraft manufacturer's aircraft development plans so that an engine can be developed which will meet the aircraft's need. The strategy directed at the airlines is to be the industry leader in engine product features and service and obtain a premium in purchase conditions. If an engine manufacturer is unsuccessful in achieving industry leadership in services and product features, the purchase condition strategy becomes one of providing the price concessions necessary to maintain a minimum acceptable market share.

Success in the commercial aircraft engine business requires not only an effective marketing strategy, but an effective process for implementing the strategy. This chapter will examine how one successful manufacturer, General Electric, is organized and implements its marketing strategy.

7.1 ORGANIZATIONAL ROLES INVOLVED IN SALES AND MARKETING

The General Electric Aircraft Engine Group is organized by function as shown in Figure 7.1. The

**FIGURE 7.1
GENERAL ELECTRIC AIRCRAFT ENGINE GROUP
ORGANIZATION CHART**



business aspects of the engine programs are divided up into two Operations reporting to Senior Vice President Brian Rowe with one Operation for commercial engines and one operation for military engines. Each Operation contracts with the engineering and manufacturing Divisions to perform the work necessary to support each engine program. In addition, each of the Operations and Divisions contracts for support from the group-wide staff positions of Finance, Legal, Human Resources, and Market Development and Administration. The hierarchy of management within each Operation and Division, shown in Figure 7.2, starts with the manager of the Operation or Division who a Vice President and General Manager. This is followed by General Manager, Section Manager, and Sub-Section Manager.

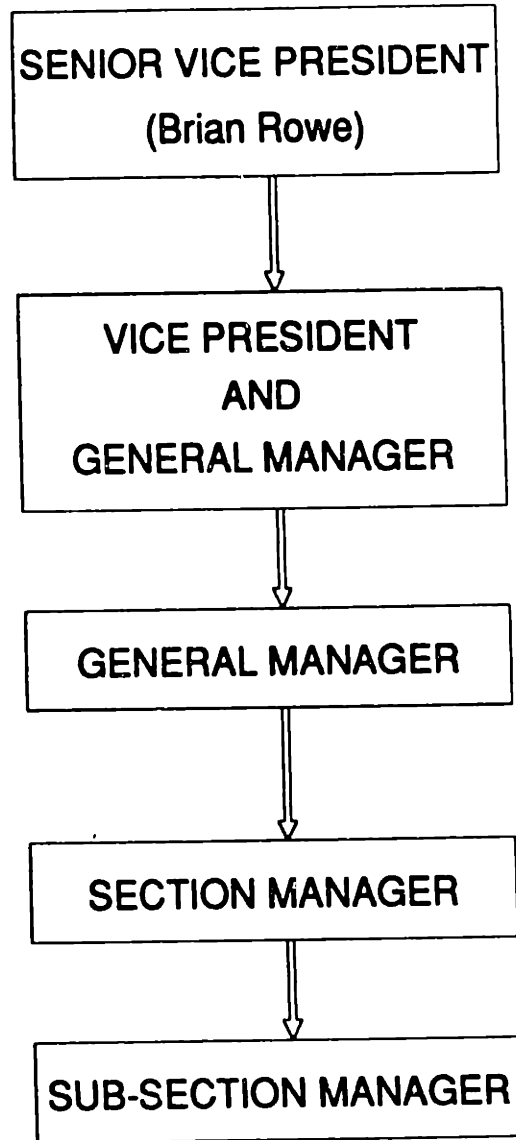
Implementation of the marketing strategies is centered in the Commercial Engine Operation where the following key groups and positions are located:

Project Group - Is the central focus for an engine program coordinating all aspects of the marketing, engineering, and manufacturing.

Market Development Manager - Is responsible for the sales and sales strategy of a specific engine program. Strategic plans are coordinated with the Project Group.

FIGURE 7.2

MANAGEMENT HIERARCHY AT GENERAL ELECTRIC



Sales Manager - Is responsible for sales to specific airlines on any engine program. Their strategies are coordinated by the Market Development Manager.

Product Support - Is responsible for coordinating the service provided to each airline.

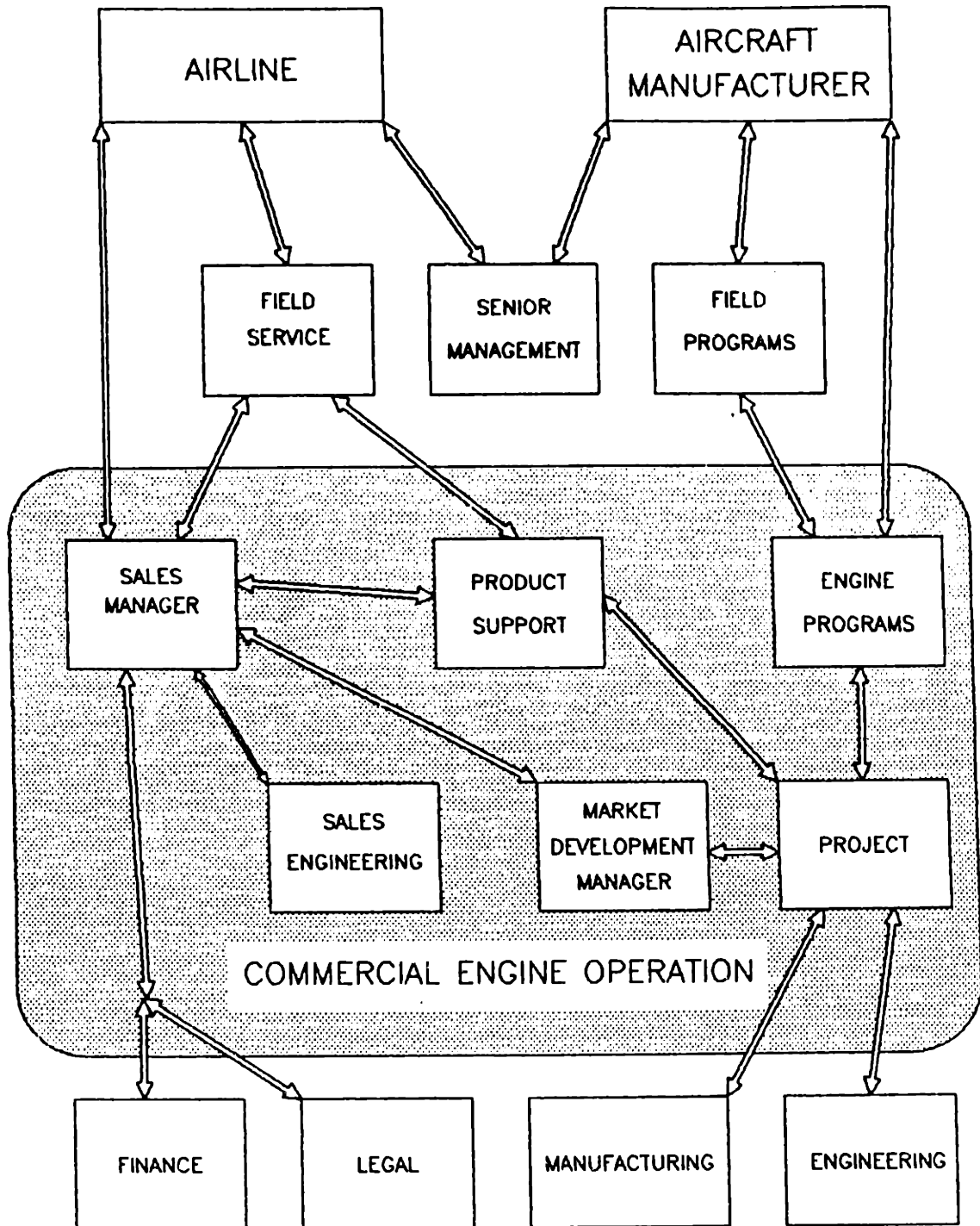
Engine Programs - Is responsible for coordinating activities and plans with the aircraft manufacturers.

The interrelationships between the positions within the Commercial Engine Operation, the customers, and other Aircraft Engine Group organizations are shown in Figure 7.3. Communications with the aircraft manufacturer are coordinated by the Engine Programs Manager and an on-site Field Programs office. Communications with the airlines are through the Sales Manager, Product Support, and on-site Field Service Office.

The responsibility for implementing the marketing strategy directed towards the aircraft manufacturers is with the Market Development Manager and the Sales Managers. The responsibility for meeting General Electric's strategy of being the market leader in satisfying airlines engine service objectives is with the Product Support organization and the Field Service Office. A group consisting of Project, the Market Development Manager, the Engine Programs Manager, and senior management implements the engine development strategy

FIGURE 7.3

GENERAL ELECTRIC'S USE OF ITS ORGANIZATION IN
MARKETING COMMERCIAL AIRCRAFT ENGINES



designed to provide market leadership in satisfying the airline's product features objectives.

Further detail on the role and responsibilities of each position involved in implementing General Electric's commercial engine marketing strategy is provided in Appendix C.

7.2 THE SALES CAMPAIGN - WINNING THE CUSTOMER OVER TIME

The actions and interactions of the different parts of the General Electric organization in implementing the marketing strategy can best be described in the context of a generic sales campaign for selling engines to a specific airline. The process is divided into pre-evaluation, evaluation, and post-evaluation.

7.2.1 PRE-EVALUATION - CUSTOMER DEVELOPMENT

The sale of engines to an airline begins with the airline's primary contact with General Electric, the Sales Manager. The Sales Manager's initial objective is to know his airlines. As Gil Eckler, Director - Airline Sales for

General Electric, said:^{1/}

My job is to know my customers from the very top to the very bottom of their organization. I know what their requirements are, and apply my products to meet those requirements.

Also, as Tony Rascov, Manager - Airline Sales for General Electric, said:^{2/}

Our measurement is to know the customer, to get inside the customer, to be able to know what his plans are, where he is going, and what his future is. . . . Those who are successful know what is going on in this business.

This is accomplished through regular contact and visits, even if the airline is not buying. It helps the Sales Manager to understand the airline's needs and the emphasis the airline places on its different engine purchase objectives. This enables the Sales Manager, when negotiating with the airline, to put together sales proposals that best reflect the airline's specific needs. The visits also offer the Sales Managers a chance to sensitize the airlines to the advantages of General Electric's engines in terms of product features and

services. As Rascov said:^{3/}

We must always communicate that [product advantages], not just when they are ready to buy. . . . If we do that our product will be preferred.

These types of visits are just as important with airlines that operate General Electric engines as with airlines that do not operate General Electric engines and just as important the day before an airline makes an engine purchase as it is the day after an airline makes an engine purchase. In the early 1970's when General Electric was getting started in the commercial engine business, it often took many years of regular visits before the airline would purchase an engine from General Electric. Many of the Sales Managers talk with pride about patiently working with an airline for ten years or more before making a sale.

Before visiting an airline, the Sales Manager needs to be knowledgeable about how General Electric's engines at the airline are doing and what is being done to fix any problems. The best sources of information are the Field Service representative located at the airline and the Product Support organization with whom the Sales Manager works very closely. The Sales Manager has a proposal

group put together a short, professional, brochure which can be used as a presentation guide and left with the airline's management.

Some airlines are easier for the Sales Manager to get into than others. For those that are more difficult, the Sales Manager makes use of every opportunity including follow-on business meetings, conferences, and industry gatherings. Once at the airline the Sales Manager usually takes his brochure and stops in at all levels of the airline from the highest to the lowest. The meetings might be short and just provide time for the Sales Manager to talk through his short brochure of key information and answer any questions. Ray Grismer, Manager - Airline Sales for General Electric, calls the process "walking the shop" or "running the trap line".^{4/}

While the Sales Managers are making their regular airline visits the Market Development Manager uses advertisements and newsletters to keep the airlines aware of General Electric and the advantages of its engines in product features and services. This supplements the Sales Manager's visits and is especially useful with smaller, more remotely located airlines that may not be visited more than once a year. The advertisements and newsletters are aimed at the airline's decision makers and contain key

messages about General Electric's engines. An example of a recent advertisement emphasizing the durability of CFM International's CFM56 engine is shown in Figure 7.4. An example of a newsletter on the CF6-80C2 engine discussing the engine's reliability, engine growth plans, and General Electric's commitment to the customer is shown in Figure 7.5.

The Market Development Manager is also looking at the competition based on negotiation feedback and public information to try and understand their strategic plans and its potential impact on General Electric's sales activity. He then works with upper management to develop sales strategies involving concessions, guarantees, and negotiation tactics that will be effective against the competition.

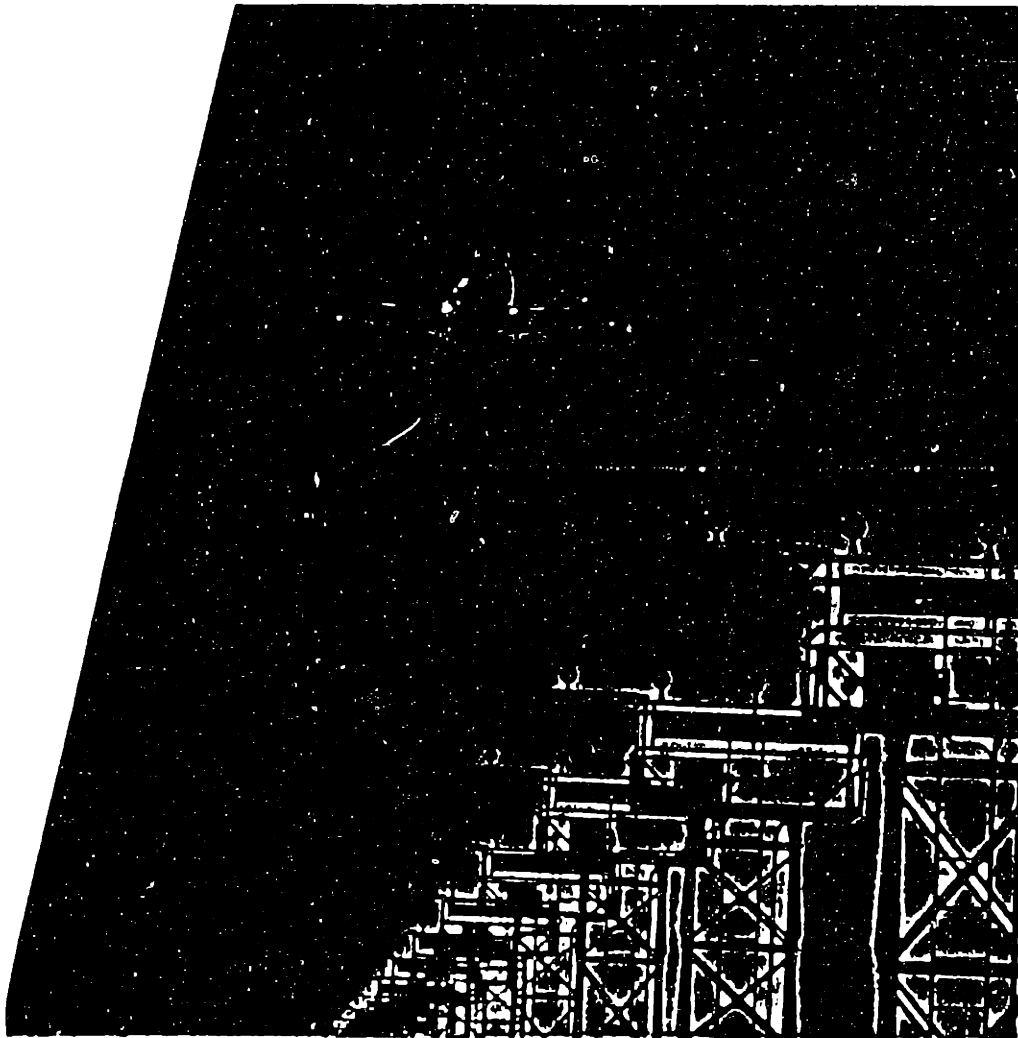
Concurrently, the Product Support organization is working with the Field Service representatives at the airline maintenance facilities to solve the everyday problems that come up in servicing an airline's fleet of engines. The Field Service representatives also pass along any information or rumors from within the airline that may be of use to the Sales Manager in better understanding what is happening at the airline.

