TRANSPORTATION:

Principles and Perspectives

Edited by

STANLEY J. HILLE

and

RICHARD F. POIST, JR.

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PREFACE

This book of text and readings is designed to supplement one of the basic texts in transportation or to stand alone for a transportation course at the elementary level. While coverage cannot be complete, an attempt to be comprehensive is made. Areas of coverage include articles about the modes and accessorial users of transportation from the points of view of carrier representatives as well as outsiders. Then the all important role of pricing in a derived demand, complex environment is discussed. This discussion naturally flows into regulatory constraints on pricing and operations as well as promotional activities which have evolved over the years, which in turn, have developed into national policies for the various transport modes. Next, a discussion of the problems inherent in urban transportation is given since the great transportation bottleneck and wastes occur in this area. Finally, a look at special areas of interest is provided for it is from these areas that new policies regarding transportation evolve. This final area also includes a section which describes key elements in the transportation purchasing decision by the firm.

While the cooperation of numerous parties is required in the preparation of such a volume, we wish to express special appreciation to our colleagues in transportation education for their encouragement and aid in this endeavor. Likewise appreciation is expressed to the publishers and authors for permission to reprint the enclosed articles. The basic sources from which articles were drawn include American Legion Magazine, Distribution Worldwide, Fortune Magazine, Handling and Shipping, Journal of Marketing, Labor Law Journal, Land Economics, MSU Business Topics, Public Utilities Fortnightly, Railway Age, Transportation and Distribution Management, Transportation Journal, and Transportation Research Forum, as well as the publications of national trade associations representing transportation.

It is the sincere hope of the authors that this book will introduce the transportation student to some of the problems and excitement of this most vital and pervasive industry.

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INTRODUCTION

Transportation has long been studied at the college level. It is many times found in economics departments or in colleges of business administration. Geographers conduct special courses in transportation geography, and transportation specialties are developing in departments of civil engineering in such areas as design and policy. What is it, then, that makes transportation worthy of study apart from other subjects and disciplines? Certainly, there must be some distinct reasons for the amount of attention that it receives from educational, governmental and private bodies. These reasons will be explored in the following sections.

TRANSPORTATION REDUCES BARRIERS TO TRADE AND PROMOTES SPECIALIZATION

If no transportation between communities existed, each would have to be self-sufficient. That is to say, it would have to provide its own agricultural as well as manufactured products. Therefore, cottage or home industries would prevail; a barter economy would likely exist, and the standard of living would be minimal since man would be devoting full-time to providing the basic necessities of life. When advanced transportation is introduced, the picture changes. The following example demonstrates this phenomenon under the simplifying assumption of two self-sufficient, two-product economies. Suppose that Economy I and Economy II produce one unit of A and one unit of B for $1.00,

Economy I		Economy II
Product A--60¢/unit Product B--40¢/unit		Product A--40¢/unit Product B--60¢/unit
2 units = $1.00		2 units = $1.00

but at differing costs as described above. If a new road is built between these two economies which will haul goods for 5¢ per unit, then Economy I will specialize in Product B and Economy II will specialize in Product A. As a consequence, one unit of each product can now be purchased in each economy for a cost of 85¢ thereby leaving 15¢ (7-½¢ per unit) to devote to other matters. See example below.

Economy I		Economy II
2 units of Product B Produced for 80¢	← Transportation 5¢/unit of A or B →	2 units of Product A Produced for 80¢

Consumption

Economy I		Economy II
1 unit of A = 40¢ + 5¢ transp. = 45¢		1 unit of A = 40¢
1 unit of B = 40¢		1 unit of B = 40¢ + 5¢ transp. = 45¢
Cost of goods consumed = 85¢		Cost of goods consumed = 85¢

Further reductions in the cost of these products might occur because of economies of scale due to increased specialization and large quantity production. Transportation thus allows the individual producer to achieve economies of scale in reaching distant markets by substituting transportation costs for lowered costs of the other factors of production (i.e. land, labor, capital).

