Transportation and Logistics

Marvin L. Fair
Ernest W. Williams, Jr.

Transportation and Logistics

Marvin L. Fair, Ph.D.
Professor of Transportation Emeritus
Formerly Director
Transportation and Logistics Program
The American University

Ernest W. Williams, Jr., Ph.D.
Graduate School of Business
Columbia University

1981 Revised Edition

BUSINESS PUBLICATIONS, INC. Plano, Texas 75075
Irwin-Dorsey Limited Georgetown, Ontario L7G 4B3

Previous edition of this book was published under the title *Economics of Transportation and Logistics.*

ISBN 0-256-02308-5
Library of Congress Catalog Card No. 80-69962

Printed in the United States of America

1 2 3 4 5 6 7 8 9 0 MP 8 7 6 5 4 3 2 1

TRANSPORTATION AND LOGISTICS

Preface

When the first edition of this book was written, the theory and practice of business logistics had been undergoing rapid development for several decades. The increase in course offerings in logistics suggested the desirability of change in the basic transportation course. The principles of transportation as conventionally taught appeared to require a tie with the principles of logistics. Thus the first course could establish a background for both fields and explore the relationships between them. The resulting treatment relates transportation cost and service to the economics of total flow in the conduct of commerce. It also provides a more adequate frame of reference for the study of business and community logistics. The plan adopted in the first edition is continued here.

Among social scientists there is a rising tide of interest in the economics of regional development and the importance of spatial relations in determining not only the extent of markets and scale of production, but also the social and political relationships in metropolitan areas, regions, and nations. This book is designed to explore these relationships more effectively. Not only does it expand the treatment of transport in relation to economic development, but it adds urban transport to the range of subject matter surveyed.

Interest in materials management and physical distribution, both of which can be encompassed within the term *business logistics*, has mounted in the business world. Indeed, logistics may be regarded as the latest revolution in scientific management, comparable to the earlier ones in production and merchandising. Control of total cost and time in the physical flow of orders and deliveries has given us a new business profession. Schools of business increasingly recognize logistics as a prime business function along with production, finance, and marketing. Accordingly, the literature of the subject has expanded rapidly.

Transportation will remain the primary function and major source of cost in physical distribution. Unlike most other aspects of logistics, much of it will remain outside the direct control of the distribution man-

ager and deeply entwined with public policy. Hence an adequate understanding of the economics of transportation, including both rates and services, is most essential for management training in this area. It is of equal importance for those preparing for the expanding and changing field of carrier management. Once the student is fully embarked upon the methodology of distribution systems management the complexities of transport procurement and policy tend to move into the background. A solid beginning with transportation, therefore, helps to establish a firm foundation for advanced work in logistics principles.

This book preserves the across-the-board treatment of the several transport modes with respect to the economics of rates and service which has tended to replace separate modal analysis. It well-nigh eliminates the historical approach to transport. It encapsulates the development and substance of regulation in a single chapter. Most important, it endeavors to describe the functions of business logistics and the way logistics managers relate them to transportation realities in decision making. The effects upon carriers that flow from the changed emphasis which the logistics discipline has brought to the carriers' customers appear in the examination of carrier performance.

The present edition has been greatly affected by the changes in the plan of economic regulation which have occurred in the past five years. The reduction in regulatory control over rates and the emphasis that is placed upon the competitive making of rates today has made discussion of rate structures and the regulation of intercarrier competition mostly of historic interest. Hence the chapters that dealt with these topics have been deleted. The treatment of the structure and substance of regulation has been brought up to date to include the motor and rail acts passed this year and early steps for their implementation.

MARVIN L. FAIR
ERNEST W. WILLIAMS, JR.

Contents

1

The Transport System of the United States: Its Importance, the Saga of Its Development, Its Competition

IMPORTANCE OF MOVEMENT CAPABILITY

The economic, political, and social progress of any group, whether nation, region, or community, depends upon reduction of the inconvenience and cost of overcoming space. All of Man's activities are involved. Accordingly, movement capability has always occupied center stage in human experience whether for prehistoric or modern Man. Transportation and logistics are the institutions designed to provide movement capability.