FIGURE 7.4

GENERAL ELECTRIC COMMERCIAL AIRCRAFT ENGINE
ADVERTISEMENT EMPHASIZES DURABILITY

CFM56/Earning it.

CFM56 engines are earning a reputation for durability* that goes beyond expectations. Partly because the engine was developed specifically for one-hour flights. Partly because it offers the best of a proven design and high technology. If you don't believe it, ask an operator. Any operator.



* Before its first stop visit, a typical CFM56 engine flies over 5,000,000 miles with only routine, on-wing maintenance.

cfm  international

CFM56 is a joint product of SNECMA (France) and General Electric Company (U.S.A.)

FIGURE 7.5

GENERAL ELECTRIC NEWSLETTER EMPHASIZES
RELIABILITY, GROWTH, AND CUSTOMER COMMITMENT


GE Aircraft Engines

CF6-80C2 Report

August 10, 1986

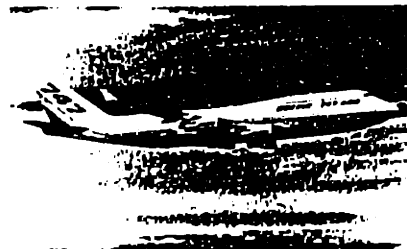
Unprecedented Reliability

We continue to be genuinely pleased with the success of our CF6-80C2 engine in service, and the broad acceptance of the engine into the airline fleets worldwide. To date, some 39 operators have placed firm orders for 303 airplanes representing 12 different aircraft types.

It has been nearly three years since the CF6-80C2 entered service. Since that time — October 1985 — the -80C2 has accumulated over 506,000 flight hours and 216,500 flight cycles on some 97 Boeing and Airbus Industrie airplanes. The engine has set a new standard of reliability for new generation high bypass turbofans in its thrust class.

Rugged and durable, the -80C2 has compiled some very impressive reliability statistics. For example, the engine's total shop visit rate stands at 0.104 with engine caused events at 0.070. On a cyclic basis, that's 0.24 and 0.162 respectively per 1000 cycles. The in-flight shutdown (IFSD) record is equally impressive. In fact, the pace is probably being set by the CF6-80A which recently completed one year on the Boeing 767 and 18 months

CF6-80C2 FADEC 747-400 Cert. Testing



on the Airbus Industrie A310 with zero in-flight shutdowns. The IFSD rate of the -80C2 is 0.016 per 1000 flight hours (.024/1000 cycles).

While our -80C2 delay and cancellation rate is a respectable 99.84, we have plans in place to drive this rate to 99.95.

It's this kind of demonstrated reliability that has resulted in the CF6-80C2 being the only new generation engine to be granted 120-minute approval for extended range operations (EROPS) by the U.S. Federal Aviation Administration and 138 minutes by the French DGAC.

CF6-80A and -80C2 engines have nearly 200,000 hours of EROPS experience, including over 8000 trans-Atlantic and over 1500 trans-Tasman crossings. About 100 of the trans-Atlantic crossings are at 138 minutes.

We expect to be the first of the new engines to be approved for 180-minute EROPS!

The -80C2 engine with full authority digital electronic control (FADEC) was certificated in March of this year. It is currently undergoing flight testing on the Boeing 747-400 certification program. To date, the -80C2 FADEC unit has performed extremely well. We expect the 747-400 with FADEC-equipped engines to be certified in February of '89 with first aircraft deliveries planned in the first quarter.

The Boeing 767 with -80C2 FADEC will be certified in March of '89.

FIGURE 7.5

(continued)

***Growth for
the Future***

We designed the CF6-80C2 with future growth in mind. Building on the success of that engine to date, we are embarking on its growth version. We have designated it the CF6-80E1.

This growth engine will meet the requirements of the Airbus Industrie A330, the increased gross weight Boeing 767 advanced derivatives and other potential wide-body applications. Our current -80C2 has the highest thrust rating in the industry

coupled with remarkable reliability. By going to a new larger 96-inch, high efficiency fan and booster, the CF6-80E1 will develop greater airflow and substantially increased thrust. The engine will initially be certified at 67,500 pounds of thrust in June 1992. With the addition of advanced materials in the engine core, the -80E1 has growth potential in excess of 70,000 pounds thrust. We will keep you informed as we move forward on this engine.

***Customer
Support***

The CF6 family of engines continues to build on a reputation of high reliability at all thrust ranges. At GE, we are committed to the tradition of offering engines of the highest quality and reliability for the airplanes the world's airlines require.

But most importantly, we are dedicated to continuing our tradition of product support second to none to meaningfully en-

hance our customers' operations, improve overall economics and contribute to their bottom line results.

Always, our prime objective is to better serve you — our customer — because, without you, there is no GE aircraft engine business. We firmly believe — the customer is Number One.

Sincerely,



F.C. Bavaria



L. Kapor

7.2.2 EVALUATION - THE COMPETITION

At some point in time the Sales Manager will find, either by airline visits or phone discussions with key airline contacts, that there are aircraft procurement studies going on within the airline. The airline may still be doing internal studies or may already be talking to the aircraft manufacturers. The Sales Manager will check on the airline's plans and objectives by talking with his key contacts at the airline and his counterparts at the aircraft manufacturers. It is beneficial for both the Sales Manager and his counterparts at the aircraft manufacturers to share information on their understanding of the airline's purchase plans. The Sales Manager just has to be careful not to provide one aircraft manufacturer information on one of its competitors. As Rascov said:^{5/}

I try to establish a close relationship with the salesmen from the aircraft manufacturers; it is very beneficial. There has to be a mutual sharing of information. However, I must be very careful not to give him information about his competition. There is a mutual respect among us.

Also, as Eckler said:^{6/}

You just have to have integrity with these guys.

The Sales Manager will develop a sales and negotiation strategy which will be approved by management and the Market Development Manager. Brian Rowe may place extra focus on the competition by calling it a "must win" situation. On occasion Lee Kapor will establish a task team to handle the negotiation and assure top priority in support within General Electric. This was done with recent key successful sales to Japan Air Lines and All Nippon Airways.

When the airline is ready to start considering the engine portion of the purchase, it will request a business proposal from each of the engine manufacturers. A business proposal contains the concessions and guarantees that the engine manufacturer is willing to make to the airline. This is one of the places that the salesman can make a difference. As Gil Eckler said:^{1/}

It is part of our job to be creative in putting together proposals that meet the customers needs.

Based on the terms the Sales Manager places in the business proposal, including concessions, the number of engines involved, estimated spare part sales, and guarantee costs, the finance organization will determine the dollar value of the sale to General Electric. The

Sales Manager's management will then either give approval to submit the proposal to the airline or request changes. If guarantees are involved, the Project organization's approval will also be obtained.

A series of meetings will be held with the airline where the Sales Manager, possibly his manager, and possibly the Market Development Manager will explain the proposal and justify the value of the engine. At the same meetings the airline will explain its needs, why the proposal is insufficient, and why more concessions are required. There may be financing discussions in which case the Sales Manager will bring a representative from the financial organization. The airline may have technical questions or want a technical briefing in which case members from the engineering organization will also join the Sales Manager. Members of the Product Support organization will attend meetings with those airlines that consider product support to be especially critical.

The sale of the engines to the airline comes down to highly strategic, high stakes negotiations in which the airlines use competition between manufacturers to get the lowest purchase conditions possible while each engine manufacturer tries to make the sale for the highest purchase conditions possible. It is in the negotiation

that the Sales Manager earns his pay. As Ray Grismer said:^{8/}

We have to know where to draw the line. We use judgement. . . . We take the big picture of what the sale is going to do for General Electric. If it will not do much for General Electric, it provides a good reason to tighten up. We also rely on experience and, of course, the line drawn by management represents the upper limit.

Some negotiations may require the Sales Manager to utilize the General Electric Corporation to help with offset purchases. Some foreign, government owned airlines may demand offset purchases as part of the engine purchase contract. While the Aircraft Engine Group may not be in a position to use the country's export materials, other businesses within the General Electric Company may be able to help.

Commenting on the final stages of the negotiation with the airline, Vince DiGiovanni, CF6 Market Development Manager for General Electric, said:^{9/}

I keep trying to figure out the customer; what motivates him, how he acts and how he will react. It is not always easy to understand during a competition. I can usually feel when we are winning. When we are not winning I try to figure out what I can do to turn things around but am usually not successful.

The final negotiations are performed by a small group from General Electric typically consisting of the Sales Manager, his manager, the Market Development Manager, a legal contracts representative, and a finance representative. With the smaller airlines, this group is usually able to complete the negotiations and come to an agreement. However, with the larger airlines, the size of the orders and the airline's prestige result in severe competition between manufacturers. At General Electric this usually means that, due to the size of the concessions needed to make the sale, a member of senior management such as Lee Kapor or Brian Rowe get involved in the final negotiations.

7.2.3 POST EVALUATION - RESPOND TO A WIN OR A LOSS

When the airline selects a competitor's engine, it is very disappointing, especially for those involved in the negotiations. As Eckler put it:^{10/}

We do a lot of soul searching. I personally take it very hard. My logical head says you can not win them all, but when I am in a competition I have to have a mind set that I am going to win.

The Sales Manager and Market Development Manager try to obtain a debriefing from the airline to find out what was done wrong and why General Electric did not win. Sometimes it is as simple as price, other times it involves more internal airline issues. After the loss, the Sales Manager goes back to visiting the airline periodically and looks ahead to the next competition.

When the General Electric engine is selected, it marks the beginning of activity starting with turning the negotiated business proposal into a contract. The Sales Manager negotiates the contract wording while making extensive use of the legal organization. In the end, when both the airline and General Electric are satisfied with the contract wording they sign the document. The document, as described in Chapter 3, is a Product Support Agreement with a side letter providing all the concessions and guarantees.

The large U.S. airlines may choose to announce the aircraft purchase at a conference for the stock analysts that follow the airline. This provides the airline a chance to sell the analysts on the airline and its plans for the future. General Electric would also like to take advantage of the publicity from the purchase to enhance its reputation in the industry and the reputation of the

General Electric Company among the stock analysts. Prior to the announcement, the Sales Manager may provide the airline with slides and words describing the engine for the airline to use at the announcement.

After the announcement, the job of meeting the commitments to the airline is turned over to the Product Support and Project organizations. The Project organization schedules engine production and deliveries while the Product Support organization works with the airline to set up maintenance capability and spare parts inventory prior to arrival of the first aircraft.

The Sales Manager continues to visit the airline on a regular basis to monitor the preparation for the new engines and the airline's overall satisfaction with General Electric. He also continues to listen to the customer's plans and needs so that he will be ready for the next competition.

7.3 PRODUCT DEVELOPMENT STRATEGY IMPLEMENTATION

The relative position of the engine manufacturers in product features is driven by the product development decisions of each Manufacturer. As a result, the product

development decisions made today will impact the competitive position of each engine manufacture five to ten years in the future. They involve the highest levels of management in selecting the engine's size, capabilities, and timing of introduction to be compatible with the available resources. Each manufacturer tries to leap-frog the others and gain a strategic competitive advantage, even if for a short period of time. If the demand is not there, or the competition implements a better product development strategy, the new engine will not sell well and lose money. Success is a result of hard work and a fair amount of luck.

The product development decision process starts with Ron Welsh, General Manager of Commercial Engine Programs Operation. He is closest to the aircraft manufacturers and has the best understanding of their aircraft development plans and engine needs. He, along with a small team which he calls the "think tank" consider General Electric's product position within the marketplace and where it should be going. They do a lot of brainstorming and develop a proposed business strategy. The work of Welsh's "think tank" gets combined with the thoughts of upper management, Project, and the Market Development Manager. Many engineering studies are made of different engine options and extensive use is made of

Sales Engineering's product demand forecast. In the end the product development options are narrowed down to the final choices. Brian Rowe, with input from his staff, makes the final product development decision which can impact General Electric's financial and competitive position for an extended period of time.

FOOTNOTES

1. Gil Eckler, Director - Airline Sales for General Electric Company, Interviewed by the author, Cincinnati, Ohio, 3 January, 1989.
2. Tony Rascov, Manager - Airline Sales for General Electric Company, Interviewed by the author, Cincinnati, Ohio, 5 January, 1989.
3. Ibid.
4. Ray Grismer, Manager - Airline Sales for General Electric Company, Interviewed by the author, Cincinnati, Ohio, 4 January, 1989.
5. Tony Rascov, Manager - Airline Sales for General Electric Company, Interviewed by the author, Cincinnati, Ohio, 5 January, 1989.
6. Gil Eckler, Director - Airline Sales for General Electric Company, Interviewed by the author, Cincinnati, Ohio, 3 January, 1989.
7. Ibid.
8. Ray Grismer, Manager - Airline Sales for General Electric Company, Interviewed by the author, Cincinnati, Ohio, 4 January, 1989.
9. Vince DiGiovanni, Manager of CF6 Market Development for General Electric Company, Interviewed by the author, Cincinnati, Ohio, 4 January, 1989.
10. Gil Eckler, Director - Airline Sales for General Electric Company, Interviewed by the author, Cincinnati, Ohio, 3 January, 1989.

CHAPTER EIGHT

DISCUSSION OF COMMERCIAL AIRCRAFT ENGINE MARKETING

8.1 MARKETING STRATEGY

In this study the marketing strategy used in the commercial aircraft engine business was described. The marketing strategy directed towards the airlines consists of being the market leader in meeting the airline's purchase objectives, of product features and services, and receiving a premium in purchase conditions to reflect the increased value of the engine to the airline. If unsuccessful in being the market leader in either product features or services, the purchase condition strategy is one of providing the concessions necessary to retain a minimum acceptable market share.

