Intermodal Freight Transportation - An Integrated Analysis of Strategy and Operations

by

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Abstract

The concept of Intermodal Freight Transportation (Intermodal) pertains to the
movement of freight from its origin to its destination involving multiple modes of
transportation. Specific examples are intermodal rail-truck service (local pick-up and
delivery is performed by truck, line-haul by rail) and landbridge services for
containerizable cargo moving from the Pacific Rim to the United States (port-to-port
service provided by container ship, line-haul by rail, local delivery by truck).

While most of the previous research on intermodal has exclusively dealt with it
from the point of view of transportation systems analysis, this thesis has been
conceptualized with a different focus. Intermodal as an innovative way of moving cargo,
has developed within the competitive environment of the freight transportation market in
the United States. Therefore, we feel that it is crucial to understand the strategic
perspective behind the recent growth of intermodal. The major part of the thesis is
dedicated to providing this strategic perspective.

We analyze how the stakeholders on the supply side - Railroads, Shipping Lines,
Trucking Firms (Truck-Load, Less-Than-Truckload, Small Packages) and Intermodal
Marketing Companies - have moved toward intermodal in search of a competitive
advantage. Carrier decisions are mapped into a general framework for the analysis of
intermodal integration in the operational and sales/marketing activities in the value chain.
Further, we examine the impact of intermodal on the financial condition of its proponents
and on the structure of the industries of different modes.

By now, intermodal has become part of the traffic portfolio of the majority of
large corporations. In 1992, 52% of all $1 billion plus corporations have shifted traffic
from truck-only to intermodal. However, shippers still perceive a performance gap
between trucking and intermodal in terms of travel time, reliability and other service
dimensions. This motivates the second part of the thesis in which we identify
opportunities for the improvement of system performance and areas for potential further
into intermodal operations management.

Thesis Supervisor: Dr. Cynthia Barnhart
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I am grateful to Dr. Jonathan Byrnes for the insights he gave me in his course on logistics management. He opened my eyes to the fact that the nodes and links in transportation networks can have very individual, very human characteristics.

The Operations Research Center has provided an excellent environment for my learning experience at MIT. Thanks to Paulette, Cheryl, Laura and Astrid who - as the "good ghosts" - keep this place functioning smoothly. Thanks to all my friends at the ORC for sharing the pleasures and afflictions of MIT life with me. I am looking forward to seeing most of you on my wedding.

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# Table of Contents

1. Introduction ....................................................................................................................... 5

2. History of Intermodal in the United States ........................................................................... 8

3. The Strategic Perspective on Intermodal
   
   3.1 Railroads
      
      3.1.1 Industry Evolution since 1980 .............................................................................. 15
      
      3.1.2 Railroads and Intermodal ...................................................................................... 27
   
   3.2 Shipping Lines .............................................................................................................. 52

   3.2 Motor Carriers
      
      3.2.1 The Truckload Industry (TL) .............................................................................. 61
      
      3.2.2 The Less-Than-Truckload Industry (LTL) .............................................................. 74
      
      3.3.3 The Small Package Industry ................................................................................ 82
   
   3.4 Intermodal Marketing Companies .................................................................................. 84

   3.5 Intermodal Customers ..................................................................................................... 89

4. The Operational Perspective on Intermodal
   
   4.1 A Framework for Systems Improvements ................................................................. 95

   4.2 International Container Freight .................................................................................... 96

   4.3 Domestic Rail-Truck Service ....................................................................................... 102

5. Conclusion ......................................................................................................................... 106

Appendices

Appendix A: A Mind-Map of Freight Transportation .......................................................... 108

Appendix B: Selected Concepts of Strategic Analysis ......................................................... 110

Appendix C: Selected Concepts of Financial Analysis ....................................................... 114

Appendix D: Selected Concepts of Marketing Channel Management .............................. 116

Appendix E: Maps of Carrier Service Networks .................................................................. 121

Bibliography ......................................................................................................................... 131
List of Exhibits

2.1 Trailers and Containers Transported by Rail
3.1 The Structure of the United States Railroad Industry
3.2 Class 1 Railroads - Employment
3.3 Class 1 Railroads - Miles of Road Owned
3.4 Class 1 Railroads - Revenue per Employee
3.5 Class 1 Railroads - Operating Ratio
3.6 Class 1 Railroads - Freight Revenue per Ton-Mile
3.7 Class 1 Railroads - Operating Revenues versus Operating Expenses
3.8 Class 1 Railroads - Return on Assets
3.9 Market Share of Railroads and Trucks in the US Intercity Freight Market
3.10 The US Freight Transportation Market in 1989
3.11 Norfolk Southern - Originated Coal Tonnage
3.12 Burlington Northern Railroad - Revenue per Revenue Ton Mile by Commodity Category
3.13 Effectiveness in Selling Domestic Intermodal Services
3.14 Sources of Intermodal Movements in 1991
3.15 Selected Financial Data for CSX Intermodal and Sea-Land
3.16 Segments of Intermodal Transportation as seen by the Railroads
3.17 Comparison of Coal Volume and Intermodal Volume for the Seven Transcontinental Railroads, as of 1992
3.18 Operating Ratios of the Seven Transcontinental Railroads as of December 31, 1992
3.19 American President Companies - Revenues 1984-1993
3.20 American President Companies - Operating Ratio 1984 - 1993
3.21 American President Companies - Stack-Train Volume 1989 - 1993
3.22 American President Companies - North American Revenues 1984-1993
3.23 Selected 1992 Financial Data for the Largest TL Carriers
3.24 Porter's 5 Forces for the TL Industry in the late 1980's
3.25 Typical Cost Structures of Competitors for Intermodal Freight
3.26 J.B.Hunt - Higher Leverage Through Intermodal
3.27 J.B.Hunt - Purchased Transportation as a Percentage of Operating Revenue
3.28 Selected Financial Data for the Largest LTL Carriers
3.29 The LTL Industry under Pressure
3.30 The Hub Group - Annual Sales
3.31 Major Intermodal Marketing Companies
3.32 Selection Criteria in the 1992 Intermodal Index
3.33 Traffic Shifts in 1992
4.1 Processing Steps for International Container Freight
4.2 The Transportation Chain for Intermodal Rail-Truck Service
B.1 Elements of Industry Structure: Porter's Five-Forces Model
B.2 Three Generic Strategies
B.3 The Concept of the Value Chain and its Activities
D.1 Activities in Distribution Channels
D.2 How Channels of Distribution Create Utility and Fill the Gaps between Manufacturers and Consumers
1. Introduction

Intermodal defined

The concept of *Intermodal Freight Transportation*, or short *Intermodalism* or *Intermodal*, refers to the movement of freight from its origin to its destination involving multiple modes of transportation. Typically, modes of transportation are classified according to the medium in which transportation takes place and the type of vehicle being used: land transportation by means of rail, truck, pipeline or barge; water transportation by ocean vessel, coastal vessel and inland waterway barge; air transportation by airplane and helicopter\(^1\). Different subsets of these modes can be combined to form an intermodal transportation chain, e.g.:

- **Intermodal Rail-Truck Service** (recently, the acronym *IRT* has been introduced into the literature\(^2\)) describes the particular movement of freight where the local pick-up and delivery (often called *drayage*) is performed by truck whereas the long-haul is provided by rail. *IRT* can be further classified - according to the technology employed - into *trailer-on-flatcar* (*TOFC* or *piggyback*) and *container-on-flatcar* (*COFC*).

- **Landbridge Services for International Container Freight** are combined ocean-land movements from a foreign port (mainly from the Pacific Rim) to the United States, where the cargo is being transported from port to port by ocean shipping, then transferred onto either truck or rail and delivered to its final destination. *Double-stack* - a technology where two containers are transported on top of each-other on a rail car- is widely used for the land portion of international container traffic.

---

\(^1\)See Muller (1989).
• **Air Freight** is intermodal by its very nature since it has to be moved from and to airports by surface transportation means.

**Perspectives on intermodal**

The preceding definition has characterized intermodal as a particular way of transporting freight. Hence, any discussion of the subject needs to incorporate concepts of transportation systems analysis. For the purpose of this thesis, Carl Martland's "Mind-Map of Freight Transportation" proves to be a valuable framework.³ He suggests that it is the interaction of four different factors - carrier capabilities, shipper mode choice, economic geography and government regulation that shapes the transportation market place in general, and therefore also the intermodal segment.

However, intermodal is as much a particular way of moving freight as it is an industry. If we emphasize "industry", then the classic approach of transportation systems analysis needs to be supplemented by management concepts of strategic and financial analysis⁴ in order to fully understand the dynamics behind the rapid growth of intermodal in the 1980's.⁵ To illustrate this idea, the stakeholders in intermodal are not generic "shippers" or "carriers", but individual companies (Santa Fe Pacific Railroad, American President Lines, J.B. Hunt etc.) that design and implement certain strategies to achieve a competitive advantage.

**Thesis outline**

Following a brief account of the history of intermodal in the US in Chapter 2, Chapter 3 is dedicated to the objective of presenting the strategic perspective on the intermodal freight market. The sections of this chapter cover the major stakeholders on the supply side - Railroads in Section 3.1, Shipping lines in 3.2, Motor Carriers (truck-

⁵Intermodal traffic - as measured by the number of trailers and containers transported by rail - rose from 3.1 mill. in 1980 to 6.7 mill. in 1992.
load, less-than-truckload and small package) in 3.3 and Intermodal Marketing Companies (IMC) in 3.4 - in a coherent fashion. Major trends in the evolution of each industry are being analyzed with respect to their impact on intermodal. In addition, strategies of individual companies are examined to first, demonstrate how the changing environment requires a new competitive positioning and second, illustrate the point that even carriers of the same mode exercise different options in their approach to intermodal. Finally, techniques of financial analysis are applied to measure the impact of intermodal on the financial performance of its adopters.

Carrier strategies, however well-conceived, have to pass the customer test. To provide a framework for the test of intermodal, Section 3.5 summarizes recent research on shipper mode choice, or in broader terms the transportation purchase decision. The results are then linked to the positioning and perception of intermodal as an attractive product, as evidenced by recent market research studies\(^6\). In addition, market research studies suggest operational excellence as a major point of leverage for the improvement of the competitiveness of intermodal against conventional truck-only service.

This fact leads to the second major theme of the thesis, intermodal operations management. If operational performance is of such great concern to customers, than it is certainly worthwhile probing into this particular area in greater detail, which is accomplished in Chapter 4. International Container Freight and Domestic Rail-Truck Service are studied to highlight the complexity of managing both the physical flow of goods and the flow of information across modes (which in most cases is equivalent to 'across companies'). As a result of a high-level scan, specific operational issues are identified as potential subjects for further research on intermodal freight operations.

Chapter 5 concludes this thesis with an outlook on the future of freight intermodalism and so-called seamless service.

\(^6\)See Mercer Management Consulting, *Intermodal Index*, 1992
The main body of the thesis is supplemented by five appendices that are intended to brief the reader on concepts of different fields that have been integrated into the research on intermodalism. Appendix A covers a mind-map of freight transportation. Appendix B describes selected concepts of strategic analysis that have been developed by Michael E. Porter. Appendix C summarizes financial concepts that have been used throughout the thesis to evaluate the performance of transportation carriers of different modes. Appendix D is dedicated to marketing channel management in order to provide some insights for the "wholesale" vs. "retail" discussion in Section 3.2.1. The final Appendix E contains maps of the networks of most major railroads of the United States, of J.B. Hunt and of American President Lines' doublestack service.
2. History of Intermodal in the United States

Public attention in the 1990’s

The recent extensive press coverage of intermodal can easily create the impression that it took people in the field of transportation until the 1990’s to realize that freight can actually be moved through and exchanged between multiple modes. This impression is even amplified by the fact that intermodal thinking was incorporated into the transportation policy of the Government of the United States as recently as 1991. On December 18, 1991, President Bush signed the “Intermodal Surface Transportation Efficiency Act” (ISTEA)\(^1\) with the policy goal

\(\text{“to develop a National Intermodal Transportation System that is economically efficient, environmentally sound, provides the foundation for the Nation to compete in the global economy and will move people and goods in an energy efficient manner.”} \)

However, if one takes a closer look at the history of intermodal in the US, it becomes immediately obvious that this segment of the freight transportation market has developed a long time before press and government took notice of it, and also a long time before it was labeled “intermodal”.

The early days of intermodal

In fact, it was in 1926 that the “first recorded carriage of freight by intermodal truck trailers on railroad flatcars occurred on the Chicago North Shore and Milwaukee Railroad.”\(^2\) With the emergence of the trucking industry, rail carriers had become aware

\(^2\)See Muller (1989).
of the advantages of moving freight in a truck trailer to reduce the handling at the railroad terminal and improve pick-up and delivery flexibility.

This early flirt of the railroad and trucking industries was soon overshadowed by growing competition for long-haul traffic that lead to a continuous increase of motor carrier market share and a continuous decline of rail market share. Moreover, railroads were even reluctant to cooperate among themselves. Muller (1989) mentions a 1935 resolution of the Association of American Railroads (AAR) against "through routes and joint rail-truck rates except where such arrangements would not constitute invasion of another railroad's territory."

Finally, federal regulation contributed its fair share to the impediment of intermodal growth. Without getting into all the complex details, a few regulatory measures deserve to be mentioned: In 1931, the Interstate Commerce Commission (ICC) enacted rate regulations for piggyback service that for instance required that

a) no container traffic be moved at less than the carload rate, and

b) for multi-commodity shipments the rate for the highest-rated commodity would be applied to the whole containerload.

Further, rail carriers were unable to integrate with other modes through prohibition on their ownership of carriers of other modes. This prohibition was intended to protect the then infant trucking industry from the railroads.

Slow growth until 1980

As a result of these competitive and regulatory constraints, piggyback traffic grew rather slowly until the late 1970's (see Exhibit 2.1 below). In 1955, railroads considered the TOFC/COFC traffic large enough to report those loadings as a separate business category. In 1965, piggyback loadings had reached 1.6 million. From there, intermodal traffic rose at a compound annual rate of 4.5% until it reached 3.1 million in 1980.
Breakthrough since deregulation

The year 1980 marks the beginning of the era of de-regulation in the US Transportation Industry. While deregulation is often equated with the passing of the Staggers Rail Act and the Motor Carrier Act (both of which will be discussed in the respective sections of Chapter 3), there were less well-known measures that explicitly spurred the popularity of intermodal. Intermodal traffic surged when in 1979 the ICC deregulated rail rates on fresh fruits and vegetables. Their new-found freedom enabled railroads to divert much of this traffic from long-haul truck to piggyback. Later in 1981, the ICC effectively freed rail piggyback movements from all economic regulation. In addition, ownership restrictions were lifted allowing railroads and other carriers to expand into different modes and build truly intermodal transportation companies.

With carriers’ taking advantage of the more laissez faire regulatory framework, intermodal entered a period of strong growth that lasts until the present. From 1980 to 1992 intermodal traffic more than doubled which is equivalent to a compound annual growth rate of 6.7%. During this period, two events clearly stand out as milestones.

---

3See Maze et al. (1990).
First, in 1984, American President Lines (APL) - a west-coast shipping company - pioneered double-stack container service that since then has dramatically changed the way international container freight is handled. Second, in early 1990, J.B.Hunt and Santa Fe Pacific Corporation announced QUANTUM, the first strategic alliance between a transcontinental railroad and a major trucking company.

It was the latter event and the subsequent move of other trucking firms toward cooperation, instead of confrontation, with the railroad industry that attracted significant public interest and created the "intermodal is hot" atmosphere mentioned in the beginning of this chapter. Following up on this, Chapter 3 will shed more light on the growth period of intermodal since 1980.
3. The Strategic Perspective on Intermodal

3.1 Railroads

As providers of the long-haul part of most intermodal movements, railroads are at the heart of intermodalism. Thus, it is important to understand the major developments in this industry over the past decade and their implications for the growth of the intermodal segment. Following this line of thought, a brief summary of the significant changes the railroad industry has undergone since 1980, is presented in subsection 3.1.1. In terms of intermodal, the major conclusion is that railroads have built the capability to compete in more service-sensitive segments through improvements in both efficiency and effectiveness of their operations. On the other hand, subsection 3.1.2 develops the argument that intermodal is a necessity for railroads if they want to take advantage of current and future economic growth that will favor higher value goods over bulk-commodities. From there, strategic options for railroads with respect to intermodal are discussed and compared to actual decisions rail carriers have made. Finally, the impact of intermodal on the financial performance of the industry will be assessed.

3.1.1 Industry Evolution since 1980

The year 1980 is used as a starting point for the summary of major trends in the railroad industry since on October 14 of that year the Staggers Rail Act was signed into law by President Carter. Among other benefits, deregulation gave railroads more freedom in the area of pricing through the right to enter contracts and adjust rates more quickly. Restrictions on the abandonment of track as well as mergers and acquisitions have been relaxed.

The railroad industry took advantage of the freedom it was granted through deregulation. Mergers and consolidations, downsizing of labor, equipment and track, the adaptation of innovative business practices, the application of new technology, and last
but not least, deep cultural change allowed the railroads to achieve unprecedented improvements in productivity and profitability. In the following, these points will be explained in greater detail.

**Industry concentration**

Industry concentration reduced the number of Class 1 Railroads (Railroads with annual revenues of at least $250 million as defined by the ICC) from 40 in 1977 to 12 in 1992. Among the noteworthy mergers were Union Pacific / Missouri Pacific / Western Pacific and Denver, Rio Grande and Western / Southern Pacific.\(^1\) Union Pacific’s pending request to the ICC to change its 30% non-voting stake in the Chicago and Northwestern into a voting stake demonstrates that the trend toward concentration is likely to continue.\(^2\) Although to date no attempts at a transcontinental merger have been made, industry observers believe that it is just a matter of time since the advantages of single line service and single line rates are assumed to be compelling. In addition to the Class 1 railroads, there is a large number (497) of short line, regional and local railroads (see Exhibit 3.1 below for details).

**Downsizing**

The economies of scale achieved through mergers in conjunction with subsequent operations integration and streamlining, facilitated the necessary adjustment of railroad capacity to market demand. Mirroring a general trend in large American corporations, railroads downsized their networks (labor, track and equipment) at a rapid speed. In a painful (including Presidential Emergency Boards and a 24-hour strike in April 1991) and costly process\(^3\), the Class 1 Railroads reduced their workforce from almost 460,000 in 1980 to less than 200,000 in 1992.

---


\(^3\)For example, in 1991 the seven largest Class 1 Railroads took a combined pre-tax productivity charge of $3.7 billion that was mainly related to personnel reduction (severance packages, retirement incentives etc.).
### Exhibit 3.1 The Structure of the United States Railroad Industry

#### 12 Class 1 Railroads as of December 31, 1992

(defined by the Interstate Commerce Commission as those with revenues exceeding $250 mill. p.a.)

<table>
<thead>
<tr>
<th>Railroad</th>
<th>Revenue 1992 ($ million)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Union Pacific Railroad Company</td>
<td>4,897</td>
</tr>
<tr>
<td>Burlington Northern Railroad Company</td>
<td>4,630</td>
</tr>
<tr>
<td>CSX Transportation Inc.</td>
<td>4,508</td>
</tr>
<tr>
<td>Norfolk Southern Combined Railroad Subsidiaries</td>
<td>3,709</td>
</tr>
<tr>
<td>Consolidated Rail Corporation</td>
<td>3,345</td>
</tr>
<tr>
<td>Southern Pacific Rail Corporation</td>
<td>2,876</td>
</tr>
<tr>
<td>Atchison, Topeka &amp; Santa FE Railway Company</td>
<td>2,252</td>
</tr>
<tr>
<td>Chicago &amp; Northwestern Holdings Corporation</td>
<td>985</td>
</tr>
<tr>
<td>Soo Line Railroad Company</td>
<td>600</td>
</tr>
<tr>
<td>Illinois Central Railroad Company</td>
<td>547</td>
</tr>
<tr>
<td>Grand Trunk Western Railroad Company</td>
<td>450</td>
</tr>
<tr>
<td>Kansas City Southern Railway Company</td>
<td>369</td>
</tr>
<tr>
<td>Denver &amp; Rio Grande Western Railroad</td>
<td></td>
</tr>
<tr>
<td>(subsidiary of Southern Pacific, therefore not analyzed separately)</td>
<td></td>
</tr>
</tbody>
</table>

---

#### 497 Short line, local and regional railroads

**Regional carrier:**  
- operates at least 350 miles and generates between $20 and $250 million in annual revenue

**Short Line:**  
- operates less than 100 miles of track and has annual revenue of less than $20 million

**Local carrier:**  
- switching and terminal railroads  
- provide pickup and delivery service in a single metropolitan area
While this reduction includes both administrative and operating employees, the most significant shift occurred in train crew sizes. Crew sizes were lowered to a maximum of three, in many cases (depending on the particular railroad and the geographic region) even to two (engineer plus conductor), thanks to the elimination of one or even both of the two antiquated breakmen.  

Low-density, high cost track was abandoned or sold to regional carriers as evidenced by the change in the number of road miles operated from 165,000 in 1980 to 113,000 in 1992.  

Surplus equipment was sold or retired resulting in a 37% decrease in the number of locomotive units operated from 1980 to 1992 and an almost 50% decline in the number of freight cars over the same period.