The raft, the canoe, the sledge, and the wheel were prehistoric Man's greatest inventions. Historical Man has continued to give major emphasis to improved transportation. Yet today our advanced western society finds itself deeply concerned with the advancement of movement capability without harmful ecological effects, the relief of congested airports and streets, and the development of coordinated transportation service and logistics systems that deliver what is needed for defense or business at the right time and at lowest practical cost. For the transportation of people we add convenience and comfort to time and cost. To minimize time and cost, transportation routes between points tend to be in a straight line unless natural barriers including mountains, swamps, bodies of water, congestion, and unfavorable winds interfere. Therefore, time and cost are the true dimensions for overcoming space, and the actual distance may be incidental.

In economics, transportation is considered a part of production because it creates place utility. Goods must be brought from where na-

ture provides them or people produce them to where they are consumed. The larger the country and the more advanced its economy, the more extensive its transport system must be. Our nation is among the largest and has by far the most extensive economy in terms of both production and consumption. To provide the necessary movement capability, the United States requires a transport industry that dwarfs that of any other nation and directly and indirectly exacts $400 billion a year or 20 percent of the Gross National Product in pay for services performed. This relationship has held true for more than 20 years.

THE AMERICAN TRANSPORTATION SAGA

The history of the United States is a study in the conquest of spatial relations. Settlers came to a vast continental area which became the United States with 3,000 miles across and 1,500 miles north and south. They were confronted on both the east and the west with mountain ranges that paralleled the coast lines. Only the St. Lawrence and the Mississippi river systems provided access to the vast interior free of mountain barriers. For that reason, penetration of settlers inland from the Atlantic and Pacific coasts was for many years limited to the rather short river courses between the mountains and the oceans. In the meantime settlements by the French via the St. Lawrence and Mississippi were made along the Great Lakes and the midcontinent area.

The Beginnings

Until the 19th century, reliance for transportation was on sailing boats along the coast; rafts, dugouts, and keel boats on the rivers; and on land either carts or wagons on dirt roads and pack horses and mule trains for cross-mountain transportation. For two and one-half centuries the colonists struggled with primitive transportation facilities. The only relatively economic services were those of coastal sailboats and downstream rafts; but in the last decade of the 18th century, turnpikes and canals made their appearance. The next chapter of the saga was that of intense activity in surfacing main highways to permit year-round availability and to reduce wagon and stagecoach costs and the building of canals to circumvent rapids and to connect navigable rivers. Later longer canals were built to parallel rivers and tributaries. In contrast to flowing rivers, canals provided two-way economic water transportation. Beginning in the mid-1790s, short canals were built to circumvent rapids and to connect navigable rivers in New England, New Jersey, Pennsylvania, and South Carolina. Longer canals to parallel rivers and tributaries followed after 1825 in both the eastern and middle western states. Four of these extended canals were projected to cross the Appalachian mountain range to connect the

developing seaboard with Ohio River valley and Great Lakes settlements. These were in order of completion: the Erie Canal, 1825; the Pennsylvania Public Works, 1834; the Chesapeake and Ohio Canal to Cumberland, Maryland, 1850; and the James River Canal completed to Buchanan, Virginia in 1856.

The Erie Canal was one of the two which was completed as projected and was by far the most successful. Favorably situated between the chain of Great Lakes and the extensive tidewater Hudson, it provided a new level of economic transportation between the developing Great Lakes region and the growing metropolis and seaport of New York. The success of the Erie was enhanced by a number of lateral canals constituting an extensive statewide system. The Pennsylvania Public Works was completed from Philadelphia to Pittsburgh, but it involved railroad operation to Columbia on the Susquehanna, canal to Hollidaysburg, portage railroad over the mountain to Johnstown, and canal down the Conemaugh and Allegheny rivers to Pittsburgh.