The effects of economies of scales and the benefits from transportation do have limits or else production would be even more highly specialized as to geographic area than they are today. For example, costs of holding goods in inventory are limiting. Since transportation takes time, goods must be held in transportation vehicles during the period they are being moved. These inventories require an investment in goods that have costs, namely financial, obsolescence and deterioration. The transportation mode or media also has a variability in performance which requires an accumulation of goods at either end of the "pipeline" to allow for uninterrupted availability of the product. Likewise, variability in demand in different markets accounts for inventory accumulation. In some cases, inventory overlap exists in that goods accumulated to meet one contingency will partially serve to meet another. Nevertheless, these inventory carrying costs do significantly offset benefits of cheaper transportation. Thus, it can be seen that improvements in reliability and speed of transportation may have as an important effect on transportation benefits as reduction in transportation movement costs, because improved reliability and speed reduce inventory holding costs. It should also be noted that the more valuable the commodity, the more important it is to keep inventories low since capital resources are invested in inventories.

At a certain stage, additional transportation costs are greater than production savings since economies of scale decrease after a sizeable factory has been constructed. In fact, actual diseconomies of scale may be reached at some point. This point where additional transportation and inventory costs are equal to the economies of scale sets the theoretical limit to a market. While increases in transportation productivity may add to this market and/or lower costs, these improvements become less important to the overall unit cost of the product as the service reaches a very high level of performance.

LAND TRANSPORTATION ROUTES FOLLOW THE PATTERN OF LEAST RESISTANCE

If one could produce a set of historical snapshots with regard to land transportation routes throughout the world, the snapshots would show an unusual similarity to one another over the centuries. Animals followed the "paths" of least resistance in their journeys. These paths would minimize elevational changes as well as finding the narrowest, shallowest, and calmest river or stream crossings. Water and food were also abundant along streams. Mountain passes were selected as crossing points over rugged terrain. Man followed his prey along these routes and later, he built roads along the paths, still later railroads and paved highways. The road builders straightened and graded, but essentially followed these same paths.

ADVANCED TRANSPORTATION CREATES CITIES

Exchange of goods or the passing of ownership normally took place when toods were being transferred from one means of transportation to another. Physical exchange and ownership change have often taken place simultaneously. This exchange of goods was one of the main reasons for the growth of early

cities and towns. The other aspects of commerce such as finance and government followed. As population grew, other services based on this population and only indirectly related to trade sprang up. Most U.S. cities reflect this pattern of growth with the possible exceptions of governmental cities such as state capitals. Even these were influenced by transportation to the extent that they were often centered within state boundaries to minimize travel time. The great East Coast cities of Boston, New York, Philadelphia and Baltimore were built at the head of ocean navigation. Chicago was the place where land transportation facilities merged to go around Lake Michigan or where trans-shipment took place between surface and lake modes. Detroit, Cleveland and Buffalo have similar origins. The West Coast cities of San Diego, Los Angeles, San Francisco, Portland and Seattle are all notable ports as are the Gulf cities of Savannah and New Orleans. Minneapolis and St. Paul are at the head of Mississippi navigation. Other river towns grew because of a crossing of land and water transportation routes; e.g., Cincinnati, St. Louis, Omaha and Kansas City. Perhaps the largest land crossroads city in the United States is Denver, Colorado.

Transportation not only helped locate cities. The cities in turn further developed transportation. The heavily travelled routes soon became the best maintained, and therefore the cheapest for travel or freight movements; and hence, further increased the size of some cities. In other words, there are also economies of scale in transportation.

The very shape of cities is influenced by its transportation corridors since transport routes provide access to people and land. Thus, we see residences and businesses located along these corridors. In addition, the more developed the transportation corridor the further the people can live from their place of employment and the further heavy land-use industries can be located away from their urban customers. The further from the center of the city the cheaper the land and the more expensive transportation costs. People trade off transportation costs against housing and building costs. The same phenomenon exists for land consuming industries such as warehousing and trucking terminals. When a new highway opens a commercial area, trucking firms and warehouses find that it is profitable to move out where land is cheap enough to allow for convenient one-story operations plus allowing plentiful space for parking and maneuvering vehicles. Many factories have also followed this pattern.

As people and jobs moved out from the central city, the demand between peripheral areas created the need for beltways as well as other outlying cross-town highways. These new highways, in turn, allow for the building of the satellite cities. The Downtown Central business District (CBD) itself became more specialized for those managerial and office positions which needed face-to face contact. This development was aided by vertical transportation; i.e., the elevator.