---

5 The terms "roadmiles" represents the aggregate length of roadway, excluding yard tracks, sidings and parallel lines. If those are included in the total, the term "trackmiles" is used.
6 The 50% reduction applies to Class 1 Railroads as a group. The number of cars operated by Non-Class 1 railroads and by car companies (e.g. TTX, formerly TrailerTrain) and shippers remained almost constant.
Organizational and cultural change

Equally challenging as the downsizing effort, was the push to turn around entrenched business practices and a culture that had evolved over more than a hundred years. Every textbook that contains a chapter on the history of management refers to railroads as the companies that invented the modern business bureaucracy. For example, Michael Hammer and James Champy write:7

"To prevent collisions on single-track lines that carried trains in both directions, railroad companies invented formalized operating procedures and the organizational structure and mechanisms to carry them out. Management created a rule for every contingency they could imagine, and lines of authority and reporting were clearly drawn. The railroad companies literally programmed their workers to act only in accordance with the rules, which was the only way management knew to make their one-track systems predictable, workable, and safe. Programming people to conform to established procedures remains the essence of bureaucracy even now."

In fact, this description of 19th century railroads as prototypes of large-scale bureaucracies still held true a hundred years later, in the mid-1980’s, as the case of Union Pacific Railroad (UP) illustrates.

The case of Union Pacific

Before the new CEO Mike Walsh launched his revolution at UP in 1986, the company was, in the words of Tom Peters\textsuperscript{8}, “stiff, hyper-formal, bureaucratic, stodgy, sluggish, militaristic”. In the operations hierarchy, a total of nine layers of management separated the Executive VP Operations from the railroaders who did the day-to-day work. As if this was not disastrous enough, the different railroad departments such as Operations and Marketing did hardly ever communicate, let alone cooperate with each other: “Before the reorganization, sales and marketing at the Union Pacific Railroad focused on revenue and the customer; operations focused on costs and ‘playing trains’ ... And rarely the twain did meet.” Not surprisingly, the customer suffered. (Self-report UP: “We got the car there when we got the car there. The customer could take it or leave it.”) The top management of the parent company - Union Pacific Corporation - was so displeased with the performance of the railroad that they even considered divesting of the railroad altogether.

It was in the face of this serious crisis that CEO Mike Walsh transformed UP into “a brand-new railroad.” Layers of middle management were stripped out, 30 “businesses” within the company run by superintendents of transportation services were created, decision processes were decentralized. On the other hand, Dispatching (in Omaha) and Customer Service (in St.Louis) were centralized to take full advantage of the power of state-of-the-art computer and telecommunication technology. It appears to be a contradiction, but this centralization actually empowered UP’s front-line employees.

With the systems’ handling most of the routine work, and providing “instant access to the

\textsuperscript{8}\textit{This quotation and the subsequent account of Union Pacific’s change process are based upon Peters (1992), Chapter 7.}
whole railroad”, people were left with “problem-solving to support the customer”. Thanks to modern technology, Union Pacific was able to overcome the traditional “centralization for efficiency and decentralization for effectiveness” paradigm. The company did both, it centralized and decentralized, and it achieved both, better customer service and lower cost.

Information technology enables change

Following UP’s lead, other railroads have utilized the potential of information technology as an enabler of change. For example, Burlington Northern’s Network Control Center (opened in Fort Worth in April 1992) helps the railroad to manage locomotive, train and car operations more precisely. It supports the “Integrated Network Management” process that is designed to achieve a fully scheduled railroad. To give a more recent example, in 1994, even the popular business press takes notice of the transformation of railroads into leading edge users of information technology: Conrail is singled out by Business Week as a user of parallel-processing computers for the analysis of customer shipping data and the management of daily operations, e.g., the individual tracking of 100,000 railcars.

Increased profitability despite sluggish revenue growth and shrinking rates

The rationalization of the physical plant, combined with technological and management innovation, lead to a dramatic improvement of railroad productivity over the past decade. This point can best be illustrated with the help of a few key statistics:

- **Revenue per Employee** (a financial measure of labor productivity) increased from $58,000 in 1980 to $140,000 in 1992 (see Exhibit 3.4 below).

---

11 See Appendix C for details of the operational and financial performance measures that were being used to evaluate Class 1 Railroads.
• Revenue Ton-Miles per Employee (an operational measure of labor productivity) increased from 2.1 million in 1980 to 5.4 million in 1992.

• Ton-Miles per freight train hour (a measure of both speed and asset utilization) rose from approximately 40,000 in 1980 to more than 65,000 in 1992.
- The **Operating Ratio** (a high-level efficiency parameter which measures the proportion of operating revenues that was consumed by operating expenses) went below 90% in 1990 and reached a new special-charge-adjusted low of 87.8% in 1992. It evidences the continuous improvements in operating efficiency in the railroad industry since the mid-1980's. The results for 1991 and 1992 were adjusted for non-recurring charges for employee buyouts. Without adjustment, the operating ratio would have amounted to 104.3% for 1991 and 92.0% for 1992.\(^\text{12}\)

While railroads were anxiously focusing their efforts on cost-cutting and productivity, the overall market demand for rail freight transportation services remained sluggish throughout the 1980's. Even when measured in current dollars, total revenue for Class 1 Railroads remained below the 1981 high of almost $29 million. Moreover, railroads faced high pressure on their rates in the aftermath of deregulation. Increased intra-industry as well as rail-truck competition caused a continuous decline in the rate per ton-mile (see Exhibit 3.6).\(^\text{13}\)

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\(^\text{12}\)These are the numbers that are reported in the AAR publication on railroad facts, that served as a data source for the major part of this section.

\(^\text{13}\)The careful reader will notice that Exhibit 3.6 does not have a data point for 1981 due to missing expense figures for that year.
In terms of constant 1983 dollar figures (nominal rates adjusted using the GDP price deflator), the rate per ton-mile eroded 40% from 3.119¢ in 1983 to 1.860¢ in 1992.

The profitability of a business is determined by both revenues and costs. So far, two conflicting trends (conflicting in their impact on profitability) have been highlighted. On the one hand, railroads have accomplished critical improvements on the cost side. On the other hand, declining rates and sluggish demand have prevented revenues from growing. The overall impact of these trends is summarized in Exhibit 3.7, that shows a continuous increase in operating profitability since 1986.

Exhibit 3.7: Class 1 Railroads - Operating Revenues vs. Operating Exp.

21 22 23 24 25 26 27 28 29
1980 '83 '84 '85 '86 '87 '88 '89 '90 '91 '92

Revenues
Expenses

It should be noted that the results 1991 and 1992 have been adjusted for non-recurring charges (related to employee reduction) to allow for an objective comparison with previous years. The officially reported figures (according to GAAP-Standards) would have shown a fairly dramatic swing in performance with expenses in 1991 $3.6 billion higher than depicted and $1.2 billion higher in 1992.
The final step in this analysis links railroad profitability to the investment that was required to generate these profits. With total assets only slightly increasing over the respective period, strong earnings lead to a rise in Return on Assets (ROA) with a tentative peak in 1990 at 8.11%. Again, the results for 1991 and 1992 have been adjusted to get the real picture. The officially reported ROA amounted to 1.30% for 1991 and 6.30% for 1992.

Exhibit 3.8: Class 1 Railroads - Return on Assets (in %)

For the railroad industry, this is a pretty remarkable achievement. However, if one compares the ROA to the regulatory cost of capital (calculated by the ICC), which is currently at about 11%, then it becomes clear that, though the gap between ROA and cost of capital has narrowed, the railroad industry still does not earn its cost of capital. As one industry consultant put it, "Railroading is (still) a sophisticated way of losing money", but it is getting better.¹⁴

¹⁴This statement reflects the economic definition of profitability - ROA greater than cost of capital - as opposed to accounting profitability as measured in positive net income and, thus, a positive return on assets.
Service reliability improved

In addition to improving their financial performance, railroads also made remarkable progress in the area of service reliability.

Burlington Northern (BN) instituted a Service Management System in late 1989 as a key component of its effort to become a scheduled railroad that provides consistent customer service. According to BN, on-time performance increased from 51 percent in 1990 to 63 percent in 1991 and 76 percent in 1992.15 Santa Fe Pacific, another major Western railroad, also reports substantial improvements in its service levels from 64% in the 4th quarter of 1991 to 78% in the respective period of 1992, and works currently toward the goal of 90% on-time performance.16

These numbers are attesting that the new customer-oriented philosophy at the major railroads (BN: “Reengineering customer services”, Santa Fe: “consistently meeting our customers’ expectation”, Conrail: Quality imprinted onto every locomotive) has yielded tangible results. With increased service levels, railroads are better positioned to compete against truckers for service-sensitive freight. The next chapter on railroads and intermodal will discuss how railroads can actually utilize their new capabilities in order to facilitate the growth of their intermodal segment.

3.1.2 Railroads and Intermodal

After the general discussion of the railroad industry in 3.1.1, this subsection moves on to demonstrate the importance of intermodal for long-term growth. Further, we will spell out strategic options for railroad management regarding the position of their corporations within the intermodal landscape. Afterwards, we will subject these generic strategies to a reality check and discuss examples of actual approaches that have been taken. Finally, financial data on the intermodal volume of the major US railroads will be analyzed in order to identify the financial impact of intermodal on the profitability of the industry.

The need to grow revenue

From the previous section one can infer that railroads have managed to substantially improve their cost structure and therefore profitability. However, for the long-term prosperity of the US railroad industry it is not sufficient to just focus on the cost aspect of the business. Unless management surrenders to the notion of railroads as a declining industry, it needs to identify opportunities for growth, i.e. opportunities to increase revenue.

Pondering the strategic challenge to increase revenue, management can explore a rich array of alternatives. For example, railroads can and do leverage their extensive real estate holdings in attractive metropolitan locations (sell property to developers, act as developers themselves). Further, they can expand their natural resource operations, diversify into waste disposal, just to name a few alternatives. However, none of these options will help the industry improve its core business which is “railroading”, or more broadly defined, “freight transportation”. In this core business, railroads have been steadily losing ground to truckers since the 1920’s. The market share of railroads in the US intercity freight market (based on ton-miles) has shrunk from 75% in its heyday to

27
about 37% in 1992. On the contrary, the trucking industry has advanced from a meager 3% in 1929 to more than 27% in 1992 (see Exhibit 3.9).

Yet, these numbers (that are based on non-financial output) conceal the actual development that has been far more ruinous for the railroad industry. In terms of financial output, motor carriers had captured almost 79% of the US freight dollar in 1989 whereas railroads were left with a minor 9% of a $320 billion market (see Exhibit 3.10). Since 1989, the market has further expanded for the benefit of the trucking industry. The Economist\(^1\) estimates total trucking revenues for 1993 at $280 billion, a 10% increase compared to 1989. Most of the growth has been captured by truckload carriers\(^2\) who almost doubled their segment to $40 billion. On the contrary, railroad revenues have stagnated.

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\(^2\)See Section 3.3 for a discussion of the different types of motor carriers.
Exhibit 3.10: The US Freight Transportation Market in 1989

<table>
<thead>
<tr>
<th>Motor carriers</th>
<th>Revenue in $ billion</th>
<th>Percentage of total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Public and for-hire</td>
<td>71.2</td>
<td>22%</td>
</tr>
<tr>
<td>Private and for own account</td>
<td>81.3</td>
<td>25%</td>
</tr>
<tr>
<td>Local freight services</td>
<td>101.6</td>
<td>31%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>254.1</strong></td>
<td><strong>79%</strong></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other carriers</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Railroads</td>
<td>29.6</td>
<td>9%</td>
</tr>
<tr>
<td>Water carriers</td>
<td>20.2</td>
<td>6%</td>
</tr>
<tr>
<td>Oil Pipelines</td>
<td>8.5</td>
<td>3%</td>
</tr>
<tr>
<td>Air carriers</td>
<td>11.2</td>
<td>3%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>69.5</strong></td>
<td><strong>21%</strong></td>
</tr>
</tbody>
</table>

Total 323.6 100%

Segment: Public and for-hire

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Revenue</th>
</tr>
</thead>
<tbody>
<tr>
<td>TL-general commodity</td>
<td>24</td>
</tr>
<tr>
<td>LTL</td>
<td>18</td>
</tr>
<tr>
<td>Parcel delivery services</td>
<td>11</td>
</tr>
<tr>
<td>Bulk commodity carriage</td>
<td>5</td>
</tr>
<tr>
<td>Household goods</td>
<td>5</td>
</tr>
<tr>
<td>Motor vehicle haulers</td>
<td>3</td>
</tr>
<tr>
<td>Refrigerated transport</td>
<td>3</td>
</tr>
<tr>
<td>Building materials</td>
<td>2</td>
</tr>
<tr>
<td>Heavy machine haulers</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>72</td>
</tr>
</tbody>
</table>

Source:
The potential of bulk commodities is limited

Searching for causes of this situation, it is enlightening to analyze the railroad traffic mix and put it into the perspective of the overall freight market. John Anderson, Executive Vice President for Marketing and Sales at Burlington Northern, looks at the freight market as follows:³

*Think of a continuum of commodities. At one end of the continuum are commodities that should go by train such as coal or grain. These commodities are heavy and low-cost, have low time sensitivity, and come in large lots. At the other end are commodities that should go by truck, such as strawberries, electronics and garments. These are light and high-cost, have extremely high time-sensitivity, and come in small lots. In between those two extremes are many commodities where truck and trains compete vigorously on price and service.*

These commodities “that should go by train” actually do so:

- In 1992, coal was the single largest source of railroad traffic accounting for 39.6% of the freight volume (more than 500 million tons) and 22.6% of total railroad revenue. Moreover, coal is believed to contribute a much higher proportion of rail industry profits than revenues since cost for transportation (in efficient unit trains), handling, claims and insurance are far lower than for other traffic.⁴ This belief is supported by the good standing of the largest coal hauling railroads relative to the rest of the industry.
- Farm products represent the second largest freight category (in terms of cargo volume) with 150 million tons being originated in 1992 generating 8.2% of freight revenue for U.S. railroads.

However, the paramount importance of these categories for the financial well-being of railroads can not conceal the fact that their growth potential is limited. Not so much by competition from other modes of transportation as by the commodity markets

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⁴Publicly available financial data (10K, Annual Reports) does not allow for an assessment of the profitability of individual traffic categories. While revenues are reported by commodity types, expenses are itemized according to compensation, fuel, depreciation etc.
themselves. Hence, both coal and farm products vividly illustrate the notion of transportation as a derived demand.

The future of coal traffic

There are two major consumers of coal - utilities and the steel industry - in two distinct markets, domestic and export (Exhibit 3.11 shows the relative importance of these segments for Norfolk Southern Railway, a major eastern coal hauler). The following brief discussion of the future of coal traffic will focus on the utility segment since it significantly exceeds the steel industry in size and therefore relative importance.

| Exhibit 3.11 Norfolk Southern - Originated Coal Tonnage (in million tons) |
|-----------------------------|-----------------------------|-----------------------------|
| Export                      | 32.3           | 35.3           | 36.2           |
| Utility                     | 55.3           | 56.4           | 60.4           |
| Steel                       | 19.1           | 16.6           | 19.3           |
| Other                       | 8.8            | 8.5            | 10.7           |
| Total                       | 115.5          | 116.8          | 126.6          |

The long-term prospects of the utility market will significantly depend on the energy policy of the U.S. Government. The Clean Air Act is likely to shift the demand from high-sulfur to low-sulfur coal with Union Pacific and Burlington Northern being the primary beneficiaries. A second pending proposal, the "carbon tax" or "BTU tax" could cloud the outlook for coal traffic altogether as Norfolk Southern’s (NS) strong rhetoric in the 1992 Annual Report underscores:

Efforts ... threaten to adversely affect NS rail’s coal traffic and revenues and to cause higher energy prices to consumers, job losses and competitive impacts disproportionate to any environmental benefit. NS Rail will continue to monitor closely and to oppose vigorously any such tax that improperly and indiscriminately penalizes coal use and users.
In addition to the potential substitution of coal by other fuels such as natural gas, the substitution of coal transportation by energy transportation could pose a serious threat to railroad revenues. “Coal by Wire” or “Power Wheeling” are terms used to describe the transmission of electric power between utilities. In the worst-case scenario⁵, utilities would build coal-fired plants at mine sites (thereby eliminating the need for costly transportation) and link the power to their customers through massive transmission lines.

In terms of export markets (mainly Europe), one can observe trends similar to those in the United States: Rising environmental consciousness combined with the availability of substitutes such as North Sea gas or nuclear energy (France) suggest that the future of coal export from the U.S. to European utilities is rather uncertain. In addition, the presence of low-cost foreign suppliers such as Colombia and South Africa could have negative effects on U.S. coal exports.

To summarize the previous analysis in a nutshell: As long as coal needs to be transported (for both domestic and export markets), railroads can rely on it as a safe and profitable source of traffic. However, several exogenous factors could - in the long run - adversely impact the demand for coal transportation.

The future of agricultural traffic

The category of “farm products” or “agricultural traffic” essentially refers to grain that is either consumed domestically (70%) or exported (30%). With demand from U.S. food processors and livestock breeders being fairly steady, shipments for domestic grain movements are expected to advance at an annual rate of 3% to 4% throughout the 1990’s.⁶ Yet, sluggish export demand is predicted to constrain grain traffic over the next few years. Russia, the single largest customer for U.S. grain does not have the means to finance imports at past levels of 30 million tons per annum. Other traditional net importers such as Mexico, India and China have sharply increased their domestic production up to a level where they export themselves. For instance, China was able to

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⁵As spelled out by Standard & Poor’s, Industry Survey Railroad and Trucking, 1993.
⁶See Standard & Poor’s.
export 8 million tons of corn in 1992. Finally, rival exporting nations such as Argentina, Brazil and Australia have the advantage of lower cost of land, labor and capital than farmers in the U.S. In total, these developments explain why the United States’ share of world grain markets has been steadily contracting and with it the prospects for significant growth in rail grain traffic.

The preceding discussion of the future of coal and grain traffic supports the point made in the headline of this section, indeed, the potential of bulk commodities to fuel the growth of the railroad industry is limited. Further, the relevance of bulk commodities and bulk shipments for the overall U.S. economy is continually reducing. There is no statistic available that documents the relative importance of high-density vs. low-density products. However, it seems reasonable to hypothesize that the macroeconomic shift toward the service sector is favoring goods of lower weight and higher value, a category that entails the strawberries, electronics and garments mentioned by John Anderson. In addition, the economy is shifting toward smaller size and more frequent shipments. Small and frequent shipments are at the core of supply chain management concepts (such as just-in-time) that have found widespread application in industries as diverse as automobile manufacturing, apparel, grocery and hospital supplies.\(^7\) JIT also places high emphasis on reliability. The logic here is that high reliability on the part of the carrier allows the shipper to lower the safety stock which acts as a buffer against supply uncertainties.

Taken together, these inevitable trends in the economy at large and in the logistics management function of shippers in particular, underscore that railroads - in order to benefit from current and future economic growth - need to search for opportunities in non-traditional traffic segments. They need to take on the challenge of the trucking

\(^7\)The US share of the world market for major grain groups developed as follows: Corn - 77% in 1981, 63% in 1992, Wheat - 44% in 1981, 32% in 1992, Soybeans 78% in 1981, 66% in 1992.

\(^8\)Each industry has its own approach to and terminology for supply chain management: Efficient Consumer Response for Groceries, Continuous Replenishment for Hospital Supplies, Quick Response for Apparel. Nonetheless, these approaches share the common goal of providing high quality customer service in an efficient manner (low cost, in particular low inventories).
industry and target the segments that John Anderson characterized as "in between the extremes". Here is where intermodal enters the scene.

**Intermodal promises growth**

From the point of view of railroads, intermodal is the traffic category that allows them to tap into high-value and service-sensitive segments that are truck-competitive. It is the category that grew at an annual rate of more than 6% from 1980-1992 (see Chapter 2). Moreover, intermodal has the second highest (second only to Automotive) revenue per ton-mile of all traffic categories as Exhibit 3.12 illustrates.\(^9\) Both characteristics contribute to the long-term attractiveness of intermodal and therefore suggest that railroads give prominence to intermodal in their overall traffic portfolio.

<table>
<thead>
<tr>
<th>Exhibit 3.12</th>
<th>Burlington Northern Railroad</th>
<th>Revenue per Revenue Ton Mile by Commodity Category (in cents)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1992</td>
<td>1991</td>
</tr>
<tr>
<td>Automotive</td>
<td>8.32</td>
<td>8.54</td>
</tr>
<tr>
<td>Intermodal</td>
<td>3.13</td>
<td>3.10</td>
</tr>
<tr>
<td>Industrial Products</td>
<td>2.62</td>
<td>2.61</td>
</tr>
<tr>
<td>Merchandise</td>
<td>2.49</td>
<td>2.57</td>
</tr>
<tr>
<td>Agricultural Commodities</td>
<td>2.11</td>
<td>2.04</td>
</tr>
<tr>
<td>Coal</td>
<td>1.30</td>
<td>1.31</td>
</tr>
</tbody>
</table>

**Strategic options with respect to intermodal**

Acknowledging the potential of intermodal, railroads need to perform the second step in any strategic analysis - adopt a position that gives them a competitive advantage within the intermodal business. In order to achieve this objective, it is not helpful to look at the firms' activities as a whole. Rather, it is necessary to disaggregate a business into the stages and tasks that are conducted to add value. Such a disaggregation can be based

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on Porter's concept of the "value chain", which is discussed in Appendix B. The "value chain" in its original form has been abstracted from manufacturing operations, however it can easily be fitted to intermodal transportation if one replaces the manufacturing activities by their transportation equivalents.

Two "value chain" activities are crucial with respect to intermodal - operations and sales/marketing. The operations consist of the long-haul move and the drayage on both ends for domestic rail-truck service, and of the ocean leg and the rail line-haul for international container freight.\(^\text{10}\) Here, railroads have to define whether they only want to perform the line-haul from rail terminal to rail terminal, or extend their scope into other modes (trucking, shipping line), such that they can provide origin-to-destination coverage on a single carrier.