The marketing strategy directed at the aircraft manufacturers consists of understanding the aircraft manufacturer's aircraft development plans so that an appropriate engine can be developed for use on that aircraft. If successful, the aircraft manufacturer will offer the engine as an option on the aircraft to meet its engine purchase objective of enhancing aircraft salability through multiple engine options.

An important part of the marketing strategy is leadership in product features which generally leads to market share leadership and likely the ability to obtain a

premium in purchase conditions. However, continued technological advancement makes it difficult for one manufacturer to maintain an advantage in product features for more than a few years. A key is to have the advantage during times of high market sales volume so that the market share advantage can be extended due to the inertia generated by spare parts and follow-on sales. Such a characteristic is what Michael Porter in his book Competitive Advantage calls "first mover advantages".^{1/}

Technical leadership is strategically desirable when first mover advantages exist. These allow a leader to translate a technology gap into other competitive advantages that persist even if the technology gap closes.

Up to now the marketing strategy has been discussed relative to the airlines and their purchase objectives which include services, product features, and purchase conditions. Leasing companies are an important customer who have been placing larger percentages of the aircraft orders in recent years. In 1988 they accounted for 25 percent of all aircraft orders. Their purchase objectives are strictly focused on purchase conditions and lease revenue. The marketing strategy for the leasing companies must therefore focus on providing purchase conditions more favorable than the competition. The manufacturer with the market share advantage and better product features may be

able to achieve a premium in purchase conditions if the leasing company can be convinced that it will receive higher lease revenue based on the engine selection.

8.2 FUTURE TRENDS IN THE AIRCRAFT ENGINE BUSINESS

The most difficult part of implementing the marketing strategy is the product development decisions which will affect product features. Since the time from initiating product development to production is five years, there is a risk that the environment may change and adversely affect the return on the investment. A reduction in development time would reduce the risk by reducing the opportunity for the environment to change and providing a faster return on investment. Reduced development time would also be a source of competitive advantage through faster implementation of new technology. With continued advancement in design and manufacturing capabilities the engine manufacturers will likely place increased focus on reducing development time.

A strong trend in the commercial aircraft engine business has been joint ventures between the major manufacturers and smaller manufacturers. This has allowed the major manufacturers to spread their resources among

more programs and reduce overall risk. It has allowed the smaller manufacturers to gain a piece of the commercial engine business without having to establish their own reputation with the airlines or set up a world wide service network. This should continue and expand as competition continues to push technical advancement and increase the cost to compete in each engine thrust class.

While today's engine manufacturer's are extremely competitive, they can live with each other as competitors. What none of them want is another major competitor to further dilute market share. The technology, risks, and high investment of the commercial aircraft business are significant barriers to entry, but they do not prevent entry. It is conceivable that another manufacturer could choose to enter the business. The Japanese have identified aerospace as one of their key businesses for the 1990's.^{2/} They have been slowly learning the technology through joint ventures with Rolls-Royce and IAE. Aviation Week and Space Technology reported:^{3/}

Japanese aerospace companies are using their participation in international high-technology development programs to learn modern techniques of sales, marketing and after-sales support with a view to being able to provide these components on total aerospace programs in the future. . . . JAEC, the Japanese partner in the International Aero Engine development consortium, sees the V2500 program as offering the chance to participate in the technological program and

acquire insight into modern techniques of sales, marketing, and after-sales support for civil engines.

The Japanese are putting together the pieces necessary to be a major part of the aircraft engine industry. One of the significant challenge that they will have to overcome is meeting the airline's service purchase driver. They would have to gain the confidence of the airlines and overcome the resistance to buying from a new, inexperienced manufacturer. Initially they will likely continue to work with existing manufacturer's like Pratt and Whitney and Rolls-Royce as they learn and expand their service capability. However, in the future the Japanese could find a niche application and develop that into a major competitive position.

The three major engine manufacturers need to continue to push each other to improve the ability to meet the customer's purchase objectives and keep ahead of potential new entrants to the industry. The most successful engine manufacturers will be those who best satisfy the airlines' and aircraft manufacturers' purchase objectives.

FOOTNOTES

1. Porter, M., Competitive Advantage, The Free Press, New York, 1985.
2. The Economist, "Fight Over Fighters", October, 1988
3. Aviation Week and Space Technology, "Japanese Study Partners' Sales, Support Techniques", September 21, 1987, p 49.

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APPENDIX A
COMMERCIAL AIRCRAFT ENGINES AND MANUFACTURERS

The three major engine manufacturers are Pratt and Whitney, General Electric, and Rolls-Royce. They were characterized in The Economist as follows:^{1/}

Pratt and Whitney hates to see a customer choose a rival's engine and will cut prices to the bone to secure an order. By contrast General Electric will sometimes boast of losing a customer who would not be won at a loss. At Rolls-Royce only in the past few years have its engineers conceded that engines, however excellent, have to be sold and that airlines will not of their own accord beat their way to Derby.

In addition there are two major joint venture efforts in CFM International and International Aero Engines (IAE). CFM International is made up of General Electric and SNECMA of France while IAE is made up of Pratt and Whitney, Rolls-Royce, MTU of West Germany, Fiat of Italy, and JAEC a Japanese consortium.

In the 1960's and early 1970's Pratt and Whitney dominated the commercial aircraft engine market by being the sole engine supplier to Boeing's 707, 727, and 737 aircraft as well as Douglas's DC-8 and DC-9 aircraft. Even though Pratt and Whitney launched the first wide-body aircraft, the 747, the wide-body aircraft era gave both General Electric and Rolls-Royce a window of opportunity to enter the commercial engine field. General Electric

started in the business as the sole engine supplier for Douglas's DC-10 aircraft and Airbus's first aircraft, the A300. Rolls-Royce became the sole engine supplier for Lockheed's L1011.

A new era in marketing of commercial engines occurred with multiple engine supplier options in the mid 1970's. Pratt and Whitney initiated negotiations with McDonnell-Douglas to have its engine offered on the DC-10 aircraft, while separately Boeing initiated negotiations with General Electric to have a second engine supplier option on the 747 aircraft. The practice has expanded so that today most aircraft have at least two and usually three engine supplier options.

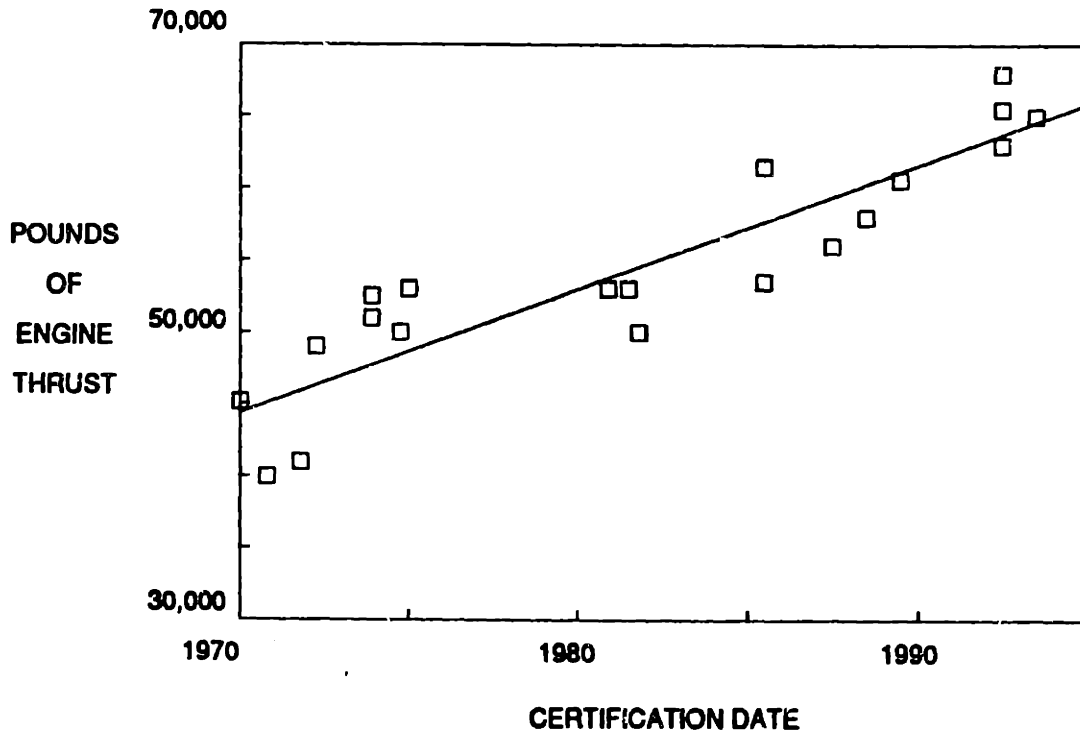
The commercial aircraft engines can be divided into three thrust classes. The small thrust class contains engines that range from 18,000 to 28,000 pounds of thrust and are used to power the smaller 150-passenger class of aircraft. The medium thrust class contains engines that range from 35,000 to 40,000 pounds of thrust and are used to power 200-passenger class of aircraft. The large thrust class contains engines that range from 50,000 to 65,000 pounds of thrust and are used to power all the wide-body aircraft which carry 250 passengers to over 500 passengers. The maximum thrust of the large thrust class

has been growing since the early 1980's as shown in Figure A.1. Sometime in the 1990's engine thrust may exceed 70,000 pounds.

The different engines in each thrust class are summarized in Table A.1.

FIGURE A.1

STEADY GROWTH IN MAXIMUM THRUST
CAPABILITY OF COMMERCIAL AIRCRAFT ENGINES



Source: Jane's All The World's Aircraft 1988-89, Jane's Information Group Limited, 1988, pp 951-964.

Table A.1

COMMERCIAL AIRCRAFT ENGINES IN PRODUCTION OR DEVELOPMENT

<u>Manufacturer</u>	<u>Engine</u>	<u>Thrust</u>	<u>Application</u>
<u>Large Thrust Class:</u>			
General Electric	CF6-80C2 (1985 cert)	53,500 to 61,500	A300-600, A300-600R A310-200, A310-300, MD-11, 747-200, 747-300, 747-400, 767-200, 767-200ER, 767-300, 767-300ER
	CF6-80E1 (1992 cert)	65,500	A330
Pratt and Whitney	PW4000 (1987 cert)	50,200 to 60,000	A300-600, A300-600R, A310-200, A310-300, MD-11, 747-400, 767-200, 767-200ER, 767-300, 767-300ER
	PW4168 (1992 cert)	68,000	A330
Rolls-Royce	RB211-524D4 (1981 cert)	53,000	747
	RB211-524G/H (1988/89 cert)	58,000 to 60,600	747-400, 767-300ER
	RB211-524L (1993 cert)	65,000	MD-11, A330
<u>Medium Thrust Class:</u>			
Pratt and Whitney	PW2037	38,200	757-200
Rolls-Royce	RB211-535E	40,100	757-200

Table A.1
(continued)

<u>Manufacturer</u>	<u>Engine</u>	<u>Thrust</u>	<u>Application</u>
<u>Small Thrust Class:</u>			
CFM Inter- national (General Electric and SNECMA)	CFM56-3	18,500 to 23,500	737-300, 737-400 737-500
	CFM56-5	25,000 to 31,200	A320, A340
Pratt and Whitney	JT8D-21	18,500 to 21,700	MD-81, MD-82, MD-83, MD-87
IAE (P&W, RR, and others)	V2500	25,000	A320

Source: Jane's All the Worlds Aircraft 1988-89, Jane's
Information Group Limited, 1988, Surrey, UK,
pp 692, 694, 711, 723, 730, 732.

APPENDIX B
COMMERCIAL AIRCRAFT AND MANUFACTURERS

The three major aircraft manufacturers are Boeing, McDonnell-Douglas, and Airbus Industries. Boeing and McDonnell-Douglas are private U.S. companies that have been major competitors in the commercial aircraft business since the beginning of the jet powered aircraft in the late 1950's. Airbus is a consortium of European aerospace companies that was started in the early 1970's with major investments by the French, West German, and British governments. Another U.S. company, Lockheed, was in the commercial aircraft business during the 1970s, but exited after sustaining large losses on its L1011 aircraft. The manufacturers were described in The Economist as follows:^{2/}

Boeing believes implicitly, and with reason, that it builds airliners more efficiently than any other company. McDonnell-Douglas is less confident; the McDonnell wing concentrating on military projects and with headquarters in St. Louis can never quite enthuse over the commercial field and the Douglas wing at Long Beach still has an inferiority complex from its ten years of losses. At Airbus Industries the French push ahead aggressively, the West German and British partners worry about money and the Spanish partner with only 4.2% share keeps quiet while it attempts to learn its colleagues technology.

The aircraft in production today are summarized in Table B.1 by flight range, passenger capacity, and engine options. Most of the different aircraft models are

produced in a number of different capacities and flight ranges to allow the aircraft manufacturer to cover more of the market with less investment. Aircraft capability is compared by passenger capacity and flight range as shown in Figure B.1.

A comparison by manufacturer of new aircraft orders since 1980 is shown in Figure B.2. Boeing has been the dominant manufacturer with over 50 percent of the orders while Airbus and McDonnell-Douglas have shared the rest. Figures B.3 through B.5 show the breakdown of orders by aircraft for each manufacturer. Boeing has four aircraft types with the 150-passenger class 737 aircraft accounting for over half of its sales. Airbus has expanded to five different aircraft types which all have an approximately equal sales volume. McDonnell-Douglas's primary product line of the 1980's has been the MD-80 family of aircraft. With orders in late 1988 and early 1989, the MD-11 aircraft is beginning to play a more significant role.