The Chesapeake and Ohio and the James River canals stopped at the foot of the Appalachian Mountain barrier because locomotive-powered railroads by midcentury had shown their superiority to the portage railroads that had been projected to surmount the mountains. The Chesapeake and Ohio Canal system was planned to go to Pittsburgh via a canal along the Monongahela, and the James River Canal was to reach the Ohio River via a canal along the Kanawha River. That over 40,000 miles of canals were built before 1850 in relatively elevated topography shows the determination and initiative of a people anxious to make of this a great country and convinced that transport was the first essential.

The need to improve principal roads for better wagon and stagecoach operation was apparent because passenger and mail service largely relied on the stagecoach. Canals were slower and did not give direct service between many commercial centers. So beginning in the 1790s, between Lancaster and Philadelphia, Pennsylvania, many post roads were surfaced with macadam, including the Cumberland Road from Cumberland, Maryland, to Vandalia, Illinois, started in 1811 and completed in 1836. While the individual states largely financed the canals and the shorter turnpikes were private enterprises, the Cumberland Road was a federal enterprise. Not until almost a century later was the federal government again to become a major factor in highway construction because reliance was placed on steam railroad development prior to the age of automotive transportation.

Steam-Powered Transportation (Railroads and Steamboats)

It remained for the railroad to provide the facilities to open up the productive and commercial potential of this vast country, although

steamboat transportation stimulated some areas before the railroads developed. The first practical use of the steam engine in transportation was in watercraft. Beginning in the first decade of the 19th century, use of the steamboat rapidly spread in the second decade to the eastern tidewater rivers, the Mississippi system, and the Great Lakes. Its early development was contemporaneous with the early turnpike and canal development but in no way interfered as a competing transport service. In fact it further stimulated canal building which would connect the larger navigable rivers with the Great Lakes. Steam packets providing economic two-way transportation greatly stimulated commercial development along the water routes they served. New Orleans, as the chief outlet for the commerce of the Mississippi River system's midcontinent area, quickly became the principal city on the Gulf Coast. The decade of the 50s was the peak period for river steamboat transportation. Over 3,500 steamboats arrived in New Orleans in 1850.[1] The limited size and slow movement of packets on circuitous rivers caused them gradually to give way after 1850 to rail competition. On the Great Lakes, however, the opening up of the St. Mary's Channel to Lake Superior and the discovery of the Mesabi iron ore resources to feed the expanding steel industry started a whole new era of large steamship transportation on the Great Lakes in midcentury.

Steam railroad transportation was begun in 1830 by the Baltimore and Ohio Railroad between Baltimore and Ellicott City, Maryland, a distance of 12 miles. A crude little vertical-boiler engine known as the "Tom Thumb" began the great age of railroads in the United States. Railroad construction elsewhere followed quickly: in 1831 between Charleston and Hamburg, South Carolina; and in 1832 between Albany and Schenectady, New York; between New Orleans and Lake Pontchartrain, Louisiana; and between Philadelphia and Columbia, Pennsylvania. New Jersey's Camden and Amboy connecting the New York and Philadelphia areas and several short railroads in Ohio were built in the early part of the same decade. The railroad fever spread rapidly from state to state. It was not until the decade of the 50s that improved technology of the new mode of transportation, and the extension and combining of early short lines, enabled the railroad to demonstrate its clear superiority over the canal boat and the steam packet for freight, and over the stagecoach for passengers as well. It is interesting to note that the decade between 1840 and 1850 was the decade of great canal building in spite of the fact that an ultimately superior mode had been discovered in 1830.

The saga of the expanding railroad system and its interaction with a growing national economy perhaps has not had a parallel in modern

---

[1] F. H. Dixon, *Traffic History of the Mississippi River* (Washington, D.C.: U.S. Government Printing Office, 1915), p. 5.

history. The 9,000 miles built between 1830 and 1850 were extended to 30,000 miles in 1860. The acceleration of railroad building prewar in the north gave the Union side a great advantage in military logistics which in time proved decisive. Aided by federal land grants, homesteading, and significant development in railroad technology, the postwar period experienced a railroad expansion that has remained unequaled. From 53,000 miles in 1876, the network expanded to 163,000 in 1890. In the meantime track gauges had been standardized and connected for through service. Steel replaced iron rails and the airbrake replaced the hand brake, permitting heavier and faster trains.