In terms of sales/marketing, railroads have to decide how they want to interface with their customers. Should they market their product through third parties such as motor carriers, shipping lines and intermodal marketing companies (indirect channels), or should they target end-customers directly, or even blend the two approaches into a dual distribution system?

As the subsequent analysis will show, the two tasks (operations and sales/marketing) are to a certain degree dependent upon each-other. Since shippers are interested in origin-to-destination movements, and not in movements from rail terminal to rail terminal, they will prefer "one-stop shopping" for intermodal and purchase the packaged product from the party that is offering it. Thus, the provision of full origin-to-destination (O-D) coverage seems to be a prerequisite for direct end-customer marketing on the part of railroads.

Options related to operational scope

\(^{10}\)In Chapter 4 we will see that in most cases there is no direct sea-rail interface, but rather an additional trucking segment between port and rail terminal. However, the omission of this detail does not impact the strategic discussions in this chapter.
Vertical Integration: Start Drayage Operation

An obvious way to achieve O-D coverage for rail-truck service, would be to set up a drayage operation that provides local pick-up and delivery for all, or at least the major, intermodal terminals of a particular railroad. This could be achieved through internal development or acquisition of small, local trucking firms that would be integrated into a drayage unit. In either case, the major benefit of this vertical integration decision would be full control over the shipment on the part of the railroad, which - according to the proponents of integration - removes organizational barriers between railroad and drayage provider, and therefore improves the service quality of intermodal. Better service would increase the ability of the integrated service provider to differentiate its product from non-integrated competitors, and hence provide a source of competitive advantage. On the other hand, the development of a proprietary drayage operation increases the fixed cost associated with the intermodal business. Railroads will only earn an adequate return on the drayage investment if they can achieve a high level of asset utilization and convince their customers that the railroad-intermodal-package is superior to alternative arrangements, such as railroad plus owner-operator, bundled by an intermodal marketing company.

Horizontal Strategy: Acquire long-haul motor carrier

A second strategy to achieve full O-D service, would be through acquisition of a long-haul motor carrier that could manage the drayage part of intermodal movements in addition to its regular trucking operations. The emphasis here is on “in addition to”. Unlike the preceding scenario of a drayage operation exclusively dedicated to the railroad’s intermodal business (vertical integration), this constitutes a case of a horizontal strategy. The adequate organizational structure for the integrated carrier seems to be a

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11A horizontal strategy is defined as “a set of coherent long-term objectives and action programs aimed at identifying and exploiting interrelationships across distinct but related business units.” Hax/Majluf (1991) is the primary source for this definition and the topics of vertical integration and horizontal strategy.
holding company with the railroad and the trucking firm as independent business units. The challenge, then, lies in the exploitation of synergies (horizontal links in the organization chart) between these subsidiaries in order to add value beyond the simple sum of independent business contributions. Given the experience that the natural response of a vertical organization is to impede and oppose the support of horizontal interrelationships, this is a highly non-trivial task. Further, in the specific case of railroad and trucking, we encounter two entities with radically distinct histories and cultures. As John R. Katzenbach and Douglas K. Smith commented with respect to rail-truck cooperation:¹²

"Railroads basically disliked truckers and viewed them as competitive upstarts...They were seen as 'fly-by-night' entrepreneurs, unconstrained by regulation, tradition, networks, or historical operating patterns. The idea that truckers and railroaders might cooperate to serve common customers was heresy within the major railroads."

As an analogy for this adversity, the relationship between local telephone companies and cable-companies comes to mind. For example, culture clashes were recently cited as a major reason for the failed merger attempt between Bell Atlantic and TCI.

Several railroads have, in fact, pursued a strategy of rail-truck integration when decade-old restrictions on multi-modal ownership and operations had been lifted in the early 1980’s. However, information on these cases is fairly limited.

The beginning was made by Norfolk Southern (NS) who gained control in 1984 over North American Van Lines, one of the largest household goods movers and general-freight truck-load carriers in the US. Muller (1989) reports that since then North American has played a very important part in introducing Norfolk Southern’s RoadRailer service (discussed below) by providing the highway portion of the movement. Beyond that, it is not clear which synergies between NS Railway and North American have been

identified and exploited, i.e., what proportion of North American’s general freight is being moved by rail or whether North American has responsibility for the railroad’s drayage operation for non-RoadRailer intermodal traffic.

Union Pacific purchased Overnite Transportation, the nation’s 5th largest LTL carrier in 1987. According to Muller (1989), Overnite aides in the consolidation of UP’s double-stack container service and provides joint truck-boxcar transloading service for the railroad. However, UP’s Annual Report for 1992 does not hint at an advanced state of integration. Rather, it stresses the fact that Overnite is leading the LTL industry in terms of profitability (lowest operating ratio of 90%). While one could argue that this proves the benefits of intermodal ownership, Overnite’s lead is more likely to be based on its freedom from union-intervention and the resulting privilege of lower labor cost and higher flexibility (see Section 3.3.2 on LTL carriers).

In both cases, the railroad and the trucking firm are kept as separate organizational entities. Norfolk Southern Railway and North American are independent subsidiaries of Norfolk Southern Corporation, Union Pacific Railroad and Overnite both report to Union Pacific Corporation. This prevalent holding company structure suggests that the degree of intermodal integration is fairly moderate. In fact, Union Pacific and Norfolk Southern resemble transportation conglomerates, rather than integrated carriers.

Burlington Northern serves as the final case study in this discussion of horizontal strategy (we will revisit the topic in the section on shipping lines). The story of BN is quite disparate from the previous accounts in that it altogether questions the wisdom of intermodal acquisitions on the part of railroads. Starting in 1985, BN had acquired five dry van truckload carriers and formed them into Burlington Northern Motor Carriers, Inc. However, in September 1988 the interest in the trucking subsidiary was discontinued (for reasons unknown to the author).

Leverage intermodal technology: Roadrailer
A third solution to the problem of full O-D coverage employs RoadRaider technology that has been specially designed for intermodal purposes. RoadRaider units are enclosed vans that can be equipped with both highway and rail wheels. This dual set of wheels allows them to be pulled over the highways in motor carrier service and over the rails by locomotive. In terms of operations, RoadRaider technology has two major advantages. First, it can be switched from rail to road (or vice versa) without the need for expensive overhead cranes, thus lowering terminal costs. Second, RoadRaider does not require investments into flatbed trailers to be moved on rail track, since rail wheels can be attached to it for the rail line haul. On the other hand, the individual trailers are supposed to be two times as expensive as conventional highway trailers and have a higher tare-weight than their highway competition, thus lower payloads.

The history of RoadRaider goes back to the late 1950’s when the Chesapeake and Ohio Railroad (C&O) developed a new type of rail-highway vehicle to haul mail and parcel traffic behind the C&O’s passenger trains. The service lasted until the mid-1960’s when passenger train service was largely discontinued. In the late 1970’s, the concept of the intermodal trailer was revitalized. Since then, several railroads have experimented with re-engineered versions of the RoadRaider.

The largest user is Norfolk Southern (NS) which launched its "Triple Crown Services" (TCS) operation in 1986 between St. Louis and Detroit. Detroit points to the fact that the large automotive manufacturers were the first customers of the service. Muller (1989) mentions the early support given to the Roadraider concept by General Motors. Subsequently, TCS expanded its business in terms of both regional scope and traffic mix. While auto parts still are the principal business, the general retail business and the paper products market have also been targeted. In April 1993, NS joined forces

13In the earlier version, labeled Mark IV, the rail wheels (retracted) were also carried when the trailer was in highway service. In order to reduce the tare weight of the Roadraider, the newer Mark V version uses detachable rail wheels that are stored at rail terminals.

14See Muller (1989).
with Conrail in a new Triple Crown joint venture (a $100 million plus business) that now has access to the New York/New Jersey region over the Conrail network.

The previous three approaches to origin-to-destination coverage (start drayage operation, purchase long-haul trucking firm, employ RoadRaile technology\textsuperscript{15}) have the common feature that railroads provide a fully integrated service, i.e. they satisfy all the needs for the assembly of the intermodal move from internal sources.

**Quasi-Integration: Alliance with trucking firm**

However, from a strategic perspective there is a fourth option to achieve the desired objective, *quasi-integration*. According to Hax/Maljuf (1991), “a quasi-integrated firm does not have full ownership of all of their assets in the value chain related to a given input or output. Rather, they resort to several mechanisms to assure steady relationships with its external constituencies, which reside somewhere in between long-term contracts and full ownership. Prevalent forms are joint ventures or alliances ...”. It seems that the Quantum service, which was started by Santa Fe Pacific and J.B. Hunt in 1990, fits that category of quasi-integration.

**Options related to Sales/Marketing Scope**

If a railroad wants to define its boundaries with respect to the marketing of intermodal services, it has to decide whether it wants to be a retailer or wholesaler of transportation services.

**Forward Integration: Retailing**

Forward integration as a strategic option for railroads has to evaluated based on the associated costs and benefits. The major cost item is going to be the development of in-

\textsuperscript{15}Strictly speaking, this is not an option that eliminates the need for a railroad to somewhat integrate with a trucking firm. However, it is unique in that the features of the technology itself a) demand this integration (would a railroad have an outsider come in with a locomotive in order to run a train made up of its own flatcars?) and b) facilitates this integration through its excellent intermodal transfer characteristics.
house sales and marketing capabilities (human resources, infrastructure etc.). Further, exclusive direct end-customer marketing inevitably leads to a loss of flexibility, because the ability to tap different distributors is curtailed. Finally, integration increases the complexity of the organizational structure and managerial processes, as for example, market incentives have to be replaced by internal incentives.

On the other hand, at least three major benefits can be obtained through integration. First, an integrated company can control more elements of the way the product is sold. Providing both the freight movement and selling the service to the customer, may allow the railroad to differentiate itself, even though its product is not superior to that of competitors. Second, integration improves the access to market information. The integrator gets closer to the stage in the value chain where the actual decision about the demand for transportation services is being made. With greater proximity to the customer, a company learns more and faster about buyer preferences, competitive developments etc. This knowledge can then be fed back into the product design process in order to better tailor the transportation service to customer needs. Proximity to or even control over the buyer become increasingly important with the evolving trend toward value-added logistics services and the outsourcing of logistics functions by shippers. Third, integrators are generally able to realize higher prices for their services. Through direct marketing, railroads could capture the value that is now being extracted from the system by third parties (intermodal marketing companies, trucking firms) that interface with the end-customer. Moreover, if railroads have full control over prices, they might be able to reap the benefits of price-discriminating against customers.

Quasi-Integration: Alliances with intermodal marketing companies

As noted in the discussion of the operational scope, there is also the opportunity of quasi-integration. Translated into marketing, this would mean for a railroad to align itself

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16 See Porter (1980).
with a particular intermodal marketing company and establish exclusive contracts for certain traffic corridors or its entire service territory.

Which of these strategies are railroads actually pursuing? There seems to be a consensus that railroads are reluctant to take the initiative on intermodal marketing themselves. This reluctance is certainly a function of their operations-driven history that impeded the build-up of marketing capabilities adequate to compete with truckers and middlemen. Exhibit 3.13 which shows ratings in selling effectiveness for different intermodal players based on the Intermodal Index 1992 (see Section 3.5) confirms this statement.

**Exhibit 3.13  Effectiveness in Selling Domestic Intermodal Services**

<table>
<thead>
<tr>
<th></th>
<th>Intermodal Users</th>
<th>Intermodal Nonusers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Motor Carriers</td>
<td>62%</td>
<td>57%</td>
</tr>
<tr>
<td>Intermodal Marketing Companies</td>
<td>41%</td>
<td>15%</td>
</tr>
<tr>
<td>Ocean Carriers</td>
<td>36%</td>
<td>34%</td>
</tr>
<tr>
<td>Railroads</td>
<td>29%</td>
<td>18%</td>
</tr>
</tbody>
</table>

*Unit of measurement: % of shippers rating effectiveness as "4" or "5" on a 1-5 scale (1=highly ineffective, 5=highly effective)*

In addition, the current structure of the intermodal market is convenient for railroads in the sense they do not have to go out and find customers, since motor carriers, shipping lines, and intermodal marketing companies (IMC's) bring in the business anyway. A railroad's entry into retailing would potentially create a conflict between the railroad
("manufacturer") and its - by now - entrenched "distributors". This channel conflict could result in price wars, termination of partnerships etc.

Further, an analysis of the sources of intermodal traffic (see Exhibit 3.14 below) reveals that more than 50% of the traffic is originated by shippers\(^\text{17}\) that are by their nature not amenable to railroad retailing. First, there is United Parcel Service, currently the single largest intermodal shipper in the US. If railroads want to obtain the valuable business from UPS, they are forced to act as wholesalers, unless they wanted to start a competing parcel operation.

<table>
<thead>
<tr>
<th>Exhibit 3.14</th>
<th>Sources of Intermodal Movements in 1991</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic Loads</td>
<td>43%</td>
</tr>
<tr>
<td>International Loads</td>
<td>37%</td>
</tr>
<tr>
<td>U.S. Postal Service / United Parcel Service</td>
<td>14%</td>
</tr>
<tr>
<td>Less-than-truckload carriers (LTL)</td>
<td>4%</td>
</tr>
<tr>
<td>Miscellaneous Sources</td>
<td>2%</td>
</tr>
</tbody>
</table>

Second, there is LTL traffic which is dominated by the "Big Three" - Yellow, Roadway and Consolidated Freightways. Again, wholesale seems to be the only feasible approach on the part of railroads. Third, there is the international container traffic which is fed into the rail network by ocean carriers. The only way to go retail would be to pursue the acquisition of a shipping line (the story of CSX), a pursuit whose wisdom is questionable at best, given the industry structure in the international liner market (see Section 3.2).

After the preceding discussion, the easy answer for a railroad seems to be to just retain the role of a wholesaler. Examples include Burlington Northern and Santa Fe Pacific Railroad.

---

\(^{17}\)These firms are shippers in the sense that they are customers for intermodal services provided by railroads, however from the perspective of their customers they are carriers themselves.
Burlington Northern generates 95% of its intermodal traffic through 3rd parties and only 5% directly through shippers’ traffic departments. Maze (1990) reports that Burlington Northern’s policy is to work through a third party for intermodal traffic except when approached directly by a shipper. Santa Fe Pacific derives 44% of its intermodal revenues from IMC’s, 19% from shipping companies and 37% from what is called ‘direct marketing’. However, this euphemism conceals the fact that most of the “direct marketing” traffic actually stems from motor carriers. Only a very small percentage is truly direct marketing, i.e. marketed to the shipper. But even so-called “3-Party-Contracts” with major manufacturers such as Procter & Gamble, involve an IMC in addition to shipper and railroad.

The example of Union Pacific shows that operational integration and marketing integration are, indeed, two distinct decisions. Despite the ownership of Overnite, which clearly has the marketing capabilities of a major trucking firm, Union Pacific Railroad markets its intermodal service through third parties. However, the company has developed close ties with a particular IMC - American President Intermodal - which could be a step toward quasi-integration.

Returning to the retailing issue that started this section, we find that only two railroads are aggressively marketing their intermodal product to the end-customer. The first example is the afore-mentioned Triple Crown Service (TCS) which was specifically designed by NS and Conrail to compete against truckers for the full-truckload business. Here it is the RoadRailer technology that drives the railroads to make the leap toward retailing. RoadRailer has the ability for O-D transportation coverage built-in, which suggests direct end-customer marketing as a logical consequence.

Second, there is CSX Transportation which has chosen to combine operational integration with direct end-customer marketing. The history of the company in the 1980’s is characterized by a sequence of aggressive acquisitions:

- 1980: Chessie Motor Express started,
1984: American Commercial Barge Lines (largest bargeline in the US) acquired,

Further, unlike Union Pacific and Norfolk Southern who prefer to run their railroad and
their trucking subsidiaries rather autonomously, CSX made a serious commitment to the
concept of intermodal integration. Two separate subsidiaries – CSX Intermodal (CSXI)
and CSX Logistics (now: Customized Transportation, Inc.) were formed to manage the
intermodal linkages within the company. The logistics subsidiary was explicitly charged
with

"developing ways to link together, or integrate transportation and distribution
services, where that service can be profitably offered." 18

CSX Intermodal embodies the most advanced state of intermodal retailing of any
railroad. From its initial task of satisfying the domestic transportation needs for its sister
Sea-Land subsidiary, CSXI went on to act like an asset-based intermodal marketing
company (see Section 3.5). It sells container space directly to the end-customer and
provides full origin-to-destination coverage through use of its own carriage fleet. What’s
more, CSXI is not restricted to the use of CSX’ rail network. Rather it can enter into
line-haul agreements with whatever railroad that provides the best solution to the
customer. Regarding CSX Intermodal, the 1992 Annual Report presents a remarkably
positive view of the synergies that were created between the container-shipping unit and
the rail unit through the establishment of the intermodal company in 1987:

"CSXI has generated numerous internal efficiencies for Sea-Land and CSX
Transportation and enhanced the service options available to our customers."

However, the positive self-assessment of CSX with respect to its intermodal aspirations is
only partly supported by the financials in the 1993 Annual Report.

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18See Muller (1989).
Exhibit 3.15  Selected Financial Data for CSX Intermodal and Sea-Land

<table>
<thead>
<tr>
<th></th>
<th>CSX Intermodal</th>
<th></th>
<th>Sea-Land</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Operating Revenue</td>
<td>793</td>
<td>739</td>
<td>686</td>
<td>3,246</td>
</tr>
<tr>
<td>Operating Expenses</td>
<td>740</td>
<td>700</td>
<td>662</td>
<td>3,053</td>
</tr>
<tr>
<td>Operating Income</td>
<td>53</td>
<td>39</td>
<td>24</td>
<td>193</td>
</tr>
<tr>
<td>Operating Ratio</td>
<td>93.3%</td>
<td>94.7%</td>
<td>96.5%</td>
<td>94.1%</td>
</tr>
</tbody>
</table>

Excluding productivity charges, CSXI has achieved a continuos improvement in its operating ratio from 96.5% in 1991 to 93.3% in 1993. However, this number is fairly high in comparison with the railroad’s benchmark of 83%. Further, the results of Sea-Land, the largest US-Flag container shipping company, are also lagging behind expectations. The company finished 1993 with an operating ratio of 94.1%.

This data should have a sobering effect on the enthusiasts of fully integrated transportation companies. Both subsidiaries, CSXI and Sea-Land are currently a drain on the resources of the CSX railroad that earns 74% of all CSX operating income on 49% of total revenue. Though CSX does not provide a breakdown of net earnings and assets by subsidiary, the numbers suggest that CSX and its shareholders would have fared better without the acquisition of Sea-Land. In line with its financial principles, CSX, therefore, has to consider sale or other disposition of its shipping subsidiary. Further, the intermodal subsidiary needs to retain its rate of improvement to make a significant contribution to CSX’ bottomline in the nearer future.

The preceding analysis of the strategic options of railroads has demonstrated the full complexity of intermodalism. In light of this complexity, it is understandable that most railroads are still acting in their traditional role as wholesalers of line haul rail

19In its 1993 Annual Report, CSX states that “Business units that do not earn above the CSX cost of capital and do not generate an adequate level of free cash flow over an appropriate period of time will be evaluated for sale or other disposition.”
transportation. Moreover, the current rapid growth of intermodalism could be used as evidence that railroads will benefit greatly if they focus on the improvement of their core competency - fast, reliable and cost-effective line-haul. However, I strongly believe that the easy wins will soon be over and that railroads will need to pay increasing attention as to where they position themselves in the intermodal landscape (which is mapped out from the railroad perspective in Exhibit 3.16) and beyond that in the overall freight transportation and logistics market. My prediction is that if other railroads thoroughly study the examples of CSX Intermodal and Triple Crown, they will listen to the doubts of McNeil Porter, CEO of CSXI, that in the long-term any railroad that cedes all its links with its customers to third parties will flourish.

A final comment on Exhibit 3.16: This map of intermodal enables the analyst to gain a better understanding of the major stakeholders in the intermodal business and therefore sets the stage for the subsequent sections in Chapter 3 that deal with these stakeholders and their approach to intermodal on an individual basis.
Financial data on railroads and intermodal

Section 3.1 built a case for intermodal based on two premises, the limited growth potential for traditional bulk commodities such as coal and grain (necessity), and the enhanced capabilities of the railroad industry itself (opportunity). Afterwards, strategic options were discussed to show how railroads could take advantage of the potential of intermodal. But, what do railroads actually gain from intermodal?

Business, i.e. revenue, is the quick answer. Intermodal traffic accounted for an estimated 19% of total railroad freight revenue ($6 million) in 1992. For individual railroads, this share of intermodal in the company's overall revenue can run as high as 40% (Santa Fe) and as low as 9.2% (Norfolk Southern). The second column of Exhibit 3.17, summarizes data on the intermodal movements of the seven major transcontinental railroads.\(^{20}\) The column “Rev-Percentage” displays the percentage of overall revenue of the railroad that is accounted for by intermodal and coal.