Table B.1

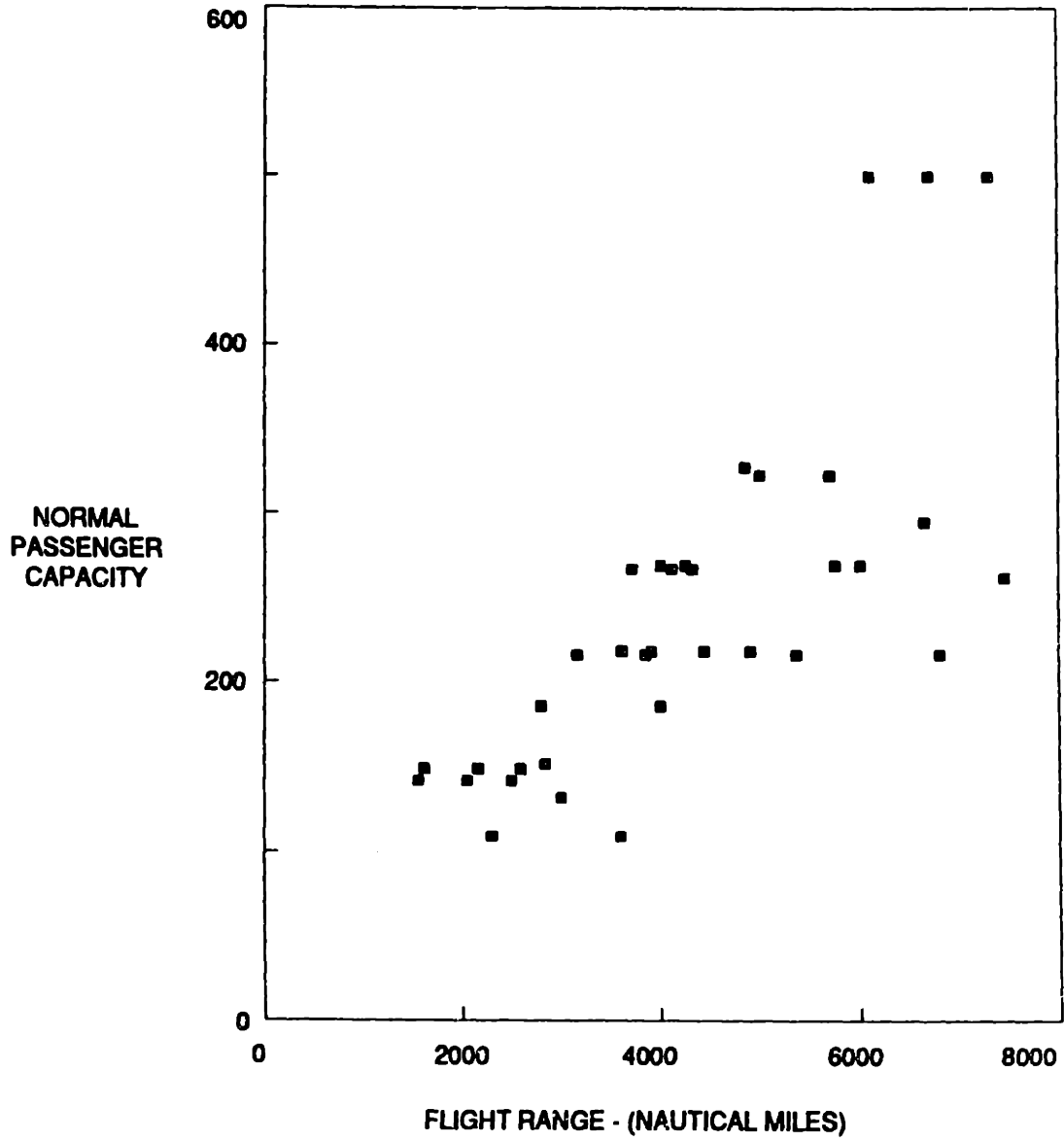
COMMERCIAL AIRCRAFT IN PRODUCTION OR DEVELOPMENT

Aircraft Type	Normal Seating	Flight Range (nm)	Engine Manufacturer				
			GE	CFM	PW	IAE	RR
<u>Boeing:</u>							
737-300	149	1615-2590		X			
737-400	149	2160-2500		X			
737-500	132	3000		X			
747-300	500	6100-6700	X		X		X
747-400	500	7300	X		X		X
757-200	186	2800-4000			X		X
767-200	216	3160-3850	X		X		
767-200ER	216	5365-6800	X		X		
767-300	269	4000-4250	X		X		X
767-300ER	269	5750-6000	X		X		
<u>McDonnell-Douglas:</u>							
MD-81	142	1560			X		
MD-82	142	2050			X		
MD-83	142	2500			X		
MD-87	109	2300-3600			X		
MD-11	323	5000-5700	X		X		
<u>Airbus:</u>							
A300-600	267	3710	X		X		
A300-600R	267	4115-4320	X		X		
A310-200	218	3610-3910	X		X		
A310-300	218	4440-4900	X		X		
A320-200	152	2840		X		X	
A330-300	328	4850	X		X		X
A340-200	262	7450		X			
A340-300	295	6650		X			

Source: Jane's All the Worlds Aircraft 1988-89, Jane's Information Group Limited, 1988, Surrey, UK, 103-109, 354-363, 431-435.

FIGURE B.1

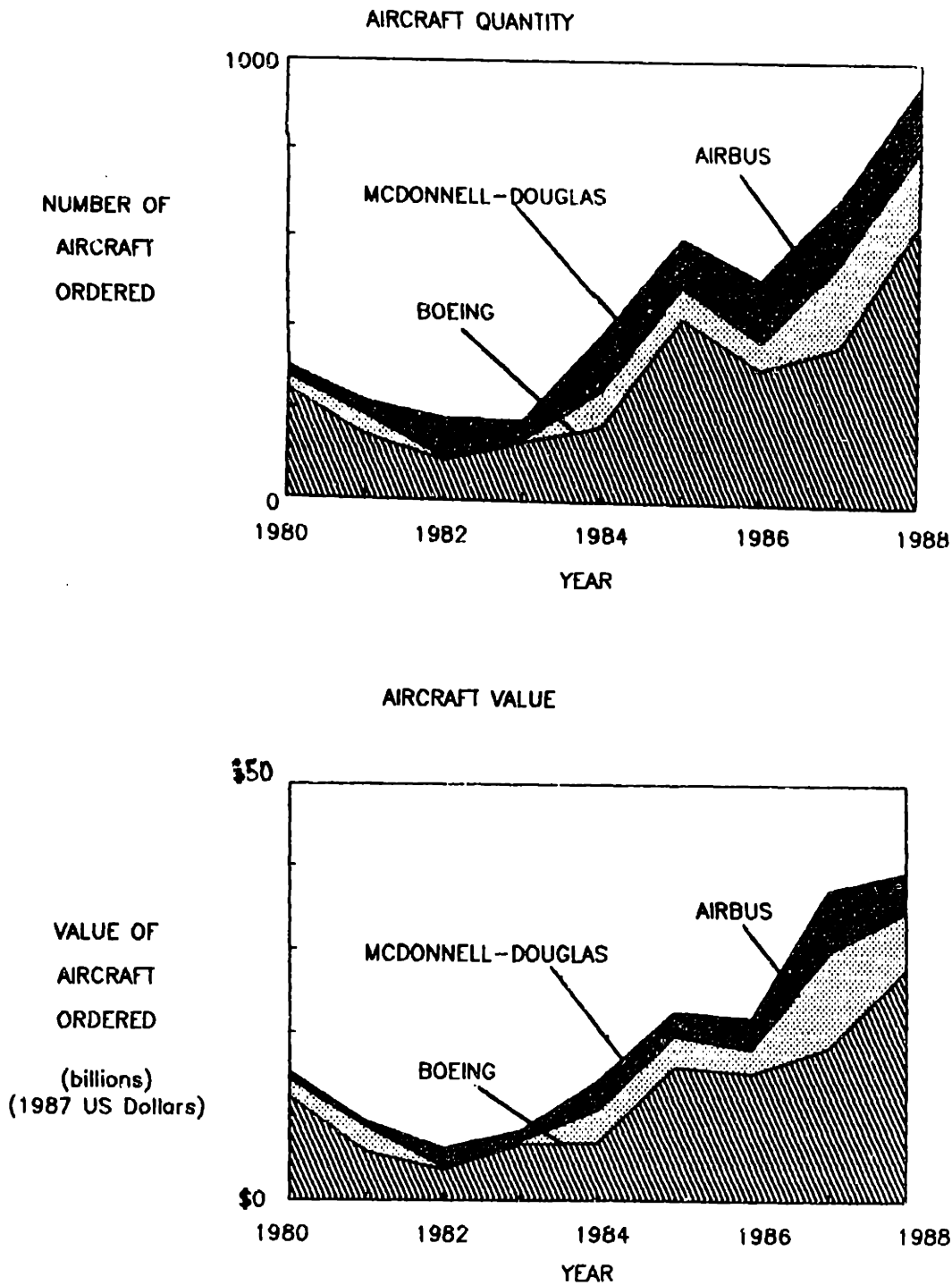
CAPABILITIES OF
TODAY'S COMMERCIAL AIRCRAFT



Source: Jane's All The World's Aircraft 1988-89, Jane's
Information Group Limited, 1988, pp103-109, 354-363, 431-435

FIGURE B.2

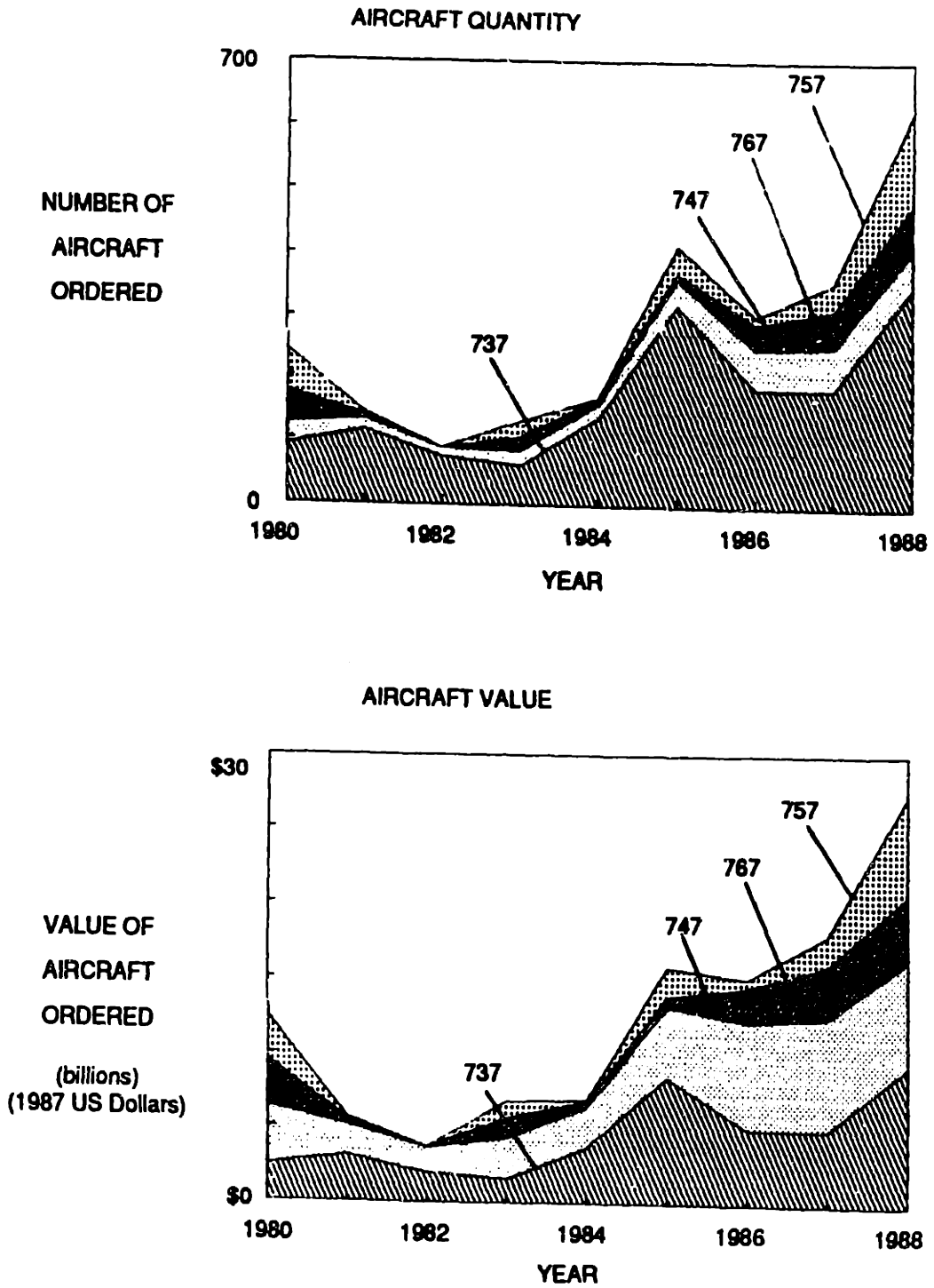
COMMERCIAL AIRCRAFT SALES DISTRIBUTION



Source: Compiled from data provided by General Electric Co. and Flight International, October 10, 1987, p 60.

FIGURE B.3

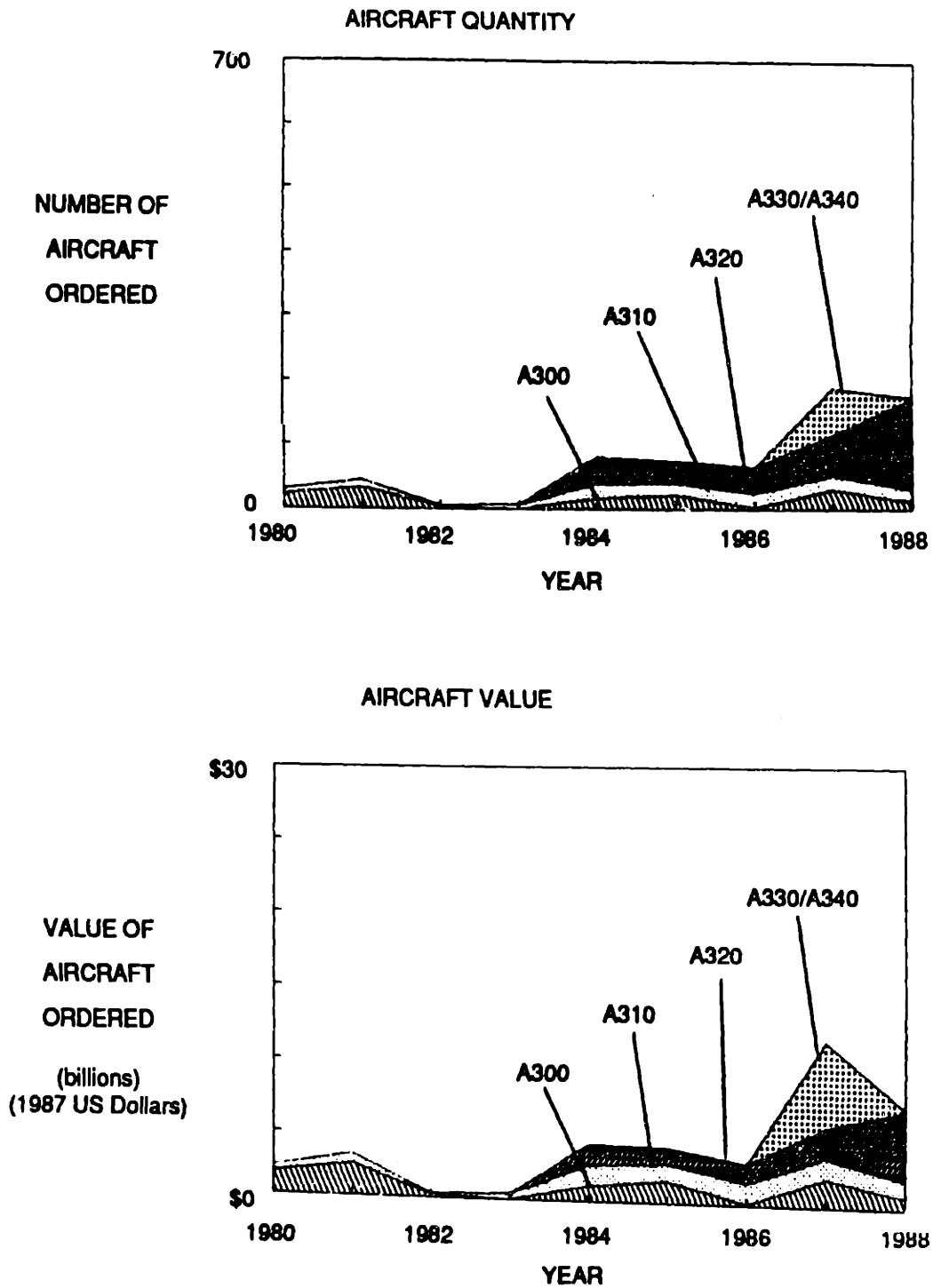
BOEING AIRCRAFT SALES DISTRIBUTION



Source: Compiled from data provided by General Electric Co. and Flight International, October 10, 1987, p 60.