Railroad construction was paralleled and fed by a comparable expansion of industry, commerce, and population. In the words of a leading historian of the period: "In four great provinces bound together by ever-constricting ties of federation—manufacturing, extractive industries, transportation, and finance—the leaders of business enterprises . . . marched from victory to victory in the decades that followed the triumph of Grant at Appomattox."[2] Almost all the trunk lines were established by 1890, but network expansion continued until the early 1920s when the mileage reached a peak of over 250,000.

Because of growing competition of other modes, railroad mileage has declined since and is presently about 190,000 miles. The once extensive intercity passenger traffic has been very largely lost to air transport and the bus and motorcar. Break-bulk less-than-carload traffic has all but disappeared. Although strengthened by dieselization of its motive power and aided by consolidation, the industry is facing a precarious future; yet it remains the largest carrier of freight in terms of ton-miles.

The 20th-Century Competitors

After 75 years of dominance and 50 of actual monopoly, the railroad industry in the second quarter of the 20th century was confronted with the beginnings of four new major modes of transportation. Two were new versions of earlier forms (highway and inland water). Another, the pipeline, resulted from the technological transformation of a hitherto rather primitive mode, while air transport belongs entirely to the 20th century. Collectively they were to have an enormous impact upon the railroad system, on the mobility of people, and on the locational structure of the economy. They were to give rise to problems of public policy altogether more complex than those which had ruled the railroad era. Each, moreover, was to be developed separately from

[2] Charles A. Beard and Mary R. Beard, *The Rise of American Civilization*, vol. 2 (New York: Macmillan Co., 1941), p. 176.

the others so that more nearly a structure than a system of transport emerged.

By the late 20s highway development had proceeded sufficiently and the technological development of motor vehicles had imparted enough carrying capability and efficiency to enable motor transport to assume importance in local and short-distance transport, both passenger and freight. By the late 30s the truck and bus had become strong competitors over longer distances and the stage was set for a nationwide network of high-quality motor transport.

Although steamboat transportation on the rivers had succumbed to rail competition, barge operations developed in bulk commodities on portions of the river system, notably in the movement of coal on the Monongahela and Upper Ohio rivers. Revived attention to waterways improvement in the 20s enabled such operations to extend over the whole of the improved inland and protected coastal waterways system. American operators pioneered the shoved tow, applied the diesel engine to towboats of large horsepower, and built a capability for moving tows which, today, sometimes reach 40,000 tons at costs well below those achieved by railroads in the movement of bulk commodities. At several periods since 1950 barge transport has been our fastest growing mode.

The Tidewater Pipe Line had been built in 1879 to pump crude oil from western Pennsylvania fields to Philadelphia. Long-distance pipelining of crude developed slowly, however, and only gradually ousted the tank car from the business. Not until the 1920s was the technology of moving refined products in pipelines worked out. Pipe diameters were gradually increased, the 12-inch lines which were large in the 30s being supplemented since 1950 by lines ranging up to 48-inches in diameter. Steam gave way to diesel as power in pumping stations; then the remotely controlled electrically propelled centrifugal pump commenced to take over. Not only were the railroads displaced from the movement of crude and refined petroleum but even the coastwise tanker gave way in part to long-distance pipelining of products.

In the present century no form of transport has captivated the public as has air transportation. Commercial operations began in the late 20s. After 1950 air transport rapidly replaced the railroad in the long-distance movement of passengers and, with the advent of jets, quickly moved into position of the nation's major commercial passenger carrier. While still a small factor in the freight market, air cargo is also rapidly growing and the speed of air transport has opened up new opportunities for the marketing of perishable and high-value goods.

Deepwater Shipping

Unlike the steam packet on the rivers, the larger steamships on the Great Lakes and in deep-sea coastal service proved able to compete