<table>
<thead>
<tr>
<th>Exhibit 3.17</th>
<th>Comparison of Coal Volume and Intermodal Volume for the Seven Transcontinental Railroads, as of 1992</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intermodal Volume</td>
<td>Coal Volume</td>
</tr>
<tr>
<td>Revenue</td>
<td>Rev-Percentage</td>
</tr>
<tr>
<td>Union Pacific</td>
<td>686</td>
</tr>
<tr>
<td>Burl. Northern</td>
<td>711</td>
</tr>
<tr>
<td>CSX Transp.</td>
<td>723</td>
</tr>
<tr>
<td>Norfolk Sthn.</td>
<td>341</td>
</tr>
<tr>
<td>Conrail</td>
<td>599</td>
</tr>
<tr>
<td>Southern Pac.</td>
<td>671</td>
</tr>
<tr>
<td>Santa Fe Pac.</td>
<td>912</td>
</tr>
</tbody>
</table>

In search of a reason for the large disparity between the industry leader, Santa Fe, and other railroads, in particular Norfolk Southern, we hypothesized that there might be a link between high coal traffic volumes and a perceived lack of urgency with respect to

\(^{20}\)The data for Exhibit 3.17 was gathered from the 1992 Annual Reports of the railroads. In the case of Union Pacific, intermodal was not listed as a separate traffic category. The number of $686 million quantifies UP’s merchandise traffic that, according to the company, is mostly intermodal in nature.
intermodal. If coal represents a stable, high-volume source of revenue for a particular railroad, then this railroad might rather concentrate its resources on the improvement of their coal operation as opposed to making a strong commitment to intermodal. On the other hand, if for reasons of economic geography and of network structure, a railroad can only attract volumes of bulk traffic far below industry average, then the pursuit of intermodal becomes not just a strategic opportunity, but rather a strategic necessity. It would be an interesting area for further research to conduct an in-depth comparative analysis of the major railroads in order to understand the motives and decisions that underlie the plain data given in Exhibit 3.17.

Related to that would be the question whether we will witness a split of the industry along the dimension of traffic mix. The “intermodal to coal ratio” (supplemented by further analysis of the overall traffic mix) hints that there could be a development toward a triad of railroads - intermodal railroads, bulk railroads and balanced/full-line railroads (as opposed to the traditional geographic division into eastern, western and central). So far, the strategy of the railroads seems to have been “We move everything that comes into the door”, which makes sense in terms of utilization of the track infrastructure. In other modes, that do not provide their infrastructure themselves, such as trucking (general freight vs. refrigerated vs. bulk) and ocean shipping (the liner shipping industry that moves exclusively containerized freight), the specialization along product lines is far more advanced.

Far more important than the question about revenue gains from intermodal, is the question about the profitability of intermodal traffic. It used to be the case, that intermodal was labeled “a good revenue business, but a poor net revenue business”, meaning railroads were not making money on it. However, supposedly with the widespread use of double-stack the tables have turned, i.e. intermodal in now profitable. This issue can not be resolved by an outside observer who has only access to financial
accounting data in the form of annual reports. Rather, it is an issue of managerial accounting that requires very detailed data and sophisticated cost allocation techniques.

This type of analysis can only be performed in-house by the railroads themselves, and would typically be considered a trade secret.

<table>
<thead>
<tr>
<th>Exhibit 3.18: Operating Ratios for the 7 Transcontinental Railroads as of December 31, 1992</th>
</tr>
</thead>
<tbody>
<tr>
<td>Railroad</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Average</td>
</tr>
<tr>
<td>Southern Pacific</td>
</tr>
<tr>
<td>Burlington Northern</td>
</tr>
<tr>
<td>Santa Fe Pacific</td>
</tr>
<tr>
<td>CSX Transportation</td>
</tr>
<tr>
<td>Conrail</td>
</tr>
<tr>
<td>Union Pacific</td>
</tr>
<tr>
<td>Norfolk Southern</td>
</tr>
</tbody>
</table>

As an attempt of a rough-cut answer, one can look at the operating ratios (see Exhibit 3.18) of the different railroads that are part of the overall profitability picture of the company and analyze the results against the background of the known traffic mix of individual railroads. This approach shows that Norfolk Southern is far ahead of the rest of the industry, whereas Southern Pacific is struggling to be profitable at all. While there are myriad factors that influence the profitability of a particular railroad (traffic mix is only one of them), it seems striking that the two railroads with the highest share of intermodal in their overall traffic (and by the way, also with the lowest share of coal) - Santa Fe Pacific and Southern Pacific - are only on place 5 and 7 in this ranking. On the other hand, the railroad with the highest share of coal, Norfolk Southern ranks first.

Hence, one could conclude that intermodal is by far less profitable than coal traffic. This leaves the railroad industry, and in particular carriers like Santa Fe and Southern Pacific with the challenge to transform the marginally profitable growth of intermodal into a highly profitable one.
3.2 Shipping Lines

In many respects, shipping lines have been the major driving force behind intermodal freight transportation in the United States. The Liner Shipping Industry pioneered the concept of containerization which first, revolutionized their own business, but subsequently also changed the way domestic truckload freight was being handled. Further, the industry conceived the idea of land-bridge (mini-bridge, micro-bridge) that were the first examples of truly intermodal sea-land service. Finally, the intermodal community owes a debt to American President Lines’ (APL) leadership in the introduction of double-stack container service that represents the breakthrough for intermodal service in the mid-1980’s. This section summarizes the evolution of sea-land intermodal services from the early days of containerization to the making of an intermodal enterprise as sophisticated as APL.

The Container-Revolution

April 26, 1956 marks a turning point in the history of intermodalism. It was the day on which Ideal-X, a tanker converted into the first containership, owned by Pan Atlantic Steamship Company - a predecessor of Sea-Land, sailed from Newark, NJ to Houston, TX touching off the container revolution.1 Although the advantages of containerization seemed to be obvious - ease of loading and unloading (reduction in transfer time and cost), unitizing freight, lower damage etc. - the industry did not immediately embrace the new technology. There were too many uncertainties, in particular the lack of crucial standards necessary in a globally operating industry that delayed large-scale investments into the container infrastructure (containers themselves, container ships, cranes and other handling equipment etc.) In fact, it took another 10 years until Sea-Land started the first transatlantic container service. However, after the establishment of ISO2 standards the container revolution quickly spread across the world.

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1See Muller (1989) for a detailed account of the history of sea-land intermodalism.
2ISO stands for International Standards Organization.
Bridge-Services

The second major innovation in sea-land intermodalism was the launch of so-called bridge services in the 1960’s. The idea of bridge services was first conceived as a more efficient means of shipping between the Far East and Europe at a time when the Suez-Canal was closed. Shipments were moved (in the same container and with a single bill of lading) through transatlantic and transpacific water transport combined with rail piggyback through the U.S./Canadian landbridge. This particular landbridge was competing against the all-water route via India.

Subsequently, other types of bridge services were introduced, both in the United States and in foreign countries. For this study, minibridge and microbridge need to be mentioned. Both refer to a combined ocean-land movement from a foreign port to the US where the land transportation replaces an ocean leg. The term minibridge is used if the destination of the movement is a US port, if it is a domestic point then the movement is called microbridge. An example for a minibridge would be Hong Kong- Los Angeles - New York with the LA-New York portion provided by rail as opposed to the all-water route through the Panama Canal. Hong Kong - Los Angeles - Chicago is an example of microbridge service.

Landbridge has been positioned as a premium service for travel-time sensitive freight. Muller (1989) estimates that landbridge between Asia and the US East Coast has a 6-12 days shorter trip time than all-water. This shorter trip time does not only reduce in-transit inventory cost, it also allows for shorter vessel cycles and therefore higher payloads per vessel.

While initially COFC traffic to and from the West Coast suffered from poor service due to coordination problems between shipping lines and railroads, unsophisticated container management etc., with rising volume carriers made a stronger commitment to the new type of service. It was American President Lines who decided that the company could increase service quality by taking full control also over the land portion of the
intermodal movement, instead of leaving it to the railroads to manage flatcars and containers. APL “Linertrains”, started in 1979, are the first examples of that dedicated unit train approach.

Double-Stack

In 1984, APL took the idea of the landbridge to the next level when it pioneered regular double-stack service between Los Angeles and Chicago. This operation was subsequently copied by most other major Pacific Ocean carriers and railroads. Wang (1993) gives a detailed account of the evolution of double-stack until the 1990’s. The major trends from the author’s perspective were:

- Creation of four major double-stack corridors:
  - Pacific North West (Seattle/Tacoma) - Chicago,
  - Pacific South West (Los Angeles/Long Beach) - Chicago,
  - Pacific South West - US Gulf and East Coast,
  - Chicago - East Coast.
- Increasing use of double-stack on branch lines,
- Establishment of more off-line points (e.g. Worcester, MA),
- Southbound reach of double-stack since 1990 (Long Beach to Mexico City).

From a strategic point of view, two additional developments had an impact on the intermodal market place. While the original motivation for double-stack was to offer a premium service for international container freight moving to and from the US, subsequently shipping lines, in particular APL (discussed below) entered the domestic market as well. Due to the imbalance of West-East freight movements, ocean carriers had to cope with large amounts of empty backhauls from the East to the West. Hence, it

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3The concept of double-stack had existed before 1984. However, first attempts with double-stack operation by Southern Pacific and Sea-Land were abandoned, since the high weight of the railcar did not allow the desired cost savings over TOFC.
was a logical step to try and attract domestic West-bound business to fill part of the empty backhaul space. APL took this concept even further and became involved in the domestic market through an intermodal subsidiary that also does business entirely unrelated to the APL double-stack trains.

**Intermodal and ocean carrier strategy**

Marcus (1989, 1994) sees the shift toward double-stack and - what he calls - “advanced intermodalism” as part of a service differentiation strategy of first tier carriers in the international liner market. After the euphoria about the container revolution was over, the industry had experienced container saturation and overcapacity. A wave of new entrants that were partly government-owned or -affiliated (and therefore sometimes function on economically questionable principles) and the decline of the traditional conference mechanism⁴, significantly spurred price competition and reduced the structural alternative of the industry. In this environment, U.S. flag carriers who are at a cost disadvantage compared to most foreign rivals (partly due to higher labor cost), could only survive if they were to adopt a service differentiation strategy built around ocean-land intermodalism.

**The case of American President Companies (APC)**

As mentioned earlier, American President Companies has lead the industry into the direction of advanced intermodalism. The company exemplifies the transition from a pure ocean carrier into a company “that provides container transportation and related services in North America, Asia and the Middle East through an intermodal system combining ocean, rail and truck transportation.”⁵ This intermodal system will be explained in more detail below.

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⁴Ocean Carrier Conferences are associations of shipowners operating in the same specific trade route who, by agreement, operate under collective conditions of carriage and conditions. In plain English, they operate as rate-setting cartels.

⁵This is APC’s own description of its business in the 1993 Form 10-K.
APC's core subsidiary **American President Lines**, an ocean common carrier, is in the business of providing ocean-going containerized cargo transportation in the trans-pacific and intra-Asian markets. In support of APL, **Eagle Marine Services**, conducts stevedoring and terminal operations on the U.S. West Coast. Another operating subsidiary, **American Consolidation Services**, provides cargo distribution and warehousing services on the East Coast of the U.S. and consolidation services (less-than-container into full container) in Asia, the Middle East, Europe and Africa.

In the North American Market, APC is active through **APL Land Transport Services** and **American Trucking Company**. These two subsidiaries together form an integrated system of rail-truck intermodalism, the primary element of which is a double-stack train network. APL maintains control over the full origin-to-destination shipment through ownership and leasing of railcars (as of December 31, the company operated 1,100 railcars, 200 of which are owned and 900 of which are leased) and containers, whereas partner railroads (such as UP) provide locomotive power, trackage, terminal services and labor. The local delivery from the railroad terminal to the final destination is carried out by a fleet of 400 trucks, 300 of which are owned or leased by APL, whereas 100 are operated by affiliated owner-operators.

In comparison with CSX (the other example of an ocean carrier/railroad/trucking integration), APC seems to have pursued a smarter strategy of intermodal integration. It did not purchase an entire railroad, just to extend its reach beyond the ocean part of the movement. Rather by concentrating on equipment control and ownership, APC stayed focused on its core business while achieving its strategic objective of full O-D coverage.

Finally, **APL Information Services, Ltd.** provides information systems development, maintenance and support services for the company. An excellent information technology infrastructure is a major prerequisite to maintain a high service quality while assuring high asset utilization in a global operation such as APL’s.

---

6In the 1970's APC had decided to concentrate solely on the trade in the Pacific Basin and to not engage in the Transatlantic business.
After this description of APC as a leading edge intermodal company, this section will conclude with a brief analysis of the financial results of the company. The question to be answered here is: "How does being cutting edge from a transportation perspective affect the financial performance of the company? Are the two related or unrelated to each-other?"

The first dimension to be discussed is revenue. Exhibit 3.19 below shows that APC experienced rapid growth until the late 1980's. As we will see later, this growth was significantly fueled by the entrance into the domestic North American market. Since 1989/1990 APC has grown rather slowly. Rates have been negatively impacted by competitive pressures on rates in two key markets (U.S. Export and Intra-Asia), such that despite volume increase overall, revenue remained rather sluggish.

![Exhibit 3.19 American President Companies - Revenues 1984 - 1993 (in $ million)](chart)

Operating efficiency as measured by the operating ratio resembles a roller coaster ride. Exhibit 3.20 illustrates the cyclicality of the earnings in this high fixed cost business, where low-cost foreign competitors resort to the cut-throat tactics of slashing fares to attract more volume, tactics that are well-known from the airline industry. After the ups and downs in the 1980's, APC's operating ratio seems to have stabilized at a fairly high level of 95%. Hence, the company must step up its cost control efforts that
are, however, somewhat limited by its status as a U.S. flag carrier. APC has already applied to the United States Maritime Administration to operate under foreign flag its six containerships that are scheduled for delivery in 1995. It continues to pressure for an extension of the U.S. government’s maritime support program that currently provides operating-differential subsidies of $65 million per year to partially compensate for the relatively greater expenses of vessel operation under U.S. registry.

Due to lower interest rates and the reduction of long-term debt, APL has managed to increase its profit margin (net income/revenue) despite the decrease in operating efficiency that is indicated by the operating ratio of 95.3%. However, the 1993 margin of 3.1% is comparably low by overall transportation standards, which themselves are already low in comparison with other industries.

The data on the North American market raises some doubt about the leadership role of APC in domestic intermodalism. On the one hand, the company has built a $600 million business almost from scratch. The annual stack-train volume of more than 500,000 FEU’s\(^7\) represents a market share of about 8% of all rail trailer and container shipments that amounted to 6.7 million units in 1992.

\(^7\)FEU stands for Forty-Foot-Equivalent Units.
On the other hand, Exhibit 3.22 indicates that revenues have somewhat leveled off since 1988. A plausible explanation could be that APL as the first mover was able to quickly build the market, however when competitors followed, rates came under pressure, and thus, volume growth could not offset the margin decline. Further, it was in 1989/1990 that truckload carriers such as J.B. Hunt entered the intermodal market. This may have adversely impacted the established double-stack operators, such as APL.
This brief financial analysis suggests that the actual situation of American President Companies is not as great as its reputation within the world of intermodal transportation. Admittedly, APL has designed and executed a coherent and innovative intermodal strategy, but the bottom line has not significantly improved over the past few years. If we remember Porter’s two dimensions of strategic analysis - industry attractiveness and competitive positioning - this apparent contradiction becomes clear. APC happens to compete in a structurally unattractive industry. So, despite its smart competitive positioning the company is in a sense held hostage by the competitive and regulatory environment.
3.3 Motor Carriers

Motor carriers shape the intermodal landscape

Motor carriers are a significant part of the intermodal equation for two reasons. On the one hand they are the overpowering competitors who move 80% of all freight in the United States and are responsible for the dramatic decline in railroad market share since World War II. On the other hand, fairly recently these competitors have turned into partners. Major truck-load firms have established “strategic alliances” with several railroads and subsequently shifted substantial parts of their long-haul freight from road to rail. Less-than truckload carriers would like to follow, however they are severely constrained by labor agreements with the Teamsters union. Hence, the usage of intermodal is a major issue in the April 1994 negotiations for a new contract. Finally, United Parcel Service has exercised the intermodal option for several decades without generating much publicity.

What are the factors that cause such a remarkable change in the competitive dynamics between the railroad and the trucking industry? What benefits do motor carriers reap if they go intermodal? What will be the shape of the future competitive landscape? These obvious questions will be at the core of the following analysis of the U.S. Motor Carrier Industry and its approach to intermodalism.

Motor Carrier Industry has distinct segments

To enhance the understanding of the subsequent analysis, a brief segmentation of the motor carrier industry will be presented. The most important dimension along which the industry has differentiated itself (and that, by the way, also provides quick labels for the various categories) is shipment size/weight. Truckload carriers (TL) move shipments with a weight of more than 10,000 pounds. While the base case is built around one truck-load shipment per trailer, TL carriers are to a certain degree consolidating multiple truckload shipments into one trailer which is feasible under the current weight limits of 80,000 pounds.
pounds for truck and trailer combined.\(^1\) *Less-than-truckload firms (LTL)* transport freight weighing from 100 up to 10,000 pounds. Last, but not least, the *small package* market which is essentially owned by UPS takes care of shipments up to 70 pounds, or more recently up to 150 pounds. Apart from shipment size, operating strategies are a major differentiating factor: TL carriers operate irregular, direct line haul networks whereas LTL and UPS serve regular routes that link extensive hub-and-spoke networks. Finally, these segments have very distinct labor relations. While TL firms enjoy the absence of unionization among their employees, both the large LTL carriers and UPS need to establish working relationships with the Teamsters union. These and other characteristics cause each segment to exhibit a particular industry structure, particular profitability and with respect to the theme of this thesis - a particular approach towards intermodalism, as will be discussed below.

\(^1\)Schneider National calculated a maximum payload capacity of 48,000 lbs. for a 53’ trailer.
3.3.1 The Truckload Industry (TL)

Industry Evolution

The Truckload Industry has seen some of the biggest success stories in the aftermath of deregulation. J.B. Hunt\(^1\) has grown at a compound annual rate of more than 30% (!) since 1980, surpassing the $1 billion threshold for the first time in 1993. Hunt is the leading example of what has been dubbed “Advanced Truckload Firm” (ATLF). Based on sophisticated operations supported by state-of-the-art information technology such as on-board computers and EDI-based automated billing and shipment status information, these ATLF's (including Hunt's major rival - Schneider National) are able to provide shippers with premium service and command premium rates. In addition, their nationwide geographic scope combined with the clout of a large in-house sales force, allow the ATLF's to exert considerable marketing power. Further, ATLF's obtain considerable economies of scale in the areas of purchasing (equipment, fuel), administration and driver training.\(^2\) Consequently, these ATLF's achieve returns that are above the average of the TL industry.

Exhibit 3.23: Selected 1992 Financial Data for the Largest TL Carriers (in $ million)

<table>
<thead>
<tr>
<th></th>
<th>Operating Revenue</th>
<th>Operating Expenses</th>
<th>Operating Ratio</th>
<th>Net Income</th>
<th>Net Profit Margin</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schneider National</td>
<td>est. 1000</td>
<td></td>
<td>(not available)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>J.B. Hunt</td>
<td>912</td>
<td>843</td>
<td>92.4%</td>
<td>39</td>
<td>4.3%</td>
</tr>
<tr>
<td>Landstar System*</td>
<td>672</td>
<td>649</td>
<td>96.6%</td>
<td>6</td>
<td>0.9%</td>
</tr>
<tr>
<td>Werner Enterprise</td>
<td>323</td>
<td>289</td>
<td>89.5%</td>
<td>19</td>
<td>5.9%</td>
</tr>
<tr>
<td>Burlington Motor Carriers</td>
<td>256</td>
<td></td>
<td>92.3%</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>Swift Transportation Co.</td>
<td>233</td>
<td>215</td>
<td>(not available)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Landstar functions as a holding company for five owner-operator companies the largest of which (Ranger) had $257 million in annual revenue.

Finally, ATLF's as well as smaller TL carriers benefit from the absence of unionization that leads to relatively low labor cost and a great deal of flexibility, unaffected

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\(^1\)J.B. Hunt will be at the center of the following discussion, since information about this public corporation is more readily available than about Schneider which is closely held.

\(^2\)For example, J.B. Hunt operates two in-house driving schools.
by cumbersome work rules. It is this point that gives the TL industry a major competitive edge over the more established LTL carriers (covered in Section 3.3.2), that used to transport a major part of the truck-load freight, but are now being driven out of the TL segment.

At the other end of the spectrum, there is a very large number of small or owner-operator firms that mostly rely on brokers to solicit their freight. With low start-up costs and ease of acquiring an operating license, entry barriers are almost non-existent. However, those low entry barriers cause the lower end of the TL market to resemble the economists’ idea of a perfectly competitive market. Extreme price competition leaves most of the players in a battle to stay alive. To give an idea of the volatility of this segment, from 1980 to 1985, 15,000 new firms have entered the industry while about 7,500 firms have left the industry.\(^1\) Another source - Rakowski et al. (1989) - reports that the number of ICC certified motor carriers with revenues of less than $1 million rose from 16,874 in 1978 to 39,602 in 1989.

**Truckload carriers and intermodal**

The preceding outline of the evolution of the TL Industry does not suggest an obvious reason for the bold move into intermodal. Indeed, there is none. Rather, this shift was triggered by one company - J.B. Hunt - that saw an opportunity to tackle some of the challenges it encountered in the late 1980's by grasping the intermodal opportunity. Porter’s 5-Forces model for strategic industry\(^2\) analysis can help to gain additional insights into their decision. In particular, it incorporates two important issues - the driver shortage and the improved cost/service performance of intermodal - into a broader framework. In fact, these issues discussed below, can be interpreted in terms of “Supplier Bargaining Power” and “Threat of Substitute Products”.

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\(^1\)These unfortunately outdated figures were reported in Glaskowsky (1986).