FIGURE B.4

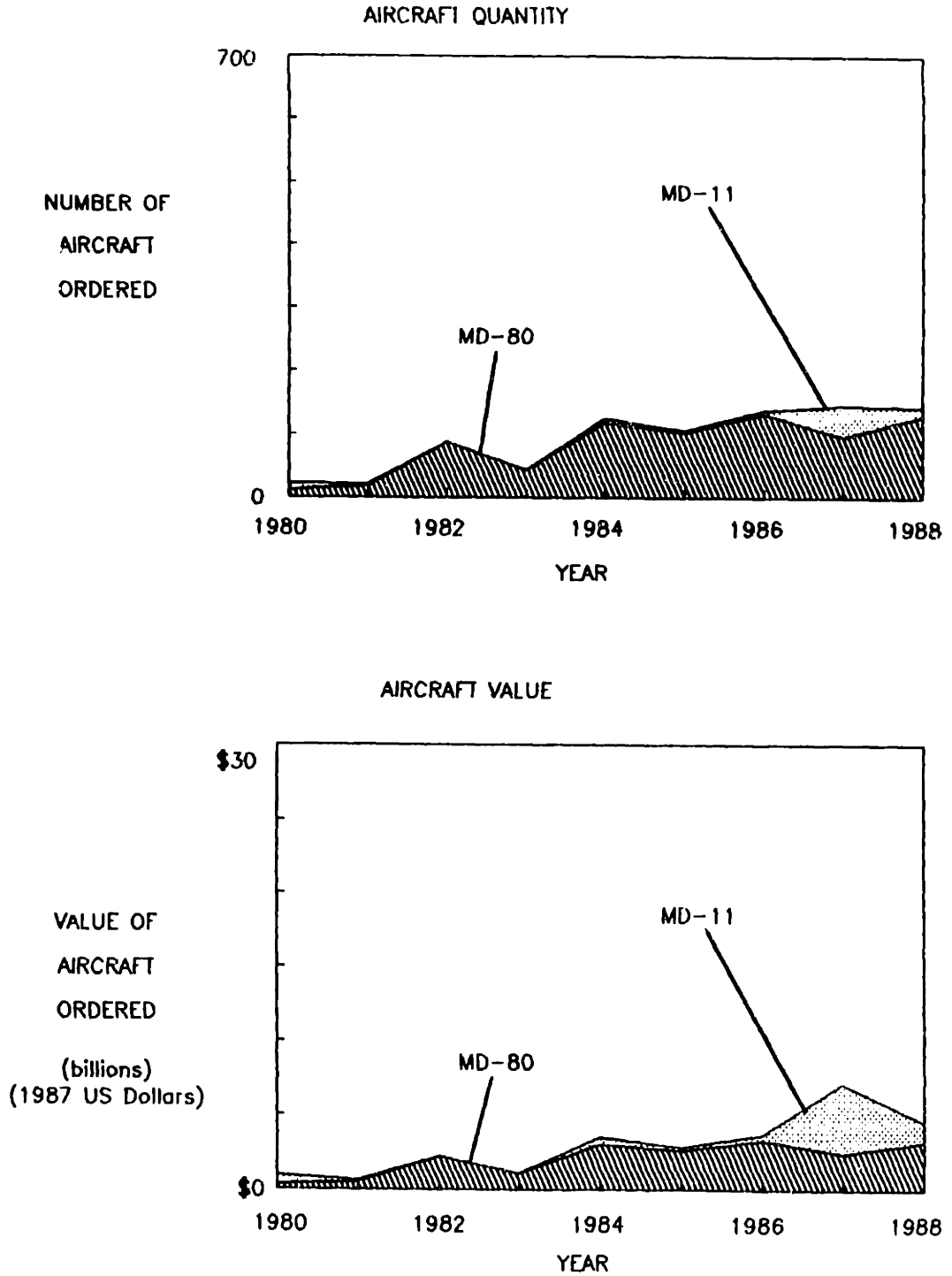
AIRBUS AIRCRAFT SALES DISTRIBUTION



Source: Compiled from data provided by General Electric Co. and Flight International, October 10, 1987, p 60.

FIGURE B.5

MCDONNELL-DOUGLAS AIRCRAFT SALES DISTRIBUTION



Source: Compiled from data provided by General Electric Co. and Flight International, October 10, 1987, p 60.

APPENDIX C

GENERAL ELECTRIC AIRCRAFT ENGINE GROUP

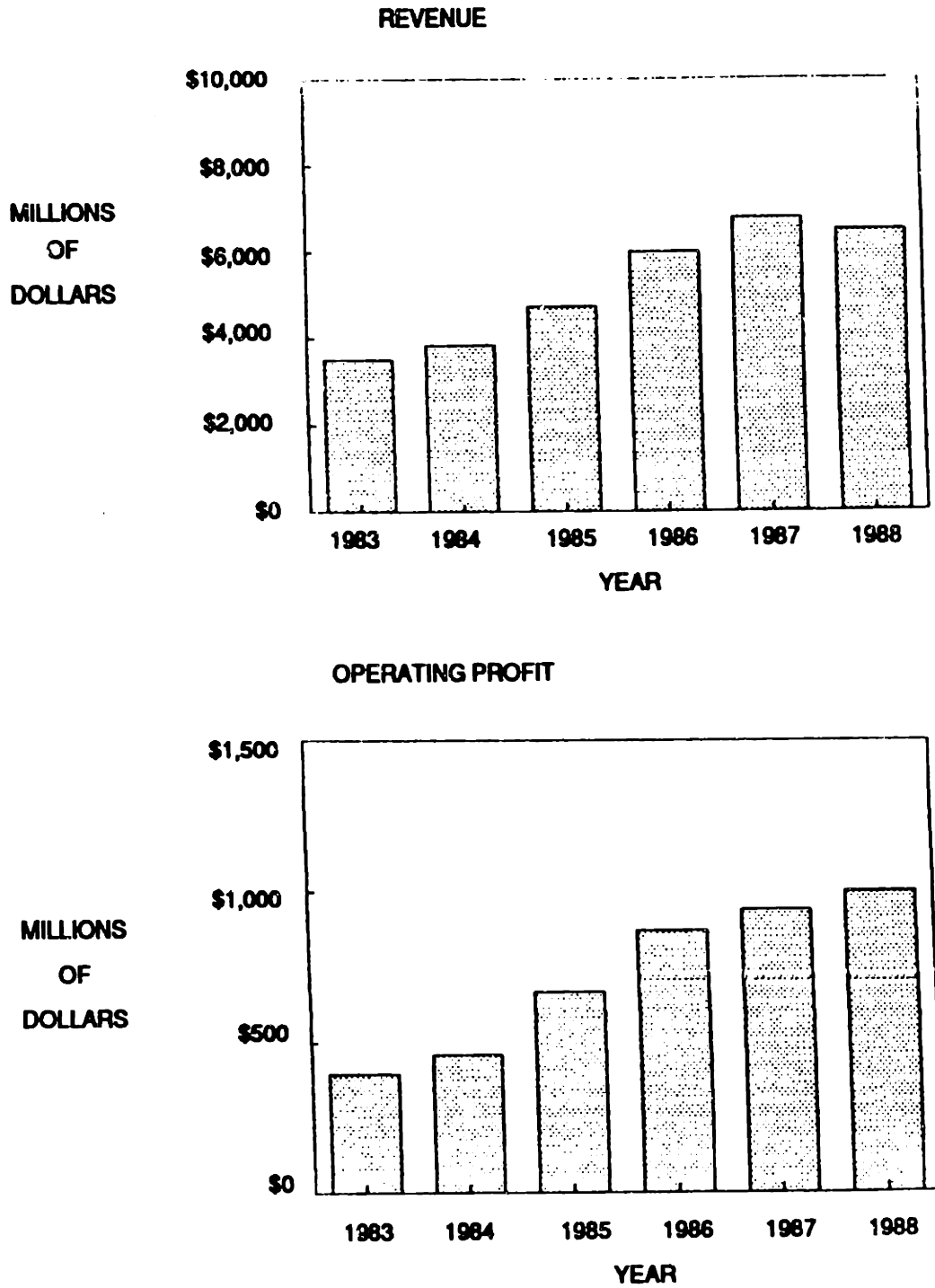
The Aircraft Engine Group is a major business within the General Electric Company with 1988 revenues of \$6,481 million and operating profits of \$1,000 million. As shown in Table C.1, this accounted for sixteen percent of General Electric's revenues and seventeen percent of its operating profit.^{3/}

The 1980s, as shown in Figure C.1, have been a time of substantial growth for General Electric's Aircraft Engine Group with both revenue and operating profit more than doubling. Part of the growth is from the success of the CFM56 and CF6-80C2 commercial engines. As shown in Figure C.2, orders for CF6-80 and CFM56 have grown from less than 100 in 1983 to over 1300 in 1988. SNECMA of France owns a 50 percent share of the CFM56 sales.

General Electric became involved in the jet engine business as a result of its 1930's experience with turbo-superchargers which were developed for the then piston-driven aircraft engines. General Electric was invited in 1941, by the U.S. military to build the jet engine that had been designed by Sir Frank Whittle of England.

FIGURE C.1

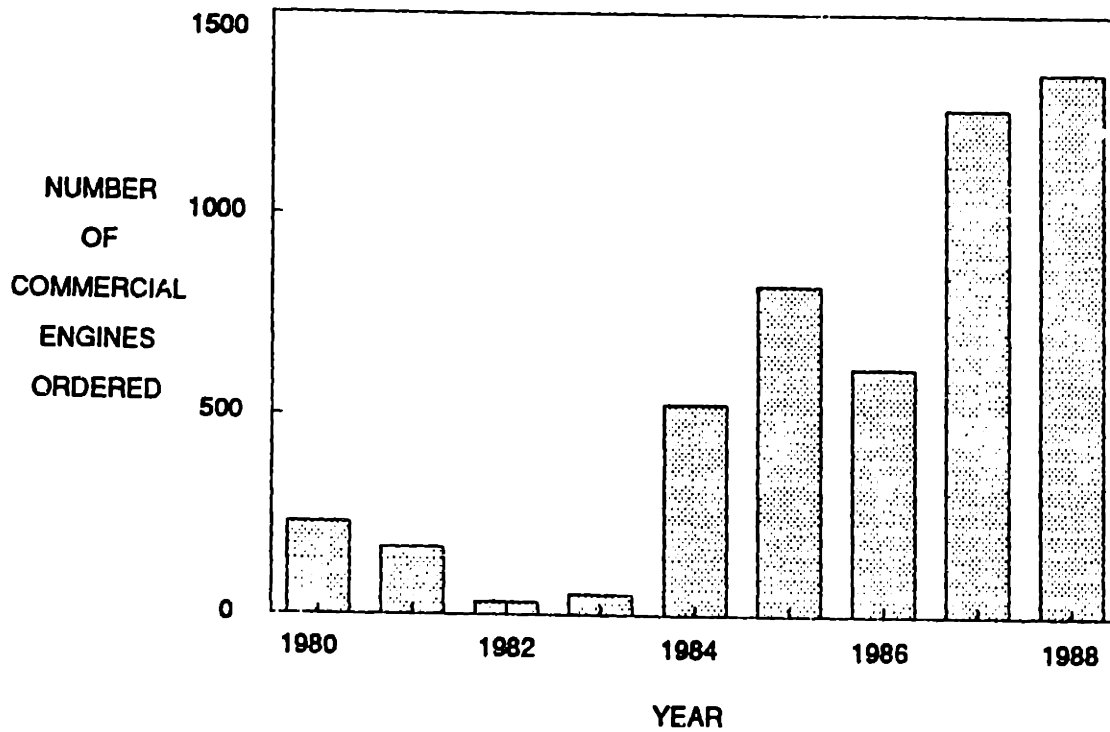
**GENERAL ELECTRIC AIRCRAFT ENGINES:
PROFIT MORE THAN DOUBLED SINCE 1983**



Source: General Electric 1988 Annual Report

FIGURE C.2

LARGE GROWTH IN COMMERCIAL ENGINE ORDERS HAS CONTRIBUTED TO GROWTH IN PROFIT AND REVENUE SINCE 1983



Note: Includes CFM International engine sales, of which General Electric owns 50 percent.

Source: Data compiled from information provided by the General Electric Company, January, 1989.

Table C.1

AIRCRAFT ENGINES CONTRIBUTION TO GENERAL ELECTRIC - 1988

<u>Business</u>	<u>Revenues</u>		<u>Operating Profit</u>	
	<u>Total</u> (millions)	<u>Percent</u>	<u>Total</u> (millions)	<u>Percent</u>
Aircraft Engines	\$6,481	16	\$1000	17
Aerospace	\$5,343	13	\$640	11
Broadcasting	\$3,638	9	\$540	9
Industrial	\$7,061	17	\$798	14
Major Appliances	\$5,289	13	\$61	1
Materials	\$3,539	8	\$733	13
Power Systems	\$4,805	12	\$503	9
Technical Products	\$4,431	11	\$484	8
GEFS	\$788	2	\$788	14
All Other	\$394	1	\$168	3
TOTAL	\$41,769	100	\$5,715	100

Source: General Electric Company 1988 Annual Report

This led to General Electric's supplying the engines for the first U.S. jet powered aircraft, The Bell P-59 which flew for the first time on October 2, 1942.^{4/} Over the years General Electric has provided engines for many military aircraft including, the Lockheed P-80 Shooting Star, the B-47 Bomber, the F-86 Sabre Jet, the B-58, the F-104, the F-14, the F-16, and the F-18. Since 1942, over 95,000 engines have been shipped all around the world and over 44,000 are still in service.^{5/}

Today General Electric's Aircraft Engine Group produces a wide range of engines from small to large for both military and commercial customers. The business is global with over 30 percent of the sales coming from outside the U.S.^{6/} The Aircraft Engine Group has over 33,000 employees, two production, engineering, and test centers; one in Cincinnati, Ohio and one in Lynn, Massachusetts, and seventeen manufacturing facilities across the U.S. Besides internal production facilities, several thousand outside companies provide a wide range of raw materials and finished parts.