TL industry faces driver shortage

Any analysis of the trucking industry would be incomplete without a reference to the most serious problem the TL industry has faced and is still facing - the widely reported shortage of qualified drivers. The industry’s difficulty to attract and retain capable employees does compromise the quality of the service TL carriers are able to deliver. Further it even leaves part of the demand for trucking services unsatisfied altogether, as firms have to cancel orders for new trucks and are forced to idle rigs.

Industry observers list multiple causes for this problem. First, there is the nature of the job itself. As companies try to maximize the utilization of their assets, they often keep drivers on the road for 3 or 4 weeks at a time. This practice combined with the irregularity of routes, means that truck drivers have to cope with an erratic lifestyle that makes it difficult to keep families intact. Additional strains are put on drivers because of shippers’ efforts to cut back on logistics costs. Instead of paying for in-house dockworkers, distribution managers simply expect drivers to load and unload large amounts of freight. And the latter don’t get paid for it.

This leads to the second major cause of the driver shortage - inadequate compensation. On paper, $32,000 to $35,000 for a driver with three years worth of experience looks reasonably attractive. However, if one considers the total time spent in the truck (driving, waiting, loading/unloading, sleeping), the hourly wage lies barely above the legal minimum. In total, the low pay for heavy work significantly reduces the pool of candidates for the TL Industry. Ironically enough, low labor cost and flexibility through non-unionization have been a source of competitive advantage for TL firms over unionized LTL carriers. Thus, we observe how a source of competitive advantage turns out to be a two-edged sword for the industry. As a response, carriers intensify their recruiting efforts,

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1 See Wall Street Journal, “Trucking Firms Find It Is a Struggle to Hire and Retain Drivers”, Dec 28, 1993.
2 For example, J.B. Hunt’s labor cost amounts to 40% of revenue as compared to 65% for Yellow Freight, one of the “Big Three” LTL carriers.
Exhibit 3.24: Porter’s 5 Forces for the TL Industry in the late 1980’s

- **New Entrants**
  - Low start-up costs
  - Operating license readily available
  - However: high barriers to entry for ATL segment - economies of scale, technology, sales force

- **Suppliers**
  - Non-unionized labor assures high flexibility
  - Shortage of drivers compromises service and constrains growth
  - Rising fuel costs (taxes)

- **Industry Competitors**
  - Bargaining power of Suppliers
  - Threat of New Entrants

- **Substitutes**
  - Cost gap between intermodal and TL widens
  - Service gap narrows

- **Buyers**
  - Increased sophistication in supply chain management, e.g. JIT
  - Reduction in the number of suppliers - “Core Carrier” Concept
  - Continuous pressure on logistics cost, amplified through recession in late 1980’s
try to lobby Congress to lower the required minimum age for drivers from 21 to 18 and are even raising driver pay by several cents per mile.\footnote{See Wall Street Journal, "Truckers Lift Rates for the Long Haul, Citing Surging Traffic and Rising Costs", March 31, 1994.} However, their ability to pass on higher labor cost to shippers in the form of higher rates is clearly limited. As noted above, the reduction of logistics cost is of grave concern to manufacturers and retailers alike.

**Intermodal as a substitute product catches up**

From a strategic perspective, intermodal acts as a substitute product for over-the-road trucking. As Michael Porter taught us, the threat of substitute products is a major determinant of the structure and profitability of an industry. Hence, TL carriers need to constantly assess the position of intermodal relative to their own product. Their traditional differentiation strategy has relied on speed, reliability and value-added services such as EDI as differentiating factors. However, like all differentiators TL carriers “cannot ignore their cost position, because their premium prices will be nullified by a markedly inferior cost position.”\footnote{See Porter (1985), p.14.} Thus, they have to aim at cost parity or proximity relative to intermodal.

As long as intermodal was restricted to TOFC or COFC, the high drayage cost (pick up and delivery) canceled the line-haul cost advantage of rail over trucking, as Exhibit 3.x indicates. Yet, with the advent of domestic double-stack, cost proximity has been lost. The rather optimistic estimate of $0.64 per mile for “TL by Irregular Route Carrier” (Investment bankers Alex. Browns & Sons consider $0.80 to be more accurate\footnote{Cited in Spasovic (1990).}) is still more than 10% above the stack train rate of $0.56 per mile. These figures were confirmed by a statement about a “10-25% cost differential between trucking and double-stack intermodal” that was attributed to the consultancy Arthur D. Little.\footnote{See The Economist, "The Return of the Railroads ?", Nov 27, 1993.} In addition, the service quality of intermodal, in particular trip time and reliability, has notably improved, such that these dimensions of differentiation between trucking and intermodal become less important from the buyer’s perspective.
## Exhibit 3.25  
**Typical Cost Structure of Competitors for General Freight**

<table>
<thead>
<tr>
<th>Mode</th>
<th>TOFC</th>
<th>TL by LTL Carrier</th>
<th>TL by Independent Contractor</th>
<th>TL by Irregular Route Carrier</th>
<th>Double-Stack Domestic Container</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trailer mile/year</td>
<td>625,000</td>
<td>80,000</td>
<td>100,000</td>
<td>140,000</td>
<td>1,040,000</td>
</tr>
<tr>
<td>Annual wage</td>
<td>$33,000</td>
<td>$27,000</td>
<td>$25,000</td>
<td>$28,000</td>
<td>$28,000</td>
</tr>
<tr>
<td>Wage plus fringe/year</td>
<td>$44,450</td>
<td>$33,750</td>
<td>$25,000</td>
<td>$32,200</td>
<td>$32,200</td>
</tr>
<tr>
<td>Labor cost/mile</td>
<td>$0.07</td>
<td>$0.42</td>
<td>$0.25</td>
<td>$0.23</td>
<td>$0.03</td>
</tr>
<tr>
<td>Fuel cost/mile</td>
<td>$0.10</td>
<td>$0.18</td>
<td>$0.26</td>
<td>$0.18</td>
<td>$0.09</td>
</tr>
<tr>
<td>Pickup &amp; delivery</td>
<td>$0.25</td>
<td>$0.075</td>
<td>0</td>
<td>0</td>
<td>$0.25</td>
</tr>
<tr>
<td>Equipment ownership</td>
<td>$0.104</td>
<td>$0.125</td>
<td>$0.212</td>
<td>$0.148</td>
<td>$0.041</td>
</tr>
<tr>
<td>Direct cost/mile</td>
<td>$0.525</td>
<td>$0.798</td>
<td>$0.752</td>
<td>$0.544</td>
<td>$0.414</td>
</tr>
<tr>
<td>Circuitry</td>
<td>1.15</td>
<td>1.10</td>
<td>1.00</td>
<td>1.00</td>
<td>1.15</td>
</tr>
<tr>
<td>Adjusted cost/mile</td>
<td>$0.604</td>
<td>$0.878</td>
<td>$0.752</td>
<td>$0.544</td>
<td>$0.476</td>
</tr>
<tr>
<td>Load ratio</td>
<td>0.65</td>
<td>0.75</td>
<td>0.85</td>
<td>0.90</td>
<td>0.90</td>
</tr>
<tr>
<td>Typical cost/loaded mile</td>
<td>$0.929</td>
<td>$1.170</td>
<td>$0.885</td>
<td>$0.604</td>
<td>$0.529</td>
</tr>
<tr>
<td>Cost/loaded mile (with</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>.85 load ratio</td>
<td>154%</td>
<td>194%</td>
<td>146%</td>
<td>100%</td>
<td>88%</td>
</tr>
</tbody>
</table>

These trends had the potential to unfavorably change the structure of the TL Industry. However, instead of waiting for the change to materialize, J.B. Hunt took the initiative themselves. That is where the ingenuity of the move towards intermodal lies. While “the railways arrogant failure to spot competition from roads 50 years ago” remains a classic business school case study" (The Economist\textsuperscript{3}), J.B. Hunt was shifting its strategy from purely over-the-road carriage to intermodal at the first signs of upcoming competition and plateauing earnings. This proactive attitude to the changing structure of the freight transportation market, enabled J.B.Hunt to take advantage of the improved performance of what is essentially a substitute product that could threaten its core business. In doing so, the company did not only alleviate problems it faced at the end of the 1980's, but also regained the extraordinary growth momentum it had maintained throughout the 1980's.

Here are some of the benefits of intermodal:

- **Intermodal mitigates the driver shortage issue.** Through usage of rail for long-haul freight, J.B. Hunt was able to create a more controlled and regular work environment for its drivers. According to the company, the annual turnover among its drivers who pick up and deliver at rail yards has dropped to 20%. Supplemented by an innovative human resource strategy that created three distinct types of driver jobs - local, regional and over-the-road - the shift to intermodal reduced the overall turnover rate to 79% for the 3rd quarter of 1993 as compared with 114% for the year earlier.

- **Intermodal moderates the cost increase associated with trucking.** Because of the significant cost savings of double-stack over its road equivalent, TL carriers are able to offer its customers a less expensive premium freight service.

- **Intermodal permits TL carriers to extend the leverage of their tractor fleet.** While the trailer/container is transported by rail to its destination, the now free tractor can pick up or deliver another trailer. In this way, trucking firms extract more revenue from the same number of tractors without pressuring Congress for the legalization of Longer-
Combination-Vehicles (LCV's). The table below demonstrates the implementation of this concept by J.B. Hunt:

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Trailers</th>
<th>Number of Tractors</th>
<th>Leverage Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>1993</td>
<td>19,089</td>
<td>6,775</td>
<td>2.82</td>
</tr>
<tr>
<td>1992</td>
<td>17,391</td>
<td>7,004</td>
<td>2.48</td>
</tr>
<tr>
<td>1991</td>
<td>12,389</td>
<td>5,843</td>
<td>2.12</td>
</tr>
<tr>
<td>1990</td>
<td>10,563</td>
<td>4,729</td>
<td>2.23</td>
</tr>
<tr>
<td>1989</td>
<td>9,339</td>
<td>4,096</td>
<td>2.28</td>
</tr>
<tr>
<td>1988</td>
<td>7,071</td>
<td>3,135</td>
<td>2.26</td>
</tr>
</tbody>
</table>

- Intermodal allows growth with the limited available driver pool. This point is related to the previous one. Increased leverage does not only mean more trailers per tractor, it also means more trailers, hence more revenue, with the same number of drivers.
- Intermodal facilitates geographic expansion, even into unbalanced markets. Through service agreements with 9 major railroads, J.B. Hunt has access to virtually the entire United States. Unbalanced markets can be served without the need to relocate tractor and driver after the shipment is delivered. The (cost-efficient) backhaul of trailer or container is simply provided by rail.

J.B. Hunts leads TL Industry into Intermodal

These numerous benefits of intermodal explain why J.B.Hunt is aggressively pursuing the path of intermodal expansion. The number of intermodal loads per month rose from 5,950 in 1991 to 13,000 in 1992. Relative to the total number of loads of 960,000 for 1992, this represents a share of 16%. In financial terms, intermodal is reflected in the growing
expense item "Purchased Transportation" ¹ that amounted to 18.4% of operating revenue in 1993 (see Exhibit 3.27 below).

Exhibit 3.27:  J.B.Hunt - Purchased Transportation as a Percentage of Operating Revenue

At the core of their intermodal strategy is the conversion of a significant portion of the current trailer fleet to container-chassis-units. Since these units can be used for both double-stack intermodal and traditional over-the-road trucking, J.B.Hunt retains the flexibility to tailor its service offering to both the needs of the customer and the availability of resources, namely drivers.

However, two points of caution related to this large-scale conversion project need to be made. First, it is a major capital investment (estimated cost of $500 million for 18,000 units²) whose long-term benefits will a) depend on the future demand for intermodal services (high leverage can turn into overcapacity if demand shrinks) and b) the sustainability of the competitive advantage of the trucking industry vis-a-vis the railroads. Second, the proceeds from the sale of the retired trailers are subject to the fluctuations in the

¹In the case of J.B.Hunt, growth in "Purchased Transportation" is exclusively due to intermodal. However, for other trucking firms, in particular Landstar, this item also includes payments made to affiliated owner-operators for the provision of transportation services.
market for used equipment. In its 1992 Annual Report, Hunt itself admits that the conversion "could result in periods of unpredictable or volatile earnings swings."

Still, the outlook for intermodal services is bright in general and even brighter for truckload carriers, since they maintain control over the intermodal value chain. Far more than glorified draymen, carriers like Schneider hold themselves accountable for every mile of service and handle all shipment status reports, billing and claims themselves. The role of the railroads in the intermodal shipment is downplayed to one of silent partner, and the emphasis is on seamless service. Thus, truckers make intermodal part of their service portfolio. In doing so, they even capture part of the market that historically had been catered to by shippers' agents, an issue that will be further discussed in Section 3.4.

Intermodal is not for all truckers

While most of the larger TL carriers follow the lead of J.B. Hunt and Schneider, the response to intermodal is not unanimously positive. CRST Inc. of Cedar Rapids, Iowa, a $200 million plus company, "after seriously looking at starting up an intermodal service", has decided against it. The firm pursues a differentiation focus strategy that is targeted at the fast, high-end segment of the market. It intends to differentiate itself from competitors based on speed:

"Reducing cycle time is going to be the critical factor for distribution managers in the future. That's what we are betting on - that we can establish ourselves as the carrier to use when speed is important." (John Smith, President and CEO, CRST Inc.)

In order to accomplish guaranteed coast-to-coast, door-to-door delivery in less than 60 hours, the company has shifted to an all-team operation in 1989. However, in order for this strategy to be sustainable, CRST needs to find an answer to the above mentioned

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1 "If you can't beat them, join them." comes to mind.
2 See Traffic World, "CRST interested in intermodal only as a competitor", April 19, 1993 for details of the following discussion.
3 See Appendix B.
driver-retention problem. Given the fact that it is even more difficult to keep two drivers productive and content as a team, it is by no means surprising to learn about John Smith’s concerns in the Wall Street Journal:1

"Over the next 10 years, my biggest concern isn’t the marketplace, but how are we going to recruit, train and retain drivers..."

A second company that distances itself from intermodal, is Werner Enterprises, the 4th largest TL carrier. According to President Jacob Wood, Werner is “always studying intermodal, but just not involved.” Again, this attitude derives from a focus strategy. Werner sees the growth in intermodal in long-haul, metropolitan-based freight whereas they target the shorter haul market and private fleet conversions.2

**Intermodal will accelerate industry concentration**

The paradigm shift towards intermodal will have serious impacts on TL carrier operations and ultimately the structure of the industry. Mercer Management Consulting predicts that the intermodal market share of trailerload shipments moving 500 miles or more will grow from 15% in 1992 to 20% in 1995.3 This trend clearly signals that in the long run pure motor carriers will be driven to the shorter end of the freight market, where intermodal is (currently) not service-competitive.4 However, in order to operate profitably on the shorter end, carriers need sophisticated management and control techniques to maintain high fleet utilization.

As a result, the growth of intermodal will further widen the gap between ATLF’s and the thousands of small and owner-operated firms. While the former are actively shaping the intermodal landscape and will in fact benefit from intermodal growth as long as

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1See Wall Street Journal, “Trucking Firms Find It Is a Struggle to Hire and Retain Drivers”, Dec 28, 1993.
3See Intermodal Index, 1992.
4The decrease of the average tractor haul from 839 miles in 1990 to 615 in 1992 on the part of J.B.Hunt provides support for this statement.
they maintain control over marketing and provision of the service, the latter will be driven out of the long-haul market. Neither do small firms have sufficient scale and operating density to be attractive intermodal partners for railroads or - at least - negotiate favorable terms, nor can they offer value-added services that could offset the rising cost differential between long-haul trucking and intermodal. To make things worse, they lack the sophistication required in the short-haul market. Hence, a further consolidation of the TL industry (in the words of S&P's Stephen R. Klein a "vicious shake-out") resulting in rising market share of ATLF's seems inevitable. By any standards, the $40 billion truckload industry is still extremely fragmented with only two firms surpassing $1 billion in annual revenues, and has therefore enough room to grow for the Hunts and Schneiders.
3.3.2 The Less-Than-Truckload Industry (LTL)

Industry Evolution

The preceding section on the TL industry started with the success story of "A-vanced Truckload Firms" such as J.B.Hunt since deregulation and went on to describe the remarkable increase in the number of "mom and pop" carriers at the lower end of the market. Yet, the situation of the LTL industry is quite different, both in terms of structure and in terms of profitability, as will be elaborated below. To facilitate the analysis, a distinction between the national and the short-haul (regional and intra-regional) segment, which both represent about 50% of the $20 billion overall LTL market, will be made.

In the national LTL market, high capital investment barriers\(^1\) have deterred new entry. This absence of new entry was one of the major driving forces behind the industry consolidation process since deregulation (the number of motor carriers providing LTL service declined by 70% from 1979 to 1992). Further, the new rate-setting freedom has lead to fierce intra-industry price-competition that was amplified by the move of shippers toward the "core carrier" concept.\(^2\) Carriers follow a malpractice that is well-known from other industries (such as the cereal business) - general rate increases are announced just to be subsequently nullified by large-scale discounts.\(^3\) On the other hand, the cost structure of most nationwide LTL carriers offers little room for flexibility. Labor cost that account for as much as 60 to 65% of revenue\(^4\) can be assumed as fixed, given the bargaining power of the Teamsters union. Moreover, carriers have to support the infrastructure associated with a nationwide over-the-road operation. As a result of high

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\(^1\) A nationwide operation requires a network of several hundred terminals and a sophisticated computer infrastructure to ensure a smooth flow of the system. In addition, a large sales force is necessary to effectively market the services to potential customers and guarantee a high utilization of the expensive assets.

\(^2\) The theory behind the "core carrier" concept is that by reducing the number of motor carriers they use and by rewarding fewer carriers with larger proportions of their transportation business, shippers can achieve greater leverage and therefore obtain better rates and service.

\(^3\) According to The Bohman Group, a Massachusetts-based consulting firm, some 58% of shippers surveyed in 1992 reported receiving discounts of 50% or more off base rates, as compared with less than 1% in 1987.

\(^4\) See for example Yellow Freight System's 1992 Annual Report.
fixed cost and sharp price competition, industry profitability has been eroded over the
past decade. According to Standard & Poor’s (1993), LTL operating profits declined by
43% (67% if measured in constant dollars) since 1980, despite a 93% increase in total
revenue. No surprise, a significant number of companies either went bankrupt or were
voluntarily liquidated. Rakowski et al. (1993) use the term “bloodbath” to refer to the
fact that at least 25 of the largest 40 carriers of 1979 were no longer in existence when the
authors conducted their industry study in 1989. The remaining players have
significantly increased their market share. The “Big Three” - Yellow Freight Systems,
Roadway Express and Consolidated Motor Freight - that all exceed $2 billion in annual
revenue, together account for 60% of the national market. However, even they are only
marginally profitable, as Exhibit 3.28 demonstrates. Roadway Express leads the group
with an operating ratio of 95% and a profit margin of 3% (as compared to J.B. Hunt’s
92% and 4% ). Lagging far behind, the results for Yellow Freight (operating ratio of
97%) and Consolidated Motor Freight (98%) are clearly unacceptable. The prosperity of
Overnite does not weaken this statement, since it is owed to the non-union status of this
Union Pacific subsidiary.

The situation in the short-haul market is more positive. Carriers have recognized
that it is feasible to eliminate a large number of intermediate breakbulk terminals in favor
of direct point-to-point shipping. In this way, they are able to avoid the cost associated
with terminal operations and additional freight handling. In addition to lower cost,
shippers welcome the improvements in speed that are accomplished by not moving
freight through terminals. Further, unlike the national market, the regional LTL segment
has continued to grow sparked by a change in shippers’ distribution patterns: Industry
observers state that JIT and “lean production” advocate for proximity of supply to
production and distribution to demand. Hence, they continue, in order to operate a JIT

5This disaster scenario reinforces the lack of entry: Even if a company was willing to overcome the entry
barriers, there is virtually no financial motivation for such a strategy, since the LTL market does not yield
an adequate return on investment.

76
Exhibit 3.28: Selected Financial Data for the Largest LTL Carriers (in $ million)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow Freight Systems</td>
<td>2344</td>
<td>2263</td>
<td>57</td>
<td>83</td>
<td>97.6%</td>
<td>96.3%</td>
<td>27</td>
<td>30</td>
<td>1.2%</td>
<td>1.3%</td>
</tr>
<tr>
<td>Roadway Express</td>
<td>2075</td>
<td>2200</td>
<td>103</td>
<td>100</td>
<td>95.0%</td>
<td>95.5%</td>
<td>62</td>
<td>62</td>
<td>3.0%</td>
<td>2.8%</td>
</tr>
<tr>
<td>Consolidated Motor Freight</td>
<td>2142</td>
<td>2184</td>
<td>52</td>
<td>27</td>
<td>97.6%</td>
<td>98.8%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overnite Transportation</td>
<td>800</td>
<td>873</td>
<td>64</td>
<td>77</td>
<td>92.0%</td>
<td>91.2%</td>
<td>50</td>
<td>60</td>
<td>6.3%</td>
<td>6.9%</td>
</tr>
<tr>
<td>ABF Freight</td>
<td>783</td>
<td>843</td>
<td>29</td>
<td>43</td>
<td>96.3%</td>
<td>94.9%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TNT Freightways</td>
<td>675</td>
<td>800</td>
<td>28</td>
<td>40</td>
<td>95.9%</td>
<td>95.0%</td>
<td>15</td>
<td>21</td>
<td>2.2%</td>
<td>2.6%</td>
</tr>
<tr>
<td>Carolina Freight</td>
<td>584</td>
<td>593</td>
<td>8</td>
<td>(2)</td>
<td>98.6%</td>
<td>100.3%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preston Corporation</td>
<td>414</td>
<td>409</td>
<td>(3)</td>
<td>(14)</td>
<td>100.7%</td>
<td>103.4%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Watkins Motor Lines</td>
<td>269</td>
<td>330</td>
<td>15</td>
<td>24</td>
<td>94.4%</td>
<td>92.7%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Central Transport</td>
<td>302</td>
<td>319</td>
<td>6</td>
<td>7</td>
<td>98.0%</td>
<td>97.8%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Sources: Standard & Poor's Industry Survey "Railroad and Trucking", November 4, 1993; Company Annual Reports

Footnotes: The figures for the "Big Three" (Roadway, Yellow, Consolidated) does not include regional or other subsidiaries.
TNT Freightways is a holding company for 6 regional carriers and a logistics subsidiary.
The figures for Overnite do not include a $20 million p.a. goodwill amortization and a 1991 pre-tax charge of $25 million.
system, a manufacturer must substitute its single national distribution center with a network of smaller regional facilities. While this logic is not entirely compelling (there are a number of cases in which manufacturers actually centralized their networks to reap economies of scale without compromising customer service), it can offer an explanation for the growth of the short-haul segment.

In any event, the local market must have appeared attractive enough to the leading carriers to justify market entry through either internal development or acquisition. Consolidated Freightways launched four regional carriers from scratch. In 1992, these four Con-Way companies generated $54 million in operating profit (twice as much as the long-haul sister subsidiary Consolidated Motor Freight) on total revenues of $724 million. This is equivalent to the remarkable operating ratio of 92.5%. Roadway Services also operates four regional carriers (Spartan Express, Central Freight Lines, Coles Express, Viking Freight System) that have been purchased since 1983. The list is completed by Yellow Corporation’s 1993 acquisition of Preston Trucking. All these local subsidiaries of the “Big Three” have one common feature - they are non-unionized. Through the adoption of a holding company structure, the major carriers have managed to segregate their Teamster long-haul subsidiaries from their non-union regional affiliates. The union claims that this move is part of a strategy to shift the bargaining power toward management. However, Robert T. Robertson, President and CEO of Con-Way Transportation, disagrees in the Wall Street Journal:7

"We aren’t a good company because we are union-free. We are union-free because we are a good company."

From an outsider’s point of view this chicken-egg problem seems irrelevant. The fact of the matter remains that unlike their nationwide cousins, the regional carriers are thriving.

A final point must be made with respect to the positioning of the LTL segment in general. By the very nature of their business, LTL carriers are somewhat stuck in a

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middle position between TL carriers and small package companies. TL carriers have made inroads into the upper end of the LTL market by developing capabilities to consolidate large size LTL shipments into full truckloads. From the lower end, small package companies, in particular UPS have taken away market share from the traditional LTL business as well.

Exhibit 3.29: The LTL Industry under Pressure

UPS recently raised the weight limit on single shipments to 150 pounds. In addition, the company launched a discount program for multiple shipments. Hence, the LTL industry is under pressure from two sides. At the same time, the lines between air freight and LTL are blurring. Standard & Poor's refers to Federal Express' "Express Saver" (discount second day delivery air freight for shipments of up to 150 pounds.) as being "little more
than a thinly-veiled LTL service.” The company is creatively exploring a loop-hole in intrastate freight regulation that only relates to trucking firms, but not to air-freight carriers.

LTL carriers have themselves taken the initiative on moving into adjacent segments. Roadway Package System (RPS), a Roadway subsidiary, competes head-on with UPS in the small package market. Consolidated Freightways acquired Emory Worldwide in order to enter the air-freight market. Following in their steps, Roadway started Roadway Global Air (RGA) in 1992. While these moves demonstrate that the LTL carriers are aggressively taking on their challengers, the long-term impacts on the structure of the industry and the competitiveness of the major players are uncertain.\(^8\)

**LTL carriers and intermodal**

In light of the distressed financial situation of the long-haul LTL business, one would expect carriers to openly embrace the opportunities offered to them by improved intermodal service. However, these expectations are not passing the reality check, as evidenced by the breakdown of intermodal traffic in Exhibit 3.14 of Section 3.1.2. LTL traffic accounted for a meager 4% of all intermodal movements in 1991, more up-to-date estimates speak of 5%.

So, what keeps LTL carriers from using intermodal more frequently? Poor service used to be the obvious answer. However, service quality has improved and if it is sufficient for J.B. Hunt and United Parcel Service, why shouldn’t it be for Roadway and Yellow Freight? The major constraints are posed by the labor contracts. Those contracts determine that a load has to go by truck if a truck and a driver are available within a two-hour time window.\(^9\) In addition, limits are being set for the total percentage of a carrier’s freight that can be moved intermodally. Hence, unionized LTL carriers are allowed to take advantage of intermodal only to manage their peak demand (end of month and prior

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\(^8\) As an interesting detail, it took Consolidated Freightways six years to make Emory profitable.

to seasonal peaks in the retail business) that exceeds over-the-road capacity, but not as a
general substitute for long haul trucking.

However, this is likely to change under the new labor contract that has just been
negotiated between Trucking Management, Inc. and the International Brotherhood of
Teamsters. Under the new accord, the companies will be able to shift a maximum of 28% of
their freight to rail. This is less than the 35% initially sought by management, but by
far exceeds the current limit of 5%. Labor has apparently realized that “without the
ability to use intermodal on long-haul to lower costs, some of the big boys would ...
perhaps be forced out of business” (Kirk A. Williams, Exel Logistics, North America).

Since railroads are also hoping to attract LTL shipments from the non-union
regional and interregional carriers, LTL has clearly the potential to develop into a major
source of intermodal traffic. However, if it will turn into “the next leap for intermodal
growth”, as Traffic World hastens to claim, remains to be seen.

\[12\] See Traffic World, “LTL Traffic predicted to be the next leap for intermodal growth, carriers say”, April 19, 1993.
3.3.3 The Small Package Industry

The small package industry essentially entails a single company, United Parcel Service (UPS), which is a long-time user and supporter of intermodal freight transportation. Thus, its approach to intermodal can serve as a role model for companies that are still in the process of assessing the potential merit of intermodal for their own strategies. Unfortunately, the amount of available information on this topic is rather limited.\(^1\) Therefore, this section can only present a brief discussion of the past and present of intermodal at UPS and highlight some of the benefits of intermodal cooperation for both UPS and its railroad partners.

UPS is the trucking firm that had the greatest influence on intermodal rail. The company started using TOFC for its three-day-or-longer service in the 1960’s in order to eliminate the need for the organization of a long-haul driver/tractor network. Interestingly enough from the perspective of the 1990’s (remember the driver shortage in the TL industry), this decision was motivated by the company’s concern for its drivers. The usage of piggyback made it possible for drivers to be home every night, which gave a boost to employee morale. Further benefits were the savings of capital for alternate purposes and the possibility to expand into unbalanced markets without being overly concerned about backhauls.

Railroads value UPS as a provider of base volume for many trains. In addition, UPS accounts for a continuous stream of earnings, since the company is willing to pay premium prices for premium service. Finally, UPS is said to have functioned as a catalyst for agreements between railroads to establish connecting intermodal train service over multiple networks. In turn, railroads were guaranteeing superior service to UPS. This superior service relies - among other features - on the design of train schedules according to UPS’ sorting schedules, the acceptance of late cut-off times for train departures and the

advance notification of UPS if delays occur so that drivers’ assignments can be adjusted accordingly.

As a result of this smooth cooperation with railroads, UPS’ intermodal volume has grown continually. For example, from 1980 to 1991 it increased by 135%. Today, UPS is the single largest intermodal shipper in the nation, accounting for approximately 10% of all intermodal car-loadings in 1992. This pervasive use of intermodal has been a major source of competitive advantage of UPS in its battle with the LTL carriers over the lower end of the LTL market. Not surprisingly, the LTLs were pointing to UPS in their recent labor conflict with the Teamsters to make a case for the shift of more long-haul freight from truck to rail.
3.4 Intermodal Marketing Companies (IMC)

Industry Evolution

Middlemen have historically played an important role in the marketing of transportation services. As intermediaries between shippers and carriers they perform a variety of transactional, physical and facilitating activities.¹ For example, by breaking a large-scale product into - for smaller customers - consumable pieces, they close a quantity gap between carrier and shipper. On the other hand, bulk breaking also guarantees a deeper penetration at the lower end of the market, which in turn increases overall carrier volume.

Mueller (1989) reports that the first attempts of rail cargo consolidation date back to the turn of the 20th century when shippers in New York and Chicago were looking for ways to save money and improve service. With the evolution of the Transportation Industry, middlemen have established themselves in other modes - besides rail - as well. Today there are numerous categories of intermediaries that are differentiated along modes, geographical scope, commodity types etc. Among them are domestic freight forwarders, import brokers, domestic airfreight forwarders, air cargo agents, transportation brokers, perishable brokers etc. Since deregulation in the early 1980’s, the growth in the number of intermediaries has accelerated. In particular, in the trucking industry the entry of thousands of new small companies has created the need for brokers to close the knowledge gap between shippers and those new entrants.

For the purpose of this thesis, one type of intermediaries - Intermodal Marketing Companies (IMCs) - is of particular relevance. Drawing upon an analogy from passenger transportation, IMCs can be best defined as “travel agents” for land-based intermodal shipments.² They assemble the intermodal transportation package for the shipper (in the language of marketing, they fill an “assortment gap”) by contracting with

¹See Appendix D for a summary of concepts of marketing channel management that will be applied to intermodal.
owner-operators for drayage at both ends of the move and scheduling the line haul with the railroad. Moreover, they take legal responsibility for the whole intermodal move, and therefore handle claims and insurance, and provide the shipper with a through rate and on-line tracking information.

IMCs have been credited with facilitating intermodal growth throughout the difficult 1970's and early 1980's. Moreover, they benefited handsomely from the intermodal breakthrough in the mid 1980's (double-stack) and the further popularization of intermodal through the rail-truck alliances since 1989/90. According to Standard & Poor's (1993), IMCs are estimated to generate $2 billion in annual revenue which represents about one third of the overall intermodal segment. The Hub Group, the largest Intermodal Marketing Company in the US, has almost doubled in size from 1990 to 1993 and reached $650 million in annual revenue in 1993 (see Exhibit 3.30 below).³

Exhibit 3.30: The Hub Group - Annual Sales (in $ million)

<table>
<thead>
<tr>
<th>Year</th>
<th>Sales in $ million</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>352</td>
</tr>
<tr>
<td>'91</td>
<td>460</td>
</tr>
<tr>
<td>'92</td>
<td>560</td>
</tr>
<tr>
<td>'93</td>
<td>650</td>
</tr>
</tbody>
</table>

To put this number in perspective, only two TL carriers - Schneider National and J.B.Hunt - surpass The Hub Group in terms of annual revenue. Further, in terms of

intermodal traffic the company tenders twice the number of trailers to the railroads as Hunt and Schneider combined.

To complete the picture, Exhibit 3.31 lists other large IMCs with their annual revenue for 1993:

<table>
<thead>
<tr>
<th>Exhibit 3.31 Major Intermodal Marketing Companies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Company</td>
</tr>
<tr>
<td>Alliance Shippers</td>
</tr>
<tr>
<td>Mark VII Transportation</td>
</tr>
<tr>
<td>Tolan O'Neal Transportation &amp; Logistics</td>
</tr>
<tr>
<td>CSX Intermodal</td>
</tr>
<tr>
<td>APL Intermodal</td>
</tr>
<tr>
<td>Con-Way Intermodal</td>
</tr>
</tbody>
</table>

In order to highlight that currently there are two different types of IMCs - independent and carrier-affiliated, the groups are separated by a dashed line. The carrier-affiliates are somewhat difficult to pinpoint, because on the one hand they are subsidiaries of transportation carriers and as such extended marketing arms of their affiliates, on the other hand they are also acting like independent IMCs, since they are not restricted to the usage of their affiliates services alone.

**Growing Challenges in the 1990’s**

After enjoying tremendous growth over the past few years, the independent IMCs will face mounting challenges in the nearer future. The major challenge comes in the form of new competition from the largest truckload carriers in the US. Those that have formed alliances with major railroads, use their in-house sales force to market the intermodal product to shippers and provide the same value-added services such as EDI, through-rate billing, claims handling etc. that used to be the stronghold of IMCs. While
the truckload carriers such as J.B. Hunt have significantly increased the popularity and fueled the growth of intermodal, they have also taken away market share from the IMCs.

In this new battle for shippers' traffic, the IMCs are trying to push the fact that they are the only party that truly represents the best interest of the shipper. Unaffected by the pressure for high utilization that goes along with asset ownership, they are able to "really present all realistic alternatives and make best decisions for customers." (Robert Jensen, President, Hub Group Logistics). Currently, IMCs are eager to take the argument of "making best decisions for customers" to the next level and position themselves as logistics service providers to whom companies can outsource part of their logistics function, in particular traffic management. Here, logistics follows a trend that has prevailed in other functions: Companies, in an effort to become leaner and more efficient, are concentrating on their core competencies and, thus, are farming out "non-strategic" functions to specialized service providers. While the logistics outsourcing rhetoric outstrips reality, there are a few instances in which companies actually fully turned over their intermodal traffic to an IMC, as in the case of Sears Logistics/Hub Group.

Carrier-affiliated IMCs and truckload firms take a different position with respect to asset ownership. They counter that it is exactly the ownership of equipment that gives them a competitive advantage over independent IMCs. They emphasize that ownership of and therefore control over equipment translates into guaranteed availability for the customer as a basis for consistent high-quality service.

Further, railroads are entering the asset vs. non-asset debate. As supplier of intermodal equipment to IMCs, they are expressing mounting discontent with the lack of commitment to asset utilization on the part of their intermodal partners. Acting as one-way transaction buyers, IMCs have not yet had to manage the equipment as if it was

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5 For instance, a corporation such as Electronic Data Systems owes much of its success to the drive in the information technology field.
their own. IMCs are gradually responding to both the concerns of shippers over equipment availability and the concerns of their intermodal partners over equipment utilization by introducing “intermodal equipment management programs” (The Hub Group) or even purchasing containers themselves (Mark VII).6

Within the framework of marketing channel management, these arising conflicts can be interpreted as a signal that the distribution channels for intermodal rail-truck are entering a different stage in their life cycle. Middlemen who played an important role in the embryonic or introductory phase of the product, are threatened by the emergence of new channels. The sustainability of their position will depend on their ability to transform themselves into broader logistics service providers or find a profitable niche (e.g. a particular industry, very small customers).

In the nearer future, intensified competition will likely result in a consolidation in the IMC Industry. Currently independent IMCs could choose to team up with particular carriers. However, we might even witness the marginalization of this distribution channel for intermodal. The Transportation Industry has seen a precedence for this scenario, when in the 1930’s and 1940’s trucklines took away the LTL/LCL traffic from both freight forwarders and railroads.

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3.5 Intermodal Customers

The preceding four sections of Chapter 3 have examined the supply side of intermodal freight transportation - railroads, shipping lines, motor carriers and intermodal marketing companies. Each of those stakeholders is in the intermodal business to not just provide a service, but to make a sale (and money) through meeting the needs of customers. In order to achieve that organizational objective, they have to "develop a keen sense of market and customers and deliver customer satisfaction more efficiently and effectively than competitors." But, what does customer satisfaction really mean with respect to intermodal?

In the following, we will address this question based on the results of a recent market research study for domestic truckload freight, put into the context of the general research on freight transportation choice. The discussion will be structured into four steps: how do shippers select (selection and evaluation), how do truck and intermodal perform (performance), which shippers use intermodal and for which purpose (use) and finally, how can the use of intermodal be improved (barriers and opportunities).

Selection and Evaluation

General Background

A substantial amount of empirical and conceptual work into transportation mode choice appeared in the literature during the 1970’s and 1980’s. Based on twelve empirical studies, that varied widely in terms of methodology, population studies, type of carrier, competitive issues (intermodal vs. intramodal), McGinnis (1990) developed the following taxonomy of variables that affect freight transportation choice:

(1) Freight rates (costs, charges, rates),

1See Koller (1988).
3This 4-step approach is borrowed from Mercer (1992).
(2) Reliability (reliability, delivery time),

(3) Transit-time (time-in-transit, speed, delivery time),

(4) Loss, Damage, Claims Processing and Tracing,

(5) Shipper market considerations (customer service, user satisfaction, market competitiveness, market influences),

(6) Carrier considerations (availability, capability, reputation, special equipment).

From his analysis, McGinnis concluded that in most instances, service (measured by variables 2-5) will be more important than price (variable 1). However, the absolute importance of freight rates was always high. This means, that transportation providers encounter markets that are service-demanding and price-competitive. In addition, the author pointed out that the priorities among service variables vary. Hence, service should not be looked at as one homogenous attribute, but rather as a multi-dimensional concept.

Intermodal

The most detailed publicly available market research study related to intermodalism is the Intermodal Index.\(^4\) For the 1992 edition, Mercer Management Consulting surveyed 502 transportation managers and 76 plant/distribution center managers on their full trailerload shipments transported 500 miles or more by truck or intermodal services. Mercer used a set of choice parameters slightly different from the McGinnis taxonomy: Exhibit 3.32 below shows the four groups of selection criteria - service, price, equipment and administration/sales with their respective sub-dimensions.\(^5\)

\(^4\)The Intermodal Index is a five-year market research initiative sponsored by The Intermodal Association of North America (IANA) and The National Industrial Transportation League, and conducted by Mercer Management Consulting.

\(^5\)From an academic point of view, one could raise several objections regarding these categories. For example: What does "quality of pick-up and delivery" stand for? How is "service reliability" different from "low risk of service failure"? Is equipment availability a service dimension or a category in itself? However, the focus of this section is the interpretation of the survey results, rather than a critique of the methodology.
Mercer found that service criteria (service reliability, quality of pick-up and delivery) dominated the rankings of the most important factors in mode and carrier selection. Price was ranked tenth, after all seven service dimensions, availability of equipment and overall ease of doing business. However, the gap between the number 1 and number 10 criterion amounted to only 10 percentage points, i.e. 94% of all shippers rated “quality of delivery” as important or very important (on a scale from 1= not important to 5=very important) versus 84% for price.

While these relatively minor differences do not allow for conclusions more specific than McGinnis’s “the market is service-demanding and price-competitive”, Mercer’s findings with respect to carrier evaluation are very enlightening: Fewer than one third of all shippers have put in place formal measurement systems (known as “report cards”) in order to evaluate the quality of transportation suppliers. As Dean Wise (Vice President at Mercer) put it: “Clearly, decisions about intermodal use are not being made on a scientific basis. They (shippers) are going on their gut feelings...”

Performance

Given the lack of formal measurement systems at more than two thirds of all shippers, most responses to questions about the relative performance of truck and intermodal are opinions, rather than objective assessments. Nevertheless, it is important

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for intermodal suppliers to understand these opinions, since they form the basis for the transportation purchase decision.

The major performance-related results of the Intermodal Index are as follows:

• Overall, transportation managers and plant/DC managers continue to rate intermodal lower than truck for shipments moving over 500 miles. Specifically, 87% of all shippers gave truck a “4” or “5” rating on a 1-5 scale (1=poor, 5=excellent), as compared to 66% for intermodal.

• However, most users of intermodal (62%) felt that intermodal performance had improved over the period from 1990 to 1992.

• There is some variation of intermodal performance by region, with the West viewed as the region with the best performance.

• The relative performance of intermodal vis-a-vis trucks improves with the length of the haul. While there is a dramatic gap of 69 percentage points for hauls less than 500 miles (again measured in the percentage of “4” or “5” ratings on a 1-5 scale), the gap reduces to 14 percentage points for 1,000 mile hauls. Intermodal outperforms trucks for hauls greater than 2,000 miles.

• On the 17 specific attributes listed under “Selection and Evaluation”, truck receives more “excellent” performance ratings from traffic/transportation managers than does intermodal along all dimensions, except for price.

Use

The perceptions about intermodal performance on the part of shippers translate into purchasing behavior, i.e., the use of intermodal. Regarding intermodal use, Mercer reports the following trends:

• A majority of the shippers surveyed - 69% - used intermodal services in 1992. However, two thirds of intermodal users rely on intermodal for less than 20 percent of their shipments of more than 500 miles.
• Intermodal use is highest in the West, and use in all regions has increased since 1990.7
• Intermodal market share is growing and will continue to grow - 39 percent of shippers expect intermodal use to increase over the next three years. Based on shippers expectations and current intermodal volumes, Mercer predicted that the intermodal market share of trailerload shipments moving 500 miles or more will increase to 20% in 1995, up from 12% in 1989 and 15% in 1992.
• One third of the shippers shifted traffic from the highway to intermodal sometime in 1992. More shippers shifted traffic from highway to intermodal than vice versa. The largest shippers were most likely to have diverted traffic to intermodal.

Exhibit 3.33  Traffic Shifts in 1992

<table>
<thead>
<tr>
<th>All Shippers</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>From Intermodal to Truck</td>
<td>19%</td>
</tr>
<tr>
<td>From Truck to to Intermodal</td>
<td>31%</td>
</tr>
<tr>
<td>Shippers with Revenues of $1 Billion or More</td>
<td></td>
</tr>
<tr>
<td>From Intermodal to Truck</td>
<td>19%</td>
</tr>
<tr>
<td>From Truck to to Intermodal</td>
<td>52%</td>
</tr>
</tbody>
</table>

Exhibit 3.33 summarizes these results on traffic shifts in 1992. As far as the higher use of intermodal by large shippers is concerned, these figures are not surprising. As Dean Wise put it: “Large corporations have a wider diversity of freight transportation needs and when they take a hard look at those needs they are more apt to find some freight that is a good fit with intermodal.” This explanation is supported by the example of DuPont8.