C.1 ORGANIZATIONAL ROLES INVOLVED IN SALES AND MARKETING

The following section provides details on the role and responsibilities of each position involved in implementing General Electric's commercial engine marketing strategies.

C.1.1 PROJECT

The Project organizations are the financial center of each engine program and are responsible for all revenues and expenses. There is one organization to handle the CF6 engine family and another one to handle the CFM56 engine family. Run by a General Manager, each organization coordinates all aspects of an engine program from revenues generated by engine and spare part sales, to expenses generated by engineering, manufacturing, and the Commercial Engine Operation.

The Project organization is directly or indirectly involved in implementing all aspects of the marketing strategy. They are involved in planning the engine development strategy and directing engineering in implementing the strategy. They coordinate spare part production and engineering efforts to solve service

related problems for the Product Support group and work with the Market Development Manager to establish sales objectives. While the Project organization does not get involved in marketing strategies for specific airlines, they do establish yearly objectives for sales quantity and average purchase conditions.

The Project organization is also responsible for establishing the purchase condition guidelines relating to guarantees and warranties. They have long-term plans for the improvement of engine product features such as performance which the Sales Managers may guarantee. Any penalties associated with not meeting the guarantee are charged against a guarantee pool that the Project organization keeps. If the Sales Manager, and his managers, decide to make a guarantee beyond the Project limit, the cost gets charged against the net engine sale price as a concession.

C.1.2 MARKET DEVELOPMENT MANAGER

The Market Development Manager, part of the Airline Marketing Division, coordinates all the Sales Manager's sales and marketing activities associated with a specific engine family. This includes showing the airlines how

General Electric can best meet their purchase condition and services objectives and in developing negotiation strategies designed to meet General Electric's purchase condition strategy. In addition, the Market Development Manager helps the Sales Managers with proposals, negotiations, or with anything that will help sell the engine.

There is one Market Development Manager for the CF6 engine family and one for the CFM56 engine family. They are essentially individual contributor positions with managerial responsibility for only a small proposal preparation group which is used by the Sales Managers.

C.1.3 SALES MANAGER - (SALESMAN)

The Sales organization is contained in the Airline Marketing Division, a group run by a Vice President and General Manager, Ed Bavaria. Reporting to him are four regional General Managers to whom the Sales Managers report.

Each Sales Manager is account oriented with responsibility for the sale of all of General Electric's commercial engines to a few specific airlines which are

grouped together geographically. They spend long periods of time being General Electric's representative to the airline and personally getting to know the airline. When the airline is ready to select engines the Sales Manager is responsible for developing the sales strategy for that airline, preparing the sales proposals, and performing the negotiations. The Sales Manager coordinates the strategy and proposals with the Market Development Manager and Management. During the negotiations help will be obtained from all aspects of the Aircraft Engine Group including Finance, Engineering, Legal, Product Support, and Management. If successful, the General Electric engine will be selected for purchase conditions that are consistent with the overall marketing strategy.

C.1.4 SALES ENGINEERING

Sales Engineering is a small group which forms the information systems portion of the commercial engine business. Upper management is provided with data on engine sales status and a forecast of future sales while the Sales Managers are provided with technical data on General Electric's and its competitor's engines. There are two parts to sales engineering, each run by a subsection manager; Market Analysis & Management Information

(MA&MI) and Aircraft Performance & Aircraft Economics (AP&AE).

The MA&MI group consists of four people who, through market research and market forecasting, provide upper management with a broad view of the business both today and in the future. Market research consists of gathering data on aircraft orders, deliveries, and the status of General Electric's sales versus the competition's sales. An internal monthly report is produced and distributed up through the Aircraft Engine Group and corporate headquarters. It is considered the "bible of how General Electric is doing in the commercial world".^{7/} Market forecasting consists of pulling together all things that effect aircraft demand including passenger traffic, aircraft deliveries, and aircraft retirements. Vern Thomas, Manager of MA&MI, then combines the data with input from senior management to come up with a long-range forecast of aircraft demand. As Thomas said:^{8/}

One of the greatest sources of information is upper management. . . I find out how Kapor perceives the market. He is out there talking to the big guys... Forecasting is much more of a judgmental and psychological process than a scientific one.

The forecast forms a base from which studies of other scenarios can be made.

The AP&AE group consists of three people who focus on helping the Sales Managers to sell today's engines. They are the Sales Manager's key source of technical information on General Electric and competitive engines including performance, reliability, and maintainability. The AP&AE group also performs engine cost of ownership analyses so that the Market Development Manager and Sales Managers can evaluate General Electric's position and develop appropriate strategies.

C.1.5 FINANCE

Today financing of an airline's aircraft purchases is an important part of making successful sales. The Customer Sales Financing section of the Finance and Business Development Operation has financial experts with whom the airline can discuss, among other things, the financing options available and potential tax implications. They are responsible for negotiating financing packages and work in concert with the Sales Manager in responding to the financing needs of the customer airlines.

The financing portion of an aircraft sale is split between the aircraft and engine manufacturer according to product content, which is usually in the range of 80% for the aircraft manufacturer and 20% for the engine manufacturer. After the General Electric portion of the financing package is negotiated, the Finance people generally go out into the financial markets to obtain the necessary loans for the airline. They often times use the General Electric Company guarantee as an inducement for the financial institution to grant the loan and usually receive a fee from the airline for providing such a guarantee. The financing package must, in some instances, be approved by the General Electric Corporate Executive Office. Currently, the Aircraft engine Group has a \$2 billion line of credit approved by the General Electric Board.

The finance group spends time communicating with the financing organizations from the aircraft manufacturers to make sure that they understand General Electric's financing ground rules. This reduces the likelihood that the aircraft manufacturer will promise a joint financing package to the airline with which General Electric will not go along.

C.1.6 FIELD SERVICE

The Field Service organization has General Electric employees stationed at the airlines to provide on-site technical and maintenance support and at the aircraft manufacturers to provide on-site representation on business and technical issues. The on-site employees are financed by and work with the Commercial Engine Operation but report to the Manager of Aircraft Engine Market Development and Administration. This separate reporting channel is used to provide an independent path for feedback received from the customers.

The General Electric employees stationed at the airlines are part of the Field Service Operation and work closely with the Product Support organization to keep the airline's General Electric engines operating efficiently and reliably. The employees stationed at the aircraft manufacturers are part of the Field Programs Operation and help implement the marketing strategy directed at the aircraft manufacturers. They make sure that General Electric's product strategy, product plans, and timing are compatible with the aircraft manufacturer's need. They also coordinate special customer engine rating needs and, when necessary, act as an interface between the Sales

Manager at General Electric and his counterpart at the aircraft manufacturer.

C.1.7 PRODUCT SUPPORT

The Product Support organization, run by a General Manager, is responsible for meeting the airline's service objectives. Product Support responds quickly to identify and solve airline problems, coordinate spare parts delivery, and develop repair and maintenance procedures. They also track operational and maintenance data on the engines in service to catch potential problems before they become major problems for the airlines. To keep the airline satisfied, Product Support relies heavily on the on-site Field Service people stationed at the airline to provide regular, day to day feedback on how the engines are doing and what problems the airline maintenance people are having.

The Product Support role is critical to being able to sell new engines. Unless the airline's service objectives are met, the airline will not likely buy new engines from that manufacturer. As Vince DiGiovanni, Manager of CF6

Market Development for General Electric said:^{9/}

If we do not do a good job keeping the customer happy after the sale there will not be another sale. Product Support must keep the fleet flying, flying efficiently, and at a minimum do an outstanding job.

C.1.8 ENGINEERING

The Engineering organization is the key to the aircraft engine business. Their efforts in implementing the Commercial Engine Operation's product development strategy determines the engine's competitive position in product features. The Engineering organization's role in marketing and sales is limited to visiting the airline if specific technical questions need answering. A part of engineering, the Advanced Technology Group, works on developing technology advances for future commercial aircraft engines. They help establish the capabilities which go into planning future product development strategy.

C.1.9 COMMERCIAL ENGINE PROGRAMS

The Commercial Engine Programs Manager, a General Manager position, is the focal point for all interface with the aircraft manufacturers. With the Field Program Office located at the aircraft manufacturers, he makes sure all engine programs in flight test, certification, and in production are going well from both General Electric's and the aircraft manufacturers' perspective. He is also responsible for implementing the marketing strategy by understanding the aircraft manufacturers' aircraft development plans and making sure General Electric has a competitive engine available to meet that aircraft need.

C.1.10 LEGAL OPERATION

The Aircraft Engine Legal Operation writes the legal contracts around the basic agreements that the Commercial Engine Operation makes with the airlines and the aircraft manufacturers. They also provide advice to the Commercial Engine Operation on business dealings overseas so that conflicts do not arise with the U.S. Foreign Corrupt Practices Act and in-country laws.

C.1.11 MANAGEMENT

The role of Management in the sale of commercial engines was described by Lee Kapor, Vice President and General Manager of Commercial Engine Operations for General Electric, as follows:^{10/}

I am the coach. I need to know what is going on in the game. I get involved where I can contribute in forcing the action in the right direction. I apply a perspective and sensitivity developed over many years in the business.

Management guides the overall strategy of the commercial engine business. They use their contacts with the senior management at the aircraft manufacturers and airlines to understand the market direction and make sure that General Electric is correctly positioned. Management also makes the difficult decisions of where to draw the line in negotiations, when to develop new engines, and how to best distribute limited financial and personnel resources.

APPENDIX D

ENGINE SELECTION PROCESS AT AMERICAN AIRLINES

American Airlines is one of the major U.S. airlines. In 1987 it was third in the world (not counting Aeroflot) in passengers carried, second in operating revenue, and first in operating profit.^{11/} American has a strong domestic and Caribbean route structure with hubs in Dallas-Fort Worth, Chicago, Nashville, Raleigh-Durham, San Jose, and San Juan. American is using its strong domestic route structure to feed into an expanding international route structure to Europe and Asia. Up to now access to Asia has been limited by route authority. With no Asian access out of the U.S. West Coast, American has been operating out of Dallas/Fort-Worth. The longer aircraft range required to support that route was an influence in a February, 1989 purchase of MD-11 aircraft.

American Airlines is headed by Bob Crandall. With a background in finance and marketing, his greatest strength has been his innovation. He is credited with the original frequent flyer program, the two-tiered wage scale, and the industry's leading computerized reservation system.^{12/} In January, 1989 he received Aviation Week and Space Technology's annual Aerospace Laurels award for Commercial Air Transport. In the citation it said:^{13/}

Robert Crandall continued to make his mark on the airline industry in 1988 as an aggressive, innovative, capable, and effective leader. . . Crandall has played a key role in developing

many of the innovations that have made American a pacesetter. . . American's bold effort to upgrade its fleet has produced a fleet of 469 aircraft with a 9.4-year average age, one of the youngest fleets among domestic carriers.

As of April, 1989 American Airlines had a fleet of 475 aircraft consisting of seven different aircraft types of aircraft with engines from General Electric, Pratt and Whitney, and soon Rolls-Royce. In addition American Airlines has 103 aircraft on order. A fleet summary is shown in Table D.1.

In purchasing aircraft and engines American Airlines has significant negotiating leverage. It is a top airline going through a period of significant expansion and is buying aircraft in large quantities. An article in Business Week estimated that in the 1988 purchase of 757 aircraft, American Airlines was able to hammer out a 20 percent price discount.^{14/} In the same article E Boullioun, former president of Pan Am was quoted as saying "American always gets a good deal, they are tough negotiators"^{15/}. In the 1987 purchase of 25 A300-600R and 15 767-300ER aircraft, American Airlines received very favorable lease terms. For the first ten years the

Table D.1

AMERICAN AIRLINES AIRCRAFT FLEET DISTRIBUTION

<u>QUANTITY</u>	<u>AIRCRAFT TYPE</u>	<u>AIRCRAFT MFR</u>	<u>ENGINE MFR</u>
39	727-100	Boeing	PW
125	727-200	Boeing	PW
10	737-200	Boeing	PW
8	737-300	Boeing	GE/SN
2	747SP	Boeing	PW
13	767-200	Boeing	GE
17	767-200ER	Boeing	GE
15	767-300ER	Boeing	GE
6	BAe 146-200	British Aerospace	LY
49	LC-10-10	McDonnell-Douglas	GE
10	DC-10-30	McDonnell-Douglas	GE
163	MD-82	McDonnell-Douglas	PW
13	A300-600R	Airbus	GE

ON ORDER

87	MD-82/83	McDonnell-Douglas	PW
10	767-300ER	Boeing	GE
12	A300-600R	Airbus	GE
75	757-200	Boeing	RR
8	MD-11	McDonnell-Douglas	GE
75	Fokker 100	Fokker	RR

CURRENT ENGINE MANUFACTURER PREFERENCES

Large Class...General Electric - CF6-80C2
 Medium Class.....Rolls-Royce - RB211-535
 Small Class..Pratt and Whitney - JT8D
 Rolls-Royce - Tay MK 650

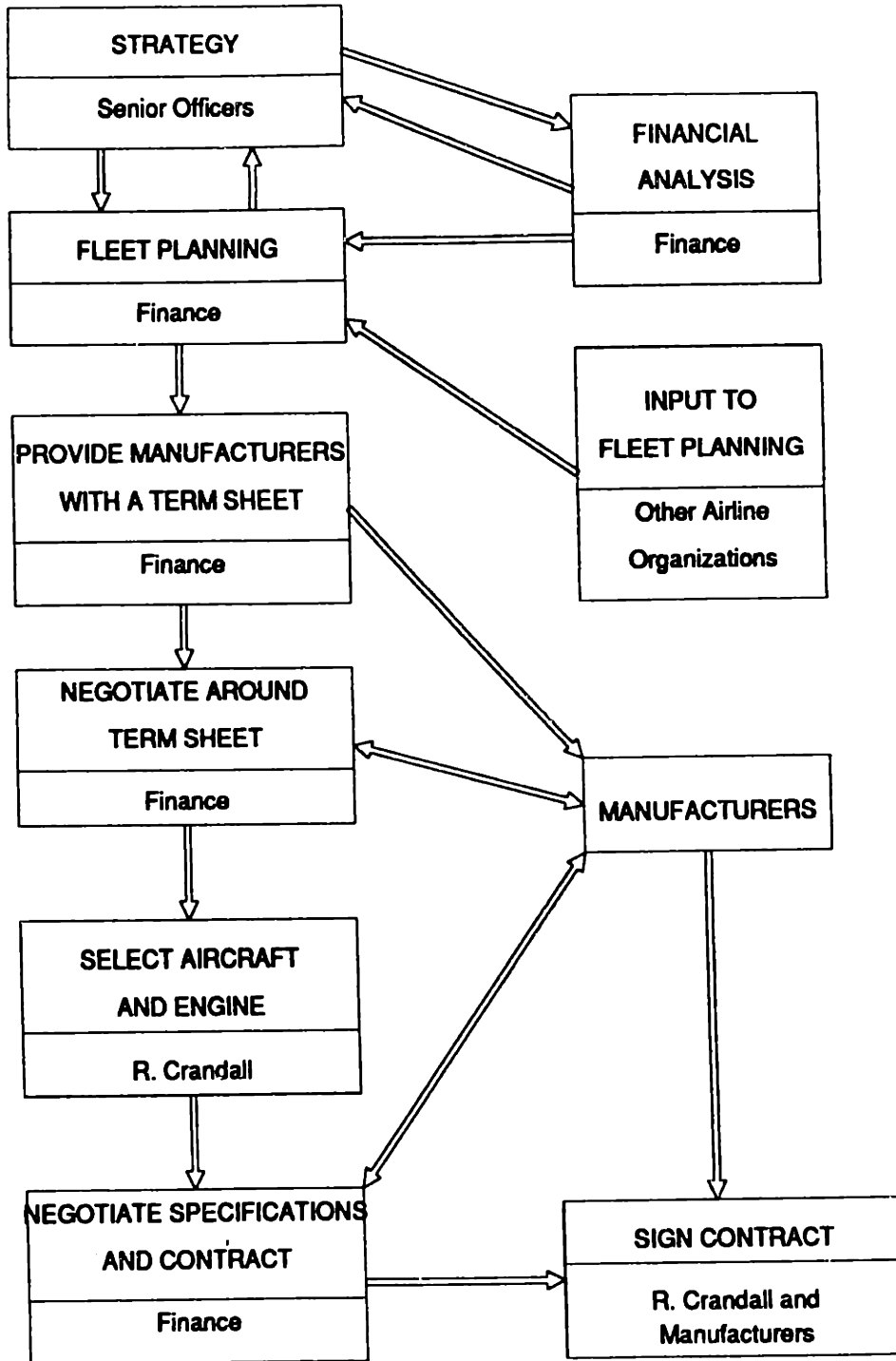
Source: Data provided by American Airlines, April, 1989,

aircraft can be returned with 30 days notice. As described in Aviation Week and Space Technology:^{16/}

Crandall said he was able to work out attractive deals with both Airbus and Boeing because he solved their problems as well as his own. Airbus wanted another major U.S. customer . . . Boeing was looking for a launch customer for the 767-300ER and wanted American committed to the long-range twin as a basic international vehicle, he said. "What we were saying is we'll solve your problem if you in turn solve our problem, and our problem is we'd like to find some uniquely flexible financing."

The evaluation and selection of aircraft and engines is centered in the financial part of the airline where economic analyses are performed and input from other organizations such as engineering is coordinated. At the top is Bob Crandall who makes the final decision on aircraft and engines. He is supported by the finance organization which interfaces with and negotiates with the manufacturers. This includes Don Carty - Senior Vice President of Airline Planning and Chief Financial Officer, Mike Durham - Vice President and Treasurer, Dan Garton - Managing Director Financial Analysis, and Ken Raff - Manager of Fleet Planning. The steps of the evaluation and selection process are shown in Figure D.1 and described below.

FIGURE D.1
AIRCRAFT/ENGINE SELECTION PROCESS AT
AMERICAN AIRLINES



Source: Interviews conducted by the author with management at American Airlines, January, 1989.

- o Fleet planning starts with the senior officers of the company discussing and developing needs for the next ten to fifteen years. The discussions are in very broad conceptual terms.

- o The strategy ideas are passed down to a financial analysis group to evaluate the economics of the various strategies. Analysis includes likely demand for specific routes, the economics of specific aircraft on those routes, and the overall attractiveness of the strategy. This information is passed on to the Manager of Fleet Planning.

- o The manager of fleet planning takes information from the financial analysis group along with the proposed strategies and puts together a long-term fleet plan. Since the mid 1980s American Airlines has been working towards a 1991 fleet size that has grown from 525 to 610 aircraft. By June of 1989 a 1995 fleet plan will have been defined.

- o When the senior executives at American Airlines decide, consistent with the fleet plan, to begin the purchase process the finance group performs an economic analysis of possible aircraft to identify their relative attractiveness for the desired

mission. The analysis is also used to determine how much the airline can afford to pay for each aircraft and still meet a desired return on investment.

- o For each aircraft and engine manufacturer, Fleet Planning puts together a term sheet. It is a short document of about six pages that lays out all the terms that American Airlines expects the manufacturers to meet. While the term sheet for each manufacturer is a little different, the objective is that if two manufacturers meet all the conditions, each manufacturer will be treated as equivalent and the competition will continue.

- o Negotiations are performed with each manufacturer around the term sheet. At this point the aircraft and engine are being negotiated separately, but at the same time. Negotiations involve all levels of management at American Airlines from the Manager of Fleet Planning to Bob Crandall.

- o As with other airlines, the manufacturers do not get "scrubbed down" by the airline technical staff like they used to. However the technical staff does play an integral role in the evaluation. The philosophy at American is that their technical people, who will

be responsible for maintaining the aircraft, must have a great deal of comfort with the aircraft and engine.

- o Bob Crandall has the final decision of what aircraft and engine to select. When negotiations around the term sheet are complete and a decision is made the deal is sealed with a handshake between Bob Crandall and the manufacturer representative.
- o The deal is based on the basic terms and conditions spelled out in the negotiated term sheet. The details of the contract and specifications remain to be worked out. After the handshake a date, approximately eight weeks later, is scheduled for a public announcement. The announcement, by Bob Crandall, will be made at that time subject to successful contract negotiation and signatures on the contract.
- o The details of the specification and contract are negotiated between the aircraft manufacturer and the airline and between the engine manufacturer and the airline. With signed contracts Bob Crandall announces the aircraft and engine selection.

At American Airlines each aircraft and engine negotiation has been different because the objectives have been different. In the early 1980's American made a major purchase of MD-80 aircraft and received favorable leasing terms. At that time the airline did not have the money and did not want to be saddled with the debt burden. In the mid 1980's American purchased A300-600R and 767-300ER aircraft. By that time the airline was in a strong financial position and the purchase objectives had changed to obtaining flexibility in the aircraft fleet. If a major economic downturn occurred in the industry, American wanted to be able to returned the aircraft to the manufacturers. Today American is looking for economically optimum deals. Overall, the terms of each purchase have reflected the strategy of the airline at that time.

APPENDIX E
ENGINE SELECTION PROCESS AT DELTA AIR LINES

Delta is one of the major U.S. airlines. In 1987 it was number one in the world (not including Aeroflot) in number of passengers transported, number three in operating revenue, and number two in operating profit.^{17/} Delta has a strong U.S. domestic route structure with hubs in Atlanta, Dallas-Fort Worth, Cincinnati, and Salt Lake City. It has used its domestic network as a base to begin international flights to Europe and the Pacific Rim.

Delta was one of the best run airlines prior to deregulation^{18/} with good profits and an AAA credit rating. Initially after deregulation it had difficulties and, in 1982 and 1983, lost money. "Industry changes were happening faster than they were reacting to them".^{19/} Since then things have been turned back around and Delta is once again a successful and profitable airline. In 1988 Ron Allen, President of Delta Air Lines described their objective as follows:^{20/}

We want to grow as a strong carrier. Our objective is to become the most respected airline, and that is complemented by our building international links out of a strong feed system domestically in the U.S.

As of June 1988 Delta had a fleet of 373 aircraft composed of nine different aircraft types and engines from all three manufacturers. They also had 53 aircraft on

order. A detailed fleet summary is shown in Table E.1. In September 1988, Delta placed a major order for 18 firm aircraft and 212 options split among MD-11, MD-88, 767-300ER, and 757-232 aircraft. Pratt and Whitney engines were selected for all the aircraft.

The aircraft and engine selection process at Delta is shown schematically in Figure E.1. The process is confined to a small group and handled very confidentially. The group consists of the Chairman and Chief Executive Officer, President and Chief Operations Officer, Chief Financial Officer, Senior Vice President of Marketing, Senior Vice President of Technical Operations, Vice President of Technical Operations, and Staff General Manager of Technical Operations Center. The specific steps of the process are as follows:

- o The selection process is initiated with a fleet plan that is maintained by finance and marketing. It is reviewed and approved periodically by the board.

- o Consistent with a need identified in the fleet plan, the small group of executives decides when to initiate an evaluation process which will lead to the purchase of new aircraft.

Table E.1

DELTA AIR LINES AIRCRAFT FLEET DISTRIBUTION

<u>QUANTITY</u>	<u>AIRCRAFT TYPE</u>	<u>AIRCRAFT MFR</u>	<u>ENGINE MFR</u>
131	727-200	Boeing	PW
61	737-200	Boeing	PW
13	737-300	Boeing	GE/SN
38	757-232	Boeing	PW
15	767-200	Boeing	GE
15	767-300	Boeing	GE
22	L1011-1	Lockheed	RR
1	L1011-100	Lockheed	RR
6	L1011-250	Lockheed	RR
10	L1011-500	Lockheed	RR
7	DC-10-10	McDonnell-Douglas	GE
7	DC-8-71	McDonnell-Douglas	GE/SN
36	DC-9-32	McDonnell-Douglas	PW
31	MD-82/88	McDonnell-Douglas	PW

ON ORDER

22	757-232	Boeing	PW
31	MD-82/88	McDonnell-Douglas	PW
9	MD-11	McDonnell-Douglas	PW
9	767-300ER	Boeing	PW

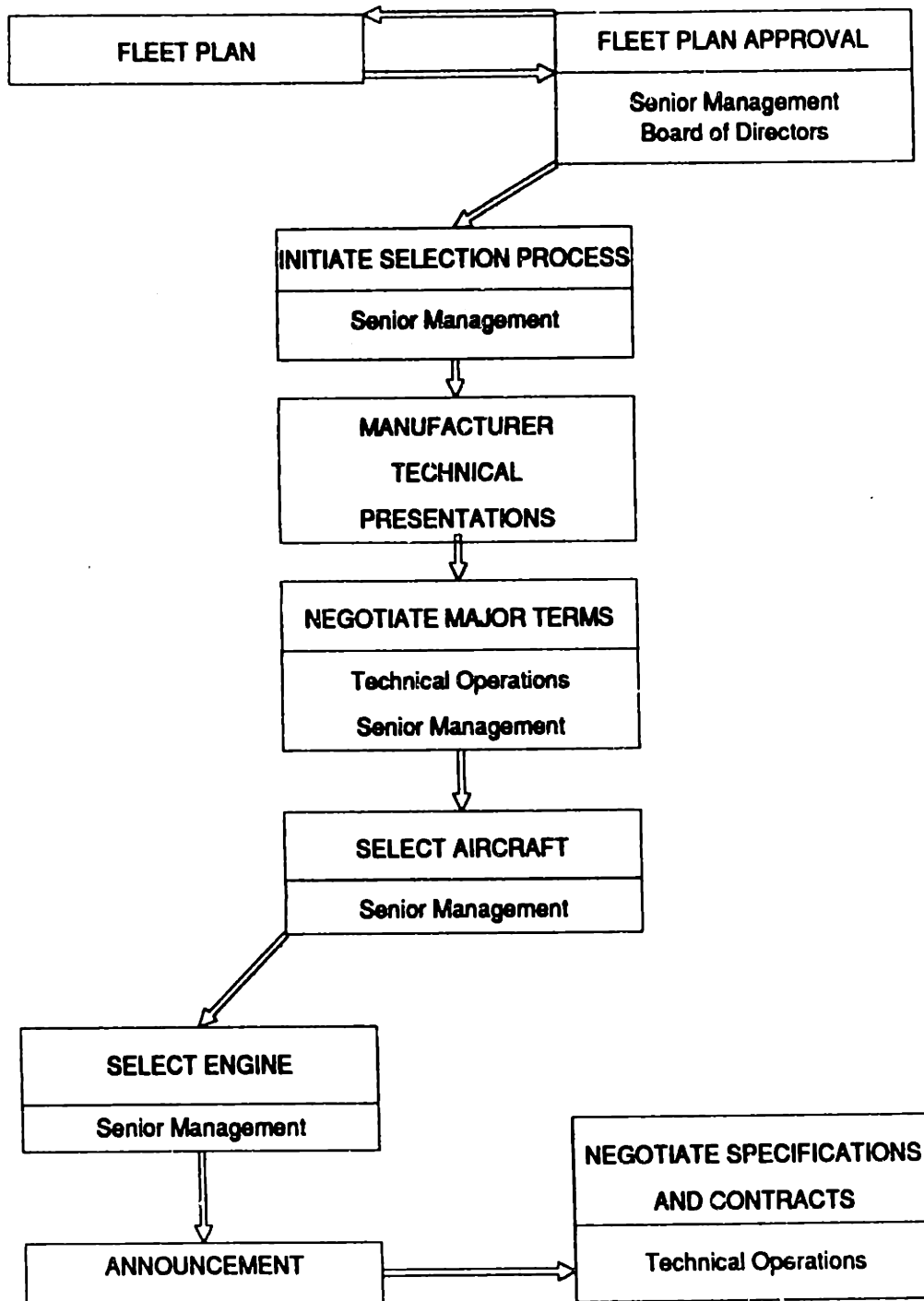
CURRENT ENGINE MANUFACTURER PREFERENCES

Large Class...Pratt and Whitney - PW4000
 Medium Class..Pratt and Whitney - PW2037
 Small Class...Pratt and Whitney - JT8D

Source: Interavia, "The World's Major Airlines",
 October, 1988, 1055.

FIGURE E.1

AIRCRAFT/ENGINE SELECTION PROCESS AT DELTA AIR LINES



Source: Interviews conducted by the author with management at Delta Air Lines, January, 1989.

- o The aircraft engine manufacturers are invited to make presentations about the product to the technical engineering group at Delta Air Lines.

- o The aircraft manufacturers are invited to make a business proposal which includes price, configuration, and financial terms. Delta prefers to start with the aircraft business proposal and then move to the engine business proposal. This allows for better balance the evaluator's work load.

- o The aircraft proposals are evaluated by the Staff General Manager of the Technical Operations Center. He combines the technical input received from the technical engineering group with the proposal data and converts everything to a common, present value cost basis.

- o The aircraft manufacturers are invited to Delta to review the proposals and make sure that there is a common understanding of what is in the proposal. The manufacturers may, at that time, make additional price concessions through an amendment to the proposal.

- o A business proposal is requested and received from the engine manufacturers.

- o The objective at this point is to get the engine manufacturers' initial proposal plugged into the evaluation. This locks in a base engine cost and allows Delta to assure themselves that the overall economics result in a positive return on investment. With that confidence Delta is ready to select an aircraft.

- o Delta requests the aircraft manufacturers' final bids and performs final negotiations. This is done at the highest levels of Delta, usually Ron Allen, Chairman and Chief Executive Officer. An internal selection of an aircraft is made.