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7This regional usage pattern is consistent with the finding that the performance of intermodal is best in the West and that the use of intermodal increases with line haul distance.
which is currently using intermodal for 10% of their truckload freight and sees the potential to increase it to 20%.

**Barriers and Opportunities**

When asked to list barriers that keep them from not using intermodal for more shipments of more than 500 miles, almost 50% of all shippers list slow and unreliable transit time. Further, high intermodal prices, lack of availability of equipment, no need for intermodal services since trucking covers all needs, large distance to the railroads and a high damage rate were cited as impeding stronger use of intermodal.

These barriers point to opportunities for intermodal carriers to increase the usage of their services if they could improve it along the dimensions mentioned above. Clearly, improvements in transit time and reliability, would have a significant impact on market demand. 69% of all intermodal users stated that they would increase their use if at least 98% of all shipments were delivered on the day scheduled for delivery. A similarly high number of shippers (65%) pronounced that a reduction in door-to-door transit time by 1 day would prompt them to raise their intermodal volume.

However, in order to achieve these desired improvements, intermodal carriers would need to make substantive investments, which need to be justified by potentially high benefits. Here, a little more than 40% of all users rated their willingness to pay premiums for premium service as “4” or “5” on a 1-5 likelihood scale. It is striking, that the gap between the proponents of “increase in usage with better service” and those of “willingness to pay a premium for service enhancements”, amounted to about 25 percentage points.
4. The Operational Perspective on Intermodal

The last section of Chapter 3 concluded with the documentation of barriers to and opportunities for intermodal growth, as seen by shippers. The results of the *Intermodal Index* clearly show that it is the area of intermodal operations that is crucial for the response to intermodal in the market place. More than 50% of all shippers criticize slow and reliable transit time. Further issues mentioned were lack of availability of equipment, large distance to the railroads and a high damage rate.

This fact raises the question as to which actions need to be taken to improve the performance of the overall intermodal system. We will first, present a framework within which to analyze intermodal systems. Second, international container service and domestic rail-truck operations will be studied to identify potential problem areas. Third, current approaches to these problems as well as areas that deserve further investigation are covered.

4.1 A Framework for System Improvements

Turnquist and List (1993) have proposed a framework for the analysis and subsequent improvement of intermodal transportation systems. They conceptualize the transportation network as consisting of three different layers of networks - *goods*, *physical resources* (equipment, people) and *information*. These three layers are independent in the sense that the elements move in their own network - goods from vehicle to vehicle, trucks or railcars move from shipment to shipment as they are used and reused (both are flowing over the physical transportation network), and information moves from computer to computer (or person to person) over the communications network. On the other hand, connections among these three layers are needed for processing steps. If one or more of the necessary elements are missing, malfunctions occur. To give an example, if the trucking firm that is responsible for the local delivery from an end-of-line rail terminal to the final destination, is not notified about the arrival
of the stacktrain, then the container will be waiting for pick-up until somebody establishes the missing link between the physical and the information layer.

Given this framework, one can categorize alternatives for system improvement accordingly and evaluate their impact on the goals of the system as a whole, with goals being defined as integration, responsiveness and resource utilization. Regarding the evaluation of alternatives, its is clear for Turnquist and List that “the connection points are critical, and that policies and research that lead to improved intermodal connections ... are key to overall system productivity.” Let us keep this in mind as we discuss the two major categories of intermodal - international container service and domestic rail-truck service in more detail.

4.2. International Container Service

This category essentially entails the double-stack container service from the U.S. West Coast to in-land or East Cost destinations and the respective backhaul. Exhibit 4.1 below, that is based on Wang (1993), shows the sequence of the major process steps in the intermodal movement of international container freight. These nine individual steps can be grouped into five major categories: Port Activities, Intermodal Transfer, Rail Linehaul, Intermodal Transfer and Local Pickup/Delivery.

### Exhibit 4.1 Processing Steps for International Container Freight

<table>
<thead>
<tr>
<th>Eastbound</th>
<th>Westbound</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vessel arrival</td>
<td>Pickup</td>
</tr>
<tr>
<td>Intermodal transfer</td>
<td>Cargo Cutoff</td>
</tr>
<tr>
<td>Cutoff for Domestic cargo</td>
<td>Container Loading</td>
</tr>
<tr>
<td>Stacktrain departures</td>
<td>Stacktrain Departure</td>
</tr>
<tr>
<td>Interline Operation</td>
<td>Interline Operations</td>
</tr>
<tr>
<td>Stacktrain Arrival</td>
<td>Stacktrain Arrival</td>
</tr>
<tr>
<td>Container Unloading</td>
<td>Intermodal Transfer</td>
</tr>
<tr>
<td>Availability</td>
<td>Availability of Domestic Cargo</td>
</tr>
<tr>
<td>Delivery</td>
<td>Vessel Departure</td>
</tr>
</tbody>
</table>
System performance can be adversely impacted at each of these five categories of steps. In the following, actual and hypothesized pitfalls will be pointed out and areas that deserve further investigation will be highlighted.

**Port activities:** The left-hand column of Exhibit 4.1 begins with the vessel arrival. This is the first step in the eastbound process that ultimately results in the delivery of the container to the consignee. Hence, system perturbations during this first step (such as poor on-time performance) can potentially trigger a chain-reaction throughout the entire process. For example, Wang describes how a vessel delay can complicate intermodal transfer due to port congestion and/or congestion of the rail terminal. Hence the following issues should be articulated and addressed:

- What is the service reliability of ocean vessels?
- How is the interface between ocean carrier and railroad designed (coordination of vessel arrival/departure and stacktrain departure/arrival)?
- How should vessel and stack-train schedule be integrated?
- Are common-user trains that are fully controlled by railroads performing better than dedicated unit-trains, since the former are decoupled from vessel activity (and therefore also from delays), whereas the latter are not?

**Intermodal transfer:**

Upon arrival, the vessel needs to be unloaded, containers need to be transferred to the rail terminal and loaded onto the stack car. This process step is subject to a variety of factors such as container stowage on board, crane productivity, workrules for longshoremen, efficiency of the drayage operation etc. In particular the last factor - the efficiency of drayage operations - has been at the center of attention in the intermodal community. Muller (1989) writes: "While intermodal enthusiasts talk about through movement of containers from ocean vessel to rail and vice versa, close inspection of
actual port activities reveals that transfer of containers is seldom direct between ship and rail."

In Los Angeles/Long Beach, intermodal containers are currently trucked between the ports and downtown railyards of Southern Pacific, Santa Fe and Union Pacific Railroads over a distance of more than 20 miles. This drayage costs the shipping lines approximately $100 (according to a major shipping line) and contributes to congestion on the metropolitan freeways. The answer to this system flaw is "on-dock rail facilities". The ports of L.A. and Long Beach are pursuing the "Alameda Corridor" project, which entails the construction of a 20-mile truck and rail route, worth $1.8 billion. The corridor is scheduled for completion in 2001, however, the outcome of the undertaking is currently far from certain.

The difficulty lies in the balancing of the public and private interests that are involved with the project. As one would expect, financial matters are at the heart of the conflict. First, there was the issue of finding a fair price for the sale of the current lines of Santa Fe and Southern Pacific, which was finally achieved in 1993.\(^1\) Second, there is the issue of user fees railroads would pay on a per container basis in order to contribute their share to the cost of construction and financing. Union Pacific puts the cost on its current line at $2.46 per container whereas the port established a fee of $30 per container, which the other two railroads have agreed to.\(^2\) Now, Union Pacific is under political pressure, but the conflict is still unresolved and the project stalled.\(^3\)

Several lessons can be derived from the case of the Alameda Corridor. First, the project is an example for Turnquist/List’s point about the significance of connections for the productivity of the intermodal system. Second, it demonstrates that the issue of intermodal transfer needs to be addressed at the level of the physical network. Third, it

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\(^3\)See Traffic World, "Union Pacific facing political flack over opposition to Alameda Corridor", April 11, 1994.
highlights the complexity and the conflicts associated with approaches to the system improvement that are based on infrastructure construction, i.e. aim at improving the physical network.

The inevitable time lag and complexity related to physical network solutions prompt the following questions: What alternatives ("soft", information-based) for the improvement of the sea-land transfer do exist? To what extent are the problems caused by institutional fragmentation and myopia, i.e. conflicts between shipping line, local trucking firm and railroad?

**Interline Operations**

According to Wang (1993), in the linehaul portion, stacktrains are not much different from other kinds of trains, except for their higher priority. That means that the typical problems of interlining, track sharing between different railroads etc. apply. However, the time sensitivity of stack-train operations suggests that one issue is of specific concern to stacktrains, the **train length**. This issue involves the familiar railroad trade-off between operating efficiencies and service levels. In order to achieve economies of scale, the typical stacktrain is composed of 27-28 cars.\(^4\) On the other hand, longer trains require more time for acceleration and deceleration. So, what is the "optimum length", if there is one?

Again, the issue of intermodal connections surfaces if one looks at Chicago as the major railroad interlining point\(^5\) of the United States (some say "railroad capital"). All major railroads serve the city, however, each at its own location. In terms of double-stack, Chicago is the meeting point of the two major corridors that link the Pacific Coast (Tacoma/Seattle and Los Angeles/Long Beach) with the Mid-West and continue to the East-Coast. While there is a certain amount of on-track exchange through local switching

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\(^4\)Here "car" actually pleans an articulated double-stack platform that can carry up to 10 containers. Thus, a typical double-stack train would carry up to 300 containers.

\(^5\)The maps of carrier networks in Appendix E show why this is the case. The railroad geography of the United States is such that the four major Western carriers serve the two-thirds of the country west of the line Chicago-Memphis-New Orleans, whereas the three major Eastern railroads cover the remaining third of the United States.
companies, railroads have generally adopted the practice of unloading trailers and containers from incoming trains and driving them to each-others terminals over city streets and highways. This cross-town drayage is estimated to generate about 220,000 trips annually. As another example of a physical network solution, the idea of a multi-user intermodal terminal inside or outside the city of Chicago, for the purpose of direct interchange, has been studied by the Federal Railroad Administration.

**Automatic Equipment Identification (AEI)**

The operational issues that have been discussed so far have focused on specific processing steps in the international container freight chain. However, a major ongoing system improvement effort is directed toward the unification of the entire process based on information technology, specifically, automated equipment identification.

Where does this technology fit in and what is it trying to accomplish? The common feature of all the individual processing steps is that they are contributing to the movement of a shipment in a container from its origin to destination. The technology that supports this physical flow of freight itself has been revolutionized over the past decades: containerships are ever increasing in size, cranes are getting more sophisticated, double-stack has been widely embraced etc. However, the capabilities for the identification, reporting and monitoring of this physical flow of freight and equipment have not significantly improved.

According to a major shipping company, the manual recording of the container numbers on a piece of paper is still common practice today. It is done as containers come off the vessels, as they go in and out of terminals, as they come off and on trains, etc. Moreover, there is the issue of container identification in ground-storage facilities. When misplacements occur, the search for a “lost container” resembles the search for a car on a

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huge parking lot if one forgot the exact location, only that most containers look alike, which makes the search even more difficult.

Against this background, AEI is seen as a technology that could support an intermodal service, in which individual units are automatically monitored as they move across ocean, rail and highway. The core of AEI consists of tagging each of the containers and highway trailers, as well as other operating equipment, such as container chassis, trucks and other moveable equipment, with a electronic radio frequency (RF) tag. With the help of readers, installed in a number of marine, rail and truck terminal facilities, movement data can be collected automatically and fed into a computer system.

This, at least, is the vision behind the AEI-based intermodal communications system. As we all know, leading edge technology often suffers from inflated promises of its advocates that are made while the actual feasibility of the equipment has not yet been tested. In reality, leading edge technology can quickly turn into bleeding edge with projects running over budget and off schedule. Sometimes, overly ambitious projects collapse altogether (see Burlington Northern’s ARES case). In the particular case of AEI, the potential pitfalls are enormous if one just thinks of the different industries and corporations that need to collaborate to make the vision happen.

Nonetheless, from an operations management perspective, this type of a system offers entirely new opportunities to manage intermodal flows. First, there is the benefit of affluent data about the movements of containers and other equipment. The analysis of this data could significantly increase the understanding of the functioning of the system as a whole: routing of freight flows, flow variation over time, bottlenecks, etc. Further, it would be easy to track and evaluate the performance of the system on a origin-to-destination basis at an unprecedented level of detail, the level of individual containers. Second, with the enhanced understanding of the system status, the interference with the intermodal system could be taken to a new level, in terms of strategic, tactical and even real-time planning.
For instance, one could conceive of something like dynamic container management as a concept of dynamically changing the allocation of containers over the intermodal network to better balance supply and demand. In that sense, Muller's prediction "Twenty years ago, 10 percent of a carrier's time was spent planning the movement of a container, and 90 percent on the movement itself. In the year 2000 those numbers will be reversed."\(^7\), could not be too far from reality.

4.3. Intermodal Rail-Truck Service (IRT)

The second type of intermodal movements that will be discussed in this section, is rail-truck service. Similar to Section 4.2, we begin with a map of the individual steps that are involved in an IRT movement. This is accomplished in Exhibit 4.2. Again, we look at individual process steps and related issues in greater detail.

<table>
<thead>
<tr>
<th>Exhibit 4.2 The Transportation Chain for Intermodal Rail-Truck Service</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) Pick-up</td>
</tr>
<tr>
<td>(2) Drayage</td>
</tr>
<tr>
<td>(3) Intermodal Transfer</td>
</tr>
<tr>
<td>(4) Line-haul</td>
</tr>
<tr>
<td>(5) Intermodal Transfer</td>
</tr>
<tr>
<td>(6) Drayage</td>
</tr>
<tr>
<td>(7) Delivery</td>
</tr>
</tbody>
</table>

**Drayage Operations Planning**

The drayage part is widely regarded as the weakest link in the intermodal rail-truck chain. Spasovic and Morlok (1992) report that "despite its short distance compared with the rail movement, drayage accounts for a large fraction of intermodal origin-to-destination cost and is a major factor in service quality as perceived by shippers.\(^7\) Estimates indicate that the price paid for drayage for a typical 1,000 mile haul is a high as

\(^7\)See Traffic World, "Intermodal terminals of the future will offer myriad of choices, demand careful planning", April 18, 1994.
40 percent of the total door-to-door rate.” The authors see the main reason in the
institutional fragmentation that characterizes intermodal rail-truck service. “In a typical
intermodal market, around the rail terminal, there are at least a dozen intermodal retailers
and as many truckers.” In order to demonstrate the benefits that could be reaped through
centrally planned operation, the authors developed a network model of *drayage
operations* that minimizes the total cost of trailer and tractor activities subject to service
quality and flow conservation constraints. Through a case study of the Conrail
intermodal terminal at Morrisville, Pennsylvania, the authors demonstrate that
“substantial cost savings could be achieved by introducing a centralized operation.”

What does this mean for the intermodal industry that was extensively discussed in
Chapter 3? First, it offers supporting evidence for the thesis that operational integration or
quasi-integration on the part of railroads has tangible operational benefits. Full origin-to-
destination control can help reduce drayage cost, and is in a sense even a major
prerequisite for the reduction of drayage cost. However, in reality it is not obvious how a
railroad would go about “centralizing” the drayage around a particular terminal without
alienating customers and losing business that had been attracted through intermodal
marketing companies before.⁸ Second, it gives an additional insight into the conflict
between intermodal marketing companies and truckload firms. Someone like J.B.Hunt
could potentially achieve the benefits of the “centralized operation” without
compromising market responsiveness and customer service. Given the obvious
economies of scale in drayage, one could hypothesize that J.B. Hunt would drive owner
operators out of drayage markets, or at least put pressure on drayage markets in which the
company is active. This hypothesis could be tested through a study of the rate structure
in different drayage markets.

⁸As long as there is a free market around rail terminals, nobody can ban owner-operators or intermodal
marketing companies from creating the type of inefficiencies, Spasovic is trying to eliminate. However, a
railroad could introduce a policy that it only accepts freight that was drayed by its own drayage company
that would then be centrally planned using the optimization model. It is doubtful whether this could happen
without alienating current customers and adversely impacting demand. After all, the railroad does not
direct any shipper’s traffic.
Network Design - Terminal Location Analysis

A second area of interest regarding drayage is the issue of network design. A recent study of Minnesota manufacturers\(^9\) found that the location of intermodal terminals (hubs) is an important factor in determining the availability of IRT to potential users. As the distance between the user and the terminal increases, so do transit time and cost. Consequently, users of IRT tend to be located relatively close to terminals (less than 100 miles away). Therefore, the authors suggest that the location problem be reduced by opening additional terminals, i.e. bringing the service closer to the potential customer.

However, this recommendation runs contrary to the consolidation strategy applied by major railroads. In order to achieve economies of scale in terms of train and terminal operation, railroads have significantly reduced the number of intermodal terminals from 1,500 in 1975 to 230 in 1990. Most of the eliminated terminals were so-called “circus-ramps” used for TOFC, but not suited to accommodate the growing volume of container traffic. Moreover, railroads felt that it was a better strategy to concentrate on fewer terminals and upgrade the handling equipment as opposed to maintaining a maze of low-density facilities. The remaining terminals were then linked through a system of direct trains to create a true hub-and-spoke network and attract higher intermodal volumes.

Recently, the attitude to intermodal terminals has shifted again. As several railroads were reaching the capacity limits of their facilities, new construction projects came under way. Santa Fe Pacific, for example, expects to complete its new $70 million facility in Willow Springs, Illinois (near Chicago) by the end of 1994. This terminal is designated to serving the adjacent major consolidation terminal being built by UPS, Santa Fe’s largest customer. In addition, Santa Fe is spending $100 million on the construction of another major facility in the Dallas/Fort Worth area. Norfolk Southern is planning a

brand-new terminal at the outskirts of Atlanta.\footnote{See Traffic World, "Intermodal terminals of the future will offer myriad of choices, demand careful planning", April 18, 1994.} As another example of terminal activity, Conrail is expanding its facility in South Kearney, N.J.

This brief analysis of the changing approaches to intermodal terminals leads to the question, how the trade-offs between revenue improvements (more terminals) and system efficiencies (fewer large-scale facilities) can be made on a rational basis. In other words, what should be the layout of intermodal hub-and-spoke systems? This question is highly relevant for both railroad and trucking firms. In the past, networks for both modes have developed in a competitive, or at least in an independent fashion. Now, in the age of intermodalism, where companies are partly integrating their operations, a fresh look at the overall network structure seems necessary. The case of the adjacent Santa Fe and UPS terminals points to the issue of how LTL carriers could use their newly gained intermodal freedom after the Teamsters agreement, given the complexity of their hub-and-spoke systems that can comprise up to 600 terminals.
5. Conclusion

Since the completion of the research for this thesis, intermodal has continued its phenomenal growth. In 1993, the intermodal volume exceeded the 7 million threshold for the first time. The 7.2 million trailers and containers that were moved by rail in 1993 represent an expansion of more than 7% over 1992. In the first 15 weeks of 1994 the growth has even accelerated. The Association of American Railroads reported an 11% increase in traffic over the respective period of 1993. These impressive figures prove the timeliness and relevance of research on intermodal.

As part of an ongoing research project on intermodal at MIT, the primary focus of this thesis was to provide an overview of the intermodal marketplace, rather than pursue a specific topic in greater detail. We identified the major stakeholders and their motivations for getting involved with intermodal. Further, we analyzed the impact of intermodal on the structure and performance of current single-mode industries, such as TL and LTL trucking. We feel that it is a contribution to the field that the strategic perspective on intermodal has been presented in a comprehensive fashion for the first time. Future researchers who will investigate more specific topics can access this thesis as a starting point in order to gain an understanding of the strategic issues underlying intermodal.

The second part of the thesis covered intermodal operations. Here, we raised a variety of issues that can serve as a stimulus for future research. These issues will be summarized below for the two major types of intermodal freight - landbridge services and domestic rail-truck service.

Landbridge Services

A promising and apparently neglected area of research is the interface between ocean carriers and railroads. For example, Wang (1993) who conducted a detailed analysis of
the service reliability of double-stack trains, did mention the intermodal transfer as a potential source for the delay of double-stack trains, but his quantitative analysis dealt solely with the rail part of the movement. Questions to be asked are:

- What is the service reliability of ocean vessels?
- How does it impact the overall reliability of the port-destination movement and of the full origin-to-destination movement?
- How is the interface between ocean carrier and railroad designed (coordination of vessel arrival/departure and stacktrain departure/arrival)?
- How should vessel and stack-train schedule be integrated?
- What is the impact of port-to-rail drayage on the transfer performance

A second timely topic of research would be to think ahead of Automated Equipment Identification (AEI). Assuming that it is going to be implemented, which new opportunities for the improvement (optimization) of systems performance arise from that?

**Intermodal Rail-Truck Service**

Again, the area of intermodal transfer, i.e. the interface between railroad and trucking, deserves particular attention. A set of questions similar to those about rail and ocean shipping for landbridge services could be raised. However, a topic specific to rail-truck service surfaced in the course of the research - network design/location analysis for intermodal terminals. Section 4.3 described the inherent trade-off between proximity to the customer and economies of scale in terminal and line-haul operation, which could motivate projects such as microstudies of local demand around rail terminals (How does demand change with distance from the rail terminal? How did it change after the railroads implemented their consolidation programs in the 1980's? What other factors impact the demand at a local level?) and ultimately lead to research on the optimal location of new facilities.
Appendix A: A Mind Map of Freight Transportation

In his course on freight transportation at MIT, Carl Martland presents to the students a general framework that he dubbed "mind map of freight transportation". This framework has proven to be useful not only for the analysis of case studies in 1.286, but for the purpose of this thesis as well. Thus, in the following we will first, briefly summarize Martland's main ideas and second, show what the "mind map of intermodal" looks like.