- o The final bids are obtained from the engine manufacturers and final negotiations held. An internal selection of an engine is made by the same group.

- o This is the desired sequence, aircraft then engine. It does not always happen that way. In the most recent purchase Delta was not ready to make an aircraft selection. It therefore continued with the

final bids on the engines and made the aircraft and engine selection at the same time.

- o Delta makes its decisions based on the business proposals which have the major business terms and price concessions from the manufacturers. The agreement to purchase the aircraft and engine is based on a handshake and subject to successful negotiation of the specifications and contracts.
- o Prior to a general announcement, the Delta executives announce to the company employees what aircraft and engine had been selected and why. This is followed by a public announcement.
- o The Staff General Manager of the Technical Operation Center puts together a team consisting of himself, a legal representative, and a finance representative to negotiate the contracts and specifications. A separate contract and specification is required for the aircraft and engine.

The contract and specification negotiation is the part of the process in which the whole company gets involved. Input is obtained from all the organizations.

The various engineering groups review specifications on their components, a pilot's group reviews the cockpit, a flight attendant's group reviews the internal aircraft layout, and a ground handler's group reviews the cargo and baggage capabilities of the aircraft. Input from all these groups is fed to the negotiating team in terms of desired changes to the manufacturer's standard specification. Delta's philosophy is that at the manufacturer there are very few people who have experience in maintaining the products. It is therefore very important for Delta to have an input into the specification. On the recent MD-11 purchase, Delta went to McDonnell-Douglas with over 400 proposed changes or additions. The issues were negotiated, sometimes very intensely, and resolved into a final specification.

The final step in the process is for Delta and the manufacturers to sign the completed contract and specification. It usually takes approximately six to eight weeks to get from a handshake to completed and signed contract.

APPENDIX F
ENGINE SELECTION PROCESS AT UNITED AIRLINES

United Airlines is one of the major U.S. airlines. In 1987 it went through a forced change in management. From 1976 to 1987 United Airlines was run by Dick Ferris who had risen through the company's Westin Hotel chain. After 1985 Ferris purchased Hertz car rental and began to develop a three-part travel empire called Allegis. This eventually caused dissatisfaction from the airline pilots who saw the airline's cash flow being siphoned off into other ventures. Investors were also not happy with the company's financial performance. The end result was Ferris was removed from the airline in 1987.

By late 1987 Steven Wolf was found to run United Airlines. He is a 21 year veteran of the airline industry with time at American, Pan Am, and Continental. He was president of Republic and the Tiger International, both airlines were failing before he came in and turned them around. His plan for United was described in Business Week as follows:^{21/}

"The company needs to get its costs in order so it can develop the profits it needs to buy aircraft to grow" said Wolf. His plan: to extract from labor a package of modest pay cuts, to improve marketing to business travelers, and to be smarter on ticket pricing. . . For now Wolf has put growth plans on hold until he can get costs in line. Wolf hopes to improve earnings by boosting capacity on his lucrative Pacific routes and by attracting a higher percentage of top-paying business flyers.

In 1987 United Airlines was second in the world in passengers transported (not including Aeroflot), first in operating revenue, and seventeenth in operating profit.^{22/} United's route structure covers North America and Asia. It had few Asian routes until, in 1985, it bought Pan Am's pacific operations and became the U.S. airline with the most Asian routes.

As of April 1988, United Airlines had 353 aircraft consisting of seven different aircraft types with engines from General Electric and Pratt and Whitney. There were an additional 107 aircraft on order. Since then an order for 30 757-200 aircraft with 30 options was placed. A fleet distribution is shown in Table F.1.

The process used by United to select aircraft and engines changed with the change in management. Under Dick Ferris, Jim Hartigan, the president, was the focal point. He utilized a planning committee which coordinated all the economic analysis. A computer model was used to take all the contract terms and convert them into a present value dollar amount. Hartigan also used the technical base in San Francisco to put together a technical book on each

Table F.1

United Airline's Fleet Distribution

<u>QUANTITY</u>	<u>AIRCRAFT TYPE</u>	<u>AIRCRAFT MFR</u>	<u>ENGINE MFR</u>
18	747-100	Boeing	PW
2	747-200B	Boeing	PW
11	747SP	Boeing	PW
19	767-200	Boeing	PW
50	727-100	Boeing	PW
104	727-200	Boeing	PW
74	737-200	Boeing	PW
22	737-300	Boeing	GE/SN
3	L1011-500	Lockheed	RR
47	DC-10-10	McDonnell-Douglas	GE
8	DC-10-30	McDonnell-Douglas	GE
29	DC-8-71	McDonnell-Douglas	GE/SN

ON ORDER

15	747-400	Boeing	PW
88	737-300	Boeing	GE/SN
30	757-232	Boeing	PW

CURRENT ENGINE MANUFACTURER PREFERENCES

Large Engines Pratt and Whitney - PW4000
 Medium Engines Pratt and Whitney - PW2037
 Small Engines CFM International - CFM56
 (GE and SNECMA)

Source: Interavia, "The World's Major Airlines",
 October, 1988, 1055.

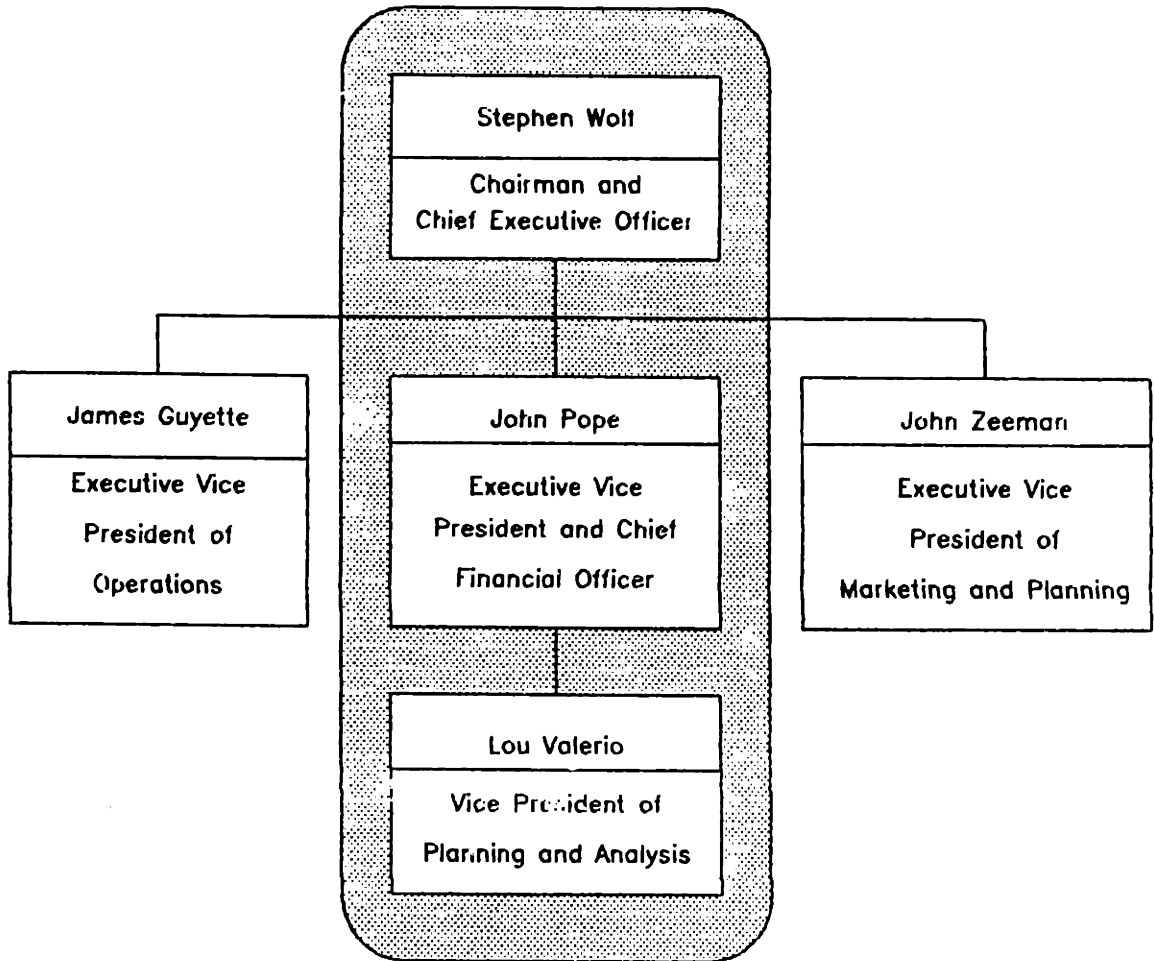
aircraft and engine to help in the evaluation. In the end it was Hartigan who conducted the final negotiations with the president of each manufacturer.

The evaluation and selection process in the new organization is centered in the financial organization under the Chief Financial Officer, Jack Pope. The organization is shown in Figure F.1. Pope joined United Airlines from American Airlines and brought along some of the techniques for evaluation of aircraft and engines such as the term sheet. Under Pope is Lou Valerio who also came from American Airlines. He has a group of about thirty who do the number crunching to determine the bottom line cost for each aircraft and engine combination. Every aspect of each manufacturer's proposal is converted to a cost. The steps in the selection process are shown in Figure F.2 and described below.

- o The decision to consider purchase of aircraft comes from management. Management uses input from the different organizations to determine that there is a need for new aircraft.

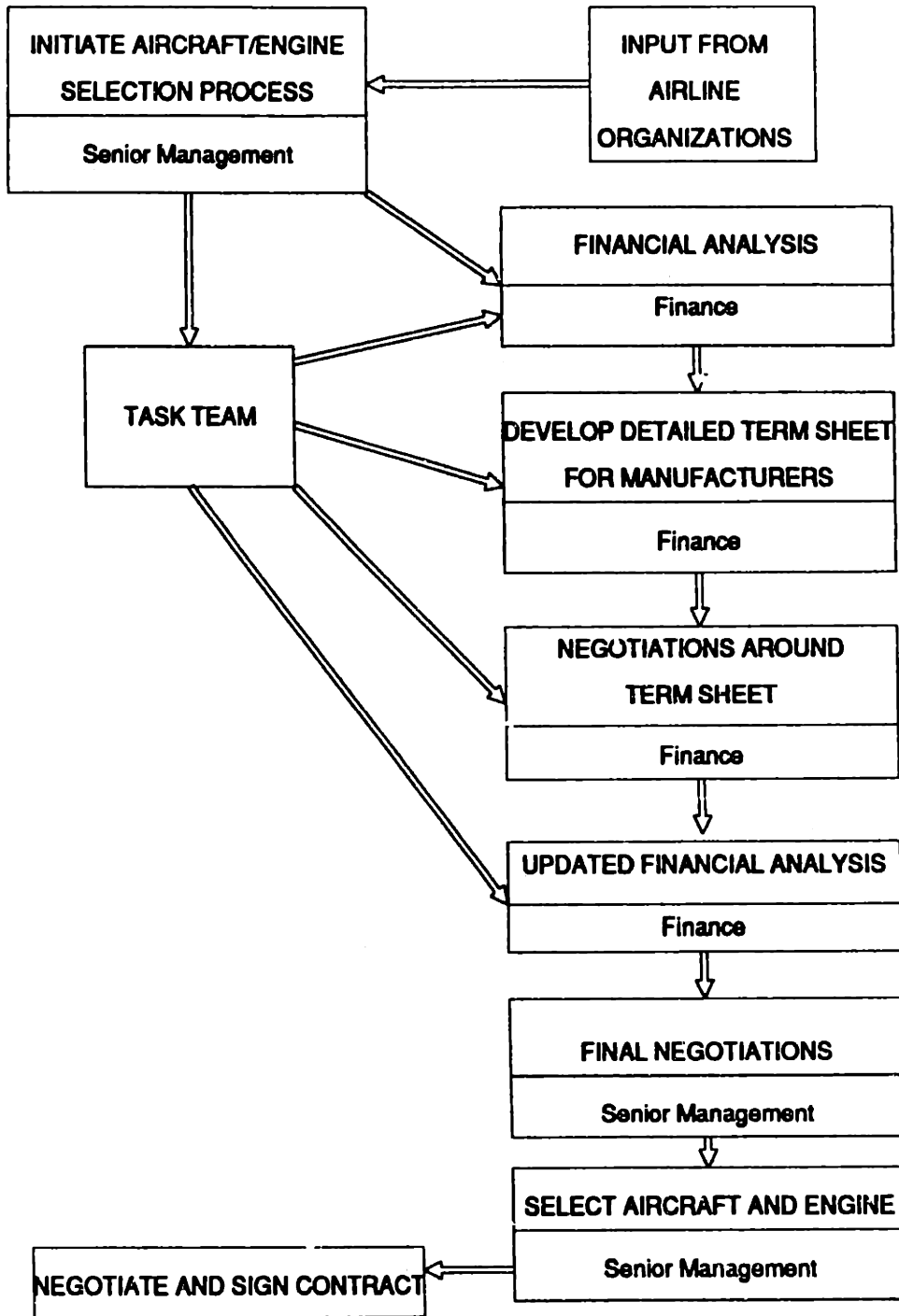
FIGURE F.1

SELECTION PROCESS AT UNITED AIRLINES CENTERED IN FINANCE



CENTER OF SELECTION PROCESS

FIGURE F.2
AIRCRAFT/ENGINE SELECTION PROCESS AT UNITED AIRLINES



Source: Interviews by the author with management from United Airlines, January, 1989.

- o A task team is put together to provide economic information to Lou Valerio's finance group. The finance group does a detailed economic analysis of potential aircraft.

- o Once the basic economic analyses are completed, the finance group puts together term sheets for each aircraft and engine manufacturer. The term sheets are provided to the manufacturers and responses requested. The responses are fed back into the economic analyses. As negotiations continue, changes to the manufacturers proposals are added to the economic analysis.

- o At United Airlines the aircraft and engine are analyzed together. The economic costs for all combinations of aircraft and engines are tracked. As negotiations continue and additional concessions provided by the manufacturers, the costs are updated. This creates a tremendous amount of analysis for the finance group, but in the end, the lowest cost aircraft-engine combination is obtained.

- o Negotiations continue around the term sheet. At a certain point the negotiation gets elevated to J Pope and S Wolf.

- o When an acceptable cost is obtained, S Wolf takes the proposal to the board for approval.

- o A public announcement can occur either before or after the final contract is signed.

The term sheet used by United has been described, both within the airline and outside the airline, as being long and very detailed with many different contingencies covered. By the time negotiations are complete, the term sheet is almost a complete contract. United views the complexity in today's purchase contracts as being driven by deregulation. They are very concerned about their position relative to their competitors. This forces them to consider things like guarantees, favored nation status, and lease termination options.

FOOTNOTES

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7. Vern Thomas, Manager of Market Analysis and Management Information for General Electric Company, Interviewed by the author, Cincinnati, Ohio, 3 January, 1989.
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