Martland states that it is the interaction of four major factors that shape freight transportation systems: carrier capabilities, shipper/customer choices, economic geography and, of course, the government. Carrier capabilities entail two fundamental aspects - a cost and a service function. Both are a function of the physics of transportation, of the network structure, of the equipment, of the information technology etc. In their combination, these system elements affect the movement of a shipment from its origin to its destination. The carrier incurs a certain cost for the shipment and provides a certain service level (represented by a trip-time distribution). Shipper/customer choices are made based on the type of shipment, its destination and relative price/service performance of different modes. The shipper is constrained in his/her choices by the origin location. Economic geography pertains to the location of people, markets, production, natural resources etc. Transportation networks link these geographically dispersed regions of production and consumption to each other. As a result, the demand for freight transportation needs to be looked at in relationship to overall trade at the national and international level. Finally, the government impacts the transportation system through the provision of the necessary transportation infrastructure, it issues economic and safety regulations, and it makes choices between the provision of financial support to transportation carriers and taxation.
How does this relate to intermodal? It relates to intermodal in that this mind-map allows to summarize several of the main ideas of this thesis from a different perspective than they have been presented in the main text.

**Carrier capabilities:** Railroads have remarkably increased their capabilities, both in terms of cost and in terms of service (see Section 3.1.1). New technology in the form of double stack has enabled shipping lines and railroads to offer innovative services (see 3.2). On the other hand, there has been no breakthrough in trucking technology that would change the cost-service curve as dramatically as double-stack did it for the rail industry. Hence, the relative capabilities of motor carriers declined vis-a-vis intermodal. (see 3.3).

**Economic geography:** The United States has gradually shifted the focus of its trade from transatlantic to transpacific. COFC and later double-stack were creative answers to the demand for high-quality transportation linking the Pacific Rim and the major consumption regions on the East coast of the United States.

**Shipper/mode choice:** With the increase in railroad and intermodal capabilities on the one hand, and rising costs of trucking on the other hand, cost-conscious shippers recognized the potential for intermodal. As service levels of intermodal increased, not just bargain-hunters, but a majority of shippers incorporated intermodal into their traffic portfolio (see Section 3.5).

**Government:** A major factor in the growth of intermodal was the deregulation of rail, trucking and ocean shipping in the 1980's. In that respect, the government contributed to intermodal development by not interfering with it. Since the 1991 enactment of the ISTEA, the government attempts to take a more active role in intermodalism. Financial support for the necessary infrastructure investments into the “connection points” (see 4.1) could facilitate further performance improvement of the intermodal system.
Appendix B: Selected Concepts of Strategic Analysis


At different places throughout the thesis, concepts and terms of strategic analysis have been used. For example, the five-forces model of industry analysis helps to understand J.B. Hunt’s move into intermodal. The abstinence of certain trucking firms from intermodal can be interpreted as a focus strategy. Options of railroads with respect to intermodal are structured by means of the value chain framework. Given this fragmented, but persistent surfacing of issues of competitive strategy, it is appropriate to summarize some of the most important concepts of this field in an appendix.

According to Porter “competitive strategy is the search for a favorable (profitable and sustainable) competitive position in an industry.” He sees two central questions underlying the choice of competitive strategy. First, there is the attractiveness of an industry for long-term profitability (not all industries offer equal opportunity for sustained profitability). Second, there is the question of competitive positioning within the industry.

With respect to industry attractiveness, the most commonly used framework is the five-forces-model. Exhibit B.1 below displays the five forces of supplier power, buyer power, the threat of substitutes, barriers to entry and the rivalry among competitors, and lists specific factors that determine the strength of each of those forces. The five forces collectively determine the profitability of an industry, because they influence prices, costs and required investments of firms in an industry - the elements of return on investment.
Exhibit B.1 Elements of Industry Structure: Porter’s Five-Forces Model

**Barriers to Entry**
- Economies of scale
- Product differentiation
- Brand identification
- Switching cost
- Access to distribution channels
- Capital requirements
- Access to latest technology
- Experience and learning effects

**Government Action**
- Industry protection
- Industry regulation
- Consistency of policies
- Capital movements among countries
- Custom duties
- Foreign exchange
- Foreign ownership
- Assistance provided to competitors

**Rivalry Among Competitors**
- Concentration and balance among competitors
- Industry growth
- Fixed (or storage) cost
- Product differentiation
- Intermittent capacity increasing
- Switching costs
- Corporate strategic stakes

**Barriers to Exit**
- Asset specialization
- One-time cost of exit
- Strategic interrelationships with other businesses
- Emotional barriers
- Government and social restrictions

**Power of Suppliers**
- Number of important suppliers
- Availability of substitutes for the suppliers’ products
- Differentiation or switching cost of suppliers’ products
- Suppliers’ threat of forward integration
- Industry threat of backward integration
- Suppliers’ contribution to quality or service of the industry products
- Total industry cost contributed by suppliers
- Importance of the industry to suppliers’ profit

**Power of Buyers**
- Number of important buyers
- Availability of substitutes of the industry products
- Buyer switching costs
- Buyers’ threat of backward integration
- Industry threat of forward integration
- Contribution to quality or service of buyers’ products
- Total buyers’ cost contributed by the industry
- Buyers’ profitability

**Availability of Substitutes**
- Availability of close substitutes
- User’s switching costs
- Substitute producer’s profitability and aggressiveness
- Substitute price-value

Source: Adapted from Michael E. Porter, *Competitive Advantage*, New York: The Free Press. 1985
A Division of Macmillan, Inc. Reprinted by permission.
The second central question in competitive strategy is a firm’s relative competitive position within its industry. Positioning determines whether the firm’s profitability is above or below the industry average. The fundamental basis for above-average performance in the long run is sustainable competitive advantage. In its pursuit of competitive advantage a firm can choose between two basic types: low cost or differentiation. These two types of competitive advantage combined with the scope of activities for which a firm seeks to achieve them lead to three generic strategies for achieving above-average performance in an industry: cost leadership, differentiation and focus. The focus strategy has two variants, cost focus and differentiation focus. See Exhibit B.2 below for details.

![Exhibit B.2: Three Generic Strategies](image)

In order to create or identify sources of competitive advantage, the firm as an entity needs to be conceptually disaggregated into its discrete activities such as design, production, marketing, delivery etc. The value chain (see Exhibit B.3) is the basic tool for doing so.
Exhibit B.3 The Concept of the Value Chain and its Activities

![Diagram of the Value Chain]

Source: This setup for the value chain was suggested by Michael E. Porter (1985), op. cit.

Figure 6-2. Definition of Activities in the Value Chain

<table>
<thead>
<tr>
<th>PRIMARY ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Inbound Logistics</strong></td>
</tr>
<tr>
<td>Receiving, storing, materials handling, warehousing, inventory control, vehicle scheduling, and returns to suppliers.</td>
</tr>
<tr>
<td><strong>Operations</strong></td>
</tr>
<tr>
<td>Transforming inputs into final product form (e.g., machining, packaging, assembly, equipment maintenance, testing, printing, and facility operations)</td>
</tr>
<tr>
<td><strong>Outbound Logistics</strong></td>
</tr>
<tr>
<td>Distributing the finished product (e.g., finished goods warehousing, material handling, delivery vehicle operation, order processing, and scheduling)</td>
</tr>
<tr>
<td><strong>Marketing and Sales</strong></td>
</tr>
<tr>
<td>Induce and facilitate buyers to purchase the product (e.g., advertising, sales force, quoting, channel selection, channel relations, and pricing)</td>
</tr>
<tr>
<td><strong>Service</strong></td>
</tr>
<tr>
<td>Maintain or enhance value of product after sale (e.g., installation, repair, training, parts supply, and product adjustment)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SUPPORT ACTIVITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Procurement</strong></td>
</tr>
<tr>
<td>Purchasing of raw materials, supplies, and other consumable items as well as assets</td>
</tr>
<tr>
<td><strong>Technology Development</strong></td>
</tr>
<tr>
<td>Know-how, procedures, and technological inputs needed in every value chain activity</td>
</tr>
<tr>
<td><strong>Human Resource Management</strong></td>
</tr>
<tr>
<td>Selection, promotion, and placement; appraisal; rewards; management development; and labor employee relations</td>
</tr>
<tr>
<td><strong>Firm Infrastructure</strong></td>
</tr>
<tr>
<td>General management, planning, finance, accounting, legal, government affairs, and quality management</td>
</tr>
</tbody>
</table>
Appendix C: Selected Concepts of Financial Analysis

Chapter 3 of this thesis presented the strategic perspective on intermodal freight transportation. In this context, it was not desirable to just verbally describe alternative approaches taken by intermodal stakeholders, but also to measure the impact of these decisions on the performance of individual companies.

We understand that performance measurement is a highly debated subject, in particular within the community of management accountants, but also within the field of transportation. Controversies arise as to what type of performance measures should be applied (financial versus non-financial versus balanced corporate scorecard) for which purpose (planning, operational control, motivation, performance evaluation).

In this particular case, the choice of performance measures was dictated by the type of information available to an outside analyst. Since most major transportation firms are public corporations, the answer was obvious - financial data from annual reports could easily be collected and then help evaluate the impact of intermodal on the financial situation of its adopters. This type of an analysis, called Financial Statement Analysis, commonly looks at two dimensions - risk and profitability.¹

The risk of a corporation is assessed both for the short and the long term. In the short term, liquidity, as measured by working capital (=current assets minus current liabilities) or the current ratio (current assets over current liabilities) is crucial. In the long term, the ability of a firm to meet interest and principal payments as they come due, is important. Financial analysts use various debt ratios (such as debt/equity, debt/total capital) for this purpose. While risk assessment would be an important part of a full-blown financial analysis, it has been consciously omitted in the “quick and dirty” calculations of Chapter 3.

Rather, we focused on the profitability of transportation carriers. In general, measures such as net profit margin (net income over revenue), return on equity (net

¹For details of the following discussion, please, refer to Stickney et al. (1991).
income over average equity) and return on assets (net income plus interest expense net of income tax savings/over total assets) serve the goal of profitability analysis. The major difference between the return on assets and the return on equity lies in the fact that the former "measures a firm's performance in using assets to generate earnings independent of financing activities", whereas the latter explicitly considers the cost of those financing activities. Further, value-related measures (such as market to book ratio, share price etc) and growth-related measures (revenues, asset size) are part of the portfolio of financial analysis.

From a transportation perspective, the single most important measure is the so-called operating ratio. The operating ratio is defined as the ratio of operating expenses to operating revenue, it is usually reported in percentages. Railroads use it as a benchmark and to set goals for the entire company. For instance, Norfolk Southern writes in its 1992 Annual Report that "the NS Rail operating ratio continues to be the best among the major railroads in the United States." In the case of Southern Pacific (SP), the operating ratio is even tied to the compensation of its President and CEO, Mr. Moyers. "If the company achieves an operating ratio of 89.5% for 1994, 88.0% for 1995 and of 85% for 1996, then Mr. Moyers will receive a stock bonus under the company's Equity Incentive Plan." 2

Given the attention that has been paid to the operating ratio in the three examples above, any financial analysis of a transportation carrier should incorporate a cross-industry analysis of this parameter into his or her research. Further, specific productivity ratios such as revenue per employee, revenue per tractor or revenue per trailer are commonly used to study labor and equipment utilization. Moreover, there are data (at least at the aggregate industry level) available that allow for a linkage between non-financial output and non-financial input, such as revenue-ton-miles per employee or ton-miles per freight train hour.

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Appendix D: Selected Concepts of Marketing Channel Management

(based on: Kenneth G. Hardy, Allan J. Magrath, Marketing Channel Management - Strategic Planning and Tactics, Glenview, IL: Scott, Foresman and Company, 1988.)

The Need for Distribution Channels

Producers need to market their goods and services to the final user. They perform this task using different channels of distribution, that are pathways to the market extending from the manufacturer or service provider to the ultimate consumer.

While manufacturers could theoretically attempt to sell all their products directly to the end-user, this method is generally neither effective (in terms of market penetration) nor efficient (in terms of marketing effort and associated cost). Therefore, most manufacturers or service providers delegate part of their marketing task to marketing intermediaries such as retailers, wholesalers, distributors and brokers that are broadly referred to as middlemen.

Value-added Activities in Distribution Channels

The members of distribution channels carry out a wide range of activities. One possible classification scheme distinguishes between transactional, physical and facilitating activities, as shown in Exhibit D.1. These activities fill gaps in form, time, place, and possession between the manufacturer and the consumer (Exhibit D.2).

Hardy and Magrath use the example of tennis equipment to highlight how channels of distribution provide form utility by overcoming both a quantity and an assortment gap. Manufacturers make tennis balls by the thousands, but consumers want to purchase only a few balls at any time. Hence, wholesalers and retailers buy in large quantities and break bulk into smaller quantities. However, consumers need more than just balls to pursue tennis. Thus, wholesalers and retailers also aggregate the customers’ desired assortment of tennis balls, racquets, presses, covers, shoes. Related to the concept of form utility is the theory of efficiency-of-exchange that suggests that the existence of middlemen reduces the number of transactions required to match supply and demand.

Regarding the other types of utility, one can think of the time gap between the customer’s desire to purchase the product on the spot and the manufacturer’s required delivery time, the difference in location between user and manufacturer, and the need for information, perhaps temporary credit, warranties etc. to complete the sale to the customer.
<table>
<thead>
<tr>
<th>Exhibit D.1</th>
<th>Activities in Distribution Channels</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Transactional Activities</strong></td>
<td></td>
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<tr>
<td>Buy products from sellers.</td>
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<tr>
<td>Promote products to customers in various ways (point-of-sales, advertising).</td>
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<tr>
<td>Absorb the risk of product ownership (inventory risks, obsolescence risk).</td>
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<tr>
<td>Price products for resale.</td>
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<tr>
<td><strong>Physical Activities</strong></td>
<td></td>
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<tr>
<td>Store the products.</td>
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<tr>
<td>Transport products from producers to consumers.</td>
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<tr>
<td>Sort and package the products.</td>
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<tr>
<td>Break bulk the products into smaller quantities.</td>
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<tr>
<td>Service and repair products.</td>
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<tr>
<td><strong>Facilitating Activities</strong></td>
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<tr>
<td>Assist with customer financing.</td>
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<tr>
<td>Grade product quality and label accordingly.</td>
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<tr>
<td>Provide market information.</td>
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<tr>
<td>Counsel customers on product use and maintenance.</td>
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<table>
<thead>
<tr>
<th>Exhibit D.2</th>
<th>How Channels of Distribution Create Utility and Fill the Gaps Between Manufacturers and Consumers</th>
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<tbody>
<tr>
<td><strong>Form Utility</strong></td>
<td><strong>Time Utility</strong></td>
</tr>
<tr>
<td><strong>Quantity Gap</strong></td>
<td><strong>Time Gap</strong></td>
</tr>
<tr>
<td>• Bulk breaking</td>
<td>• Storage</td>
</tr>
<tr>
<td>• Storage</td>
<td>• Inventories</td>
</tr>
<tr>
<td>• Packaging</td>
<td>• Warehousing</td>
</tr>
<tr>
<td><strong>Assortment Gap</strong></td>
<td>• Financing</td>
</tr>
<tr>
<td>• Order taking</td>
<td>• Expediting</td>
</tr>
<tr>
<td>• Accumulation or aggregation of an assortment</td>
<td></td>
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<tr>
<td><strong>Ownership Gap</strong></td>
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Selecting a Channel Strategy

In order to achieve their objectives of market coverage, sales growth and profitability, firms need to develop "a broad conception of how resources are to be deployed to build a channel (or channels) linking the producer to the consumer/user to ensure that the product and associated services are made available to the target market". In a nutshell, firms need to develop a channel strategy.

This strategy is typically based on choices made along four dimensions: variety, directness, density and novelty.

The decision about the variety and number of channels depends largely on the sales potential that is delivered by each channel. Akin to a window, each channel offers only a limited view at the market that might cover only specific regions or specific industries. Hence, if a manufacturer wishes to target the entire market, it might need to use multiple types of channels. On the other hand, using a wide variety of channels often results in considerable cross-channel member conflict because the different middlemen perceive themselves to be competing with each-other.

The second major choice entails how directly the firm should serve its end-customers (directness). Customer and product characteristics play an important role in that decision. If customers are few in number, large in purchasing volume, geographically concentrated and require intensive pre- and post-sale efforts, then direct sale presents a viable option. Product characteristics that favor direct sale are high complexity, infrequent demand and high gross-margins. On the contrary, products that are less technical, ordered frequently and in low volumes by small, geographically disperse customers, are more feasibly reached with indirect channels. That is the case with most consumer products. In addition to direct sale and exclusive use of middlemen, there is a third option, dual distribution, that combines direct sale with the use of middlemen. Here, volume-per-end-user-account is a key determinant for the directness of the marketing effort. Typically, large accounts will be served directly, medium-size accounts will be visited by the middleman, and small accounts will have to contact the middleman themselves.

However, there are also considerations of corporate strategy that influence the directness of distribution. The more direct an approach is to a consumer, the more control the producer has over functions such as marketing, selling, service and pricing. With a direct approach, communication and the exchange of information between buyer and seller tend to be very clear. On the other hand, if a manufacturer incurs the cost of performing all distribution functions, it also foregoes the opportunity for more profitable alternative uses of that capital.
After a manufacturer has decided on the variety and directness of the desired channels, it must decide the density of coverage that the channel network should achieve. Three broadly defined systems are normally considered: In an exclusive distribution system, the manufacturer could sell to few outlets in specific channels, thereby possibly restricting market coverage, but ensuring better compliance by the middlemen with the manufacturer's strategy. The middlemen appointed exclusively, is often prohibited, by agreement, from selling competitive products. Non-exclusive systems are categorized into selective and intensive networks, depending on the number of middlemen and the degree of overlap among them in a given territory. Stereos are an example for the former, whereas candy and cigarettes fit the latter category.

Because many distribution systems take years to evolve, manufacturers often use well-worn, familiar pathways to reach end-customers. However, a manufacturer may choose to set up or utilize a novel channel of distribution. An example was provided by the emergence of catalog stores. But, new channels are frequently met with hostility by incumbent channel organizations that do not want suppliers to sell to the new entrants, since the development of new channels may reduce profits for the incumbents.

The Concept of a Distribution Channel Life Cycle

Most technologies tend to appear, grow in sales or influence, then decline in sale, and are eventually displaced by newer products. These different stages of product evolution form the well-known product life cycle (PLC).

The PLC framework is typically depicted as an S-shaped curve for product category sales over time. Marketers divide the curve into phases denoted as embryonic, growing, mature and decline. While partitioning and naming tend to be somewhat arbitrary, marketers usually link these stages with particular required marketing activities, expenditures, types of competition, and outcomes such as revenues and profits.

The PLC concept is also important in managing channels of distribution. In the embryonic stage of a product category, the distribution tasks often focus on making the product available and explaining the product to target customers. As the product category matures, the end-customer group tends to become broader and more familiar with the product and its uses. Thus, the distribution tasks tend to shift from those of introducing, selling, applying and adapting the product to simply having it in stock, fulfilling orders for it, and handling product returns. Accordingly, specialized middlemen tend to give way to less-specialized and less-aggressive middlemen that simply supply the product. For example, personal computers were once considered too technical for any retail channel except a computer store. As acceptance of computers grew, however, and the
product moved along its life cycle, other, less specialized, retailers such as department stores began to sell computers. Today, PCs can even be purchased through mail order.

These observations support the thesis that there is a life cycle in channels, just as there is one in products. Certain channels, once predominant in the sale of various products, are of only minor importance today or not even exist. Conversely, some channels that were once minor in importance for certain products are today the biggest pipelines to the market. Without getting into the details of how to match competitive strategies to the channel life cycle, one can derive an important lesson: Smart companies change their channels and their channel management over time.
Appendix E: Maps of Carrier Service Networks

Railroads
Burlington Northern
Chicago & Northwestern
CSX Transportation
Norfolk Southern
Santa Fe Pacific
Southern Pacific
Union Pacific

Trucking
J.B. Hunt Transport Services

Ocean Shipping
American President Lines
The J.B. Hunt Network

Sales Offices:
- Montreal, Quebec
- Toronto, Ontario
- Monterrey, Mexico
- Mexico City, Mexico
- Nuevo Laredo, Mexico
- San Luis Potosi, Mexico
- Vancouver, British Columbia

Terminals:
- Atlanta, Ga.
- Chicago, IL
- Dallas, Tx.
- Detroit, Mi.
- East Brunswick, N.J.
- Houston, Tx.
- Hueytown, AL
- Kansas City, Mo.
- Laredo, Tx.
- Lathrop, Ca.
- Little Rock, Ar.
- Louisville, Ky.
- Lowell, Ar.
- Memphis, Tn.
- Oklahoma City, Ok.
- South Gate, Ca.
- Springfield, Oh.
- Syracuse, N.Y.

*Lowell, Arkansas
Corporate Headquarters

Terminals
Shuttle Yards
Sales Offices
Ramp Cities
Santa Fe
Burlington Northern
Southern Pacific
Florida East Coast
Union Pacific
Conrail
Wisconsin Central
Norfolk Southern
Canadian National
EXPANDED INTERMODAL SERVICES

- Largest stacktrain system in North America.
- APL dedicated inland terminals for greater delivery reliability.
- APL managed trucking in major cities, for single carrier control.
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132


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