TRANSPORTATION REQUIREMENTS INFLUENCE INDUSTRY LOCATION

A German location theorist by the name of Alfred Weber developed some theories which help us explain the location of many industries. He pointed out that goods which are localized in nature; i.e., found only in certain places, will force industry to locate at the source of the raw material, at the market, or somewhere in between. Goods which incorporate ubiquities (i.e., goods found nearly everywhere in abundance such as water or air) into their final product will be manufactured near the point of consumption since it is not rational to transport products unnecessarily. Consequently, such industries as soft drink

bottling companies are located in or near the consuming market. Weber also indicated that localized products which lose weight will draw manufacturing to the source of the raw material. Thus, heavy users of fuel such as steel or aluminum manufacturing must be near a source of cheap fuel or power -- all of which is used up in the manufacturing process. Even those steel mills which are near a market or located near cheap labor must be on a cheap water transportation route.

ADVANCED TRANSPORTATION REDUCES SOCIAL AND POLITICAL BARRIERS

Trade has created the opportunity for contact between people. It is not surprising then that urban dwellers of one region of the United States are very much like those of others. Mobility and face-to-face contact has created these great similarities. In fact, the early building of railroads across the Great Plains was as much an effort to weld the country together as it was an economic investment. Today, it is less of an effort to travel to Europe than it was 100 years ago to travel 100 miles. This increased contact has allowed increased size of economic trading units. Witness the development of the European Common Market as well as other trading blocs.

Fast and efficient transportation has also had certain drawbacks. Speed of missiles, airplanes and supporting transportation have allowed ever larger and more terrible confrontations between various warring groups spurred by the most primitive desires for territory or economic gains. Disintegration of communities has occurred as a consequence of their puncture by new transport routes, and even disintegration of families has been caused at least in part by the instability resulting from increased mobility.

It should be realized that while advanced transport facilities have helped build nations, win wars, and improve economic efficiency, transportation is as much a bi-product of developing economies as it is their creator. Thus, growing economies will demand new airports, highways, rail facilities, etc., as well as these facilities providing a stimulus for further economic growth. Certainly, advanced transportation is an integral part of an economy's every fiber.

TRANSPORTATION PERMEATES ALL OF SOCIETY

Transportation is both a producers' and a consumers' good. Whenever transportation is employed in the productive process, it is a producers' good. Freight movements along the channel of distribution are, therefore, examples of transportation being employed in this manner. Transportation is a consumers' good whenever it is employed as an end product in and of itself as an instrument of direct consumption, e.g., a football fan going to the big game or a family on a Sunday afternoon outing.

It can be seen then that transportation must of necessity occupy a high national priority since it not only affects our personal mobility but its efficiency directly affects the prices of the goods we buy.

TRANSPORTATION AND THE ENVIRONMENT

Modern industrial society has had detrimental side effects from its productive processes. Transportation is not excepted. Oil refining for

transportation has created air and water pollution. The greatest single air polluter in the United States is the internal combustion engine while noise pollution near highways, rail yards and airports is "deafening" to say the least. Special laws have been passed to clean up the internal combustion engine while airframe manufacturers are being forced to clean and quiet down jet engines. Much still remains to be done. New forms of power, mass transit and energy saving sources of power may have to be developed if this gradual degradation of our environment is to be prevented.

Environment is, however, broader than these three discussed areas. Webster's Third New International Dictionary defines environment as, "the surrounding conditions, influences, or forces that influence or modify: as (a) the whole complex of climatic, edaphic, and biotic factors that act upon an organism or an ecological community and ultimately determine its form and survival -- compare habitat; (b) the aggregate of social and cultural conditions (as customs, land, language, religion, and economic and political organization) that influence the life of an individual or community."

Transportation, when taken in this broader context, has indeed been influential upon the environment. Roads have opened up new communities to development, thereby assisting first in the development and later in destruction of farmlands, wetlands, wildlife sanctuaries as well as improving the economy. New transportation facilities can influence community organization by dividing it with ribbons of concrete or unite it to other communities. It is little wonder then that as economies have grown, developed and become affluent, concerns have been directed toward transportation's detrimental by-products. All costs, environmental as well as economic, must be borne by future transportation projects if they are to gain public approval.

TRANSPORTATION AND THE ENERGY CRISIS

Dependence on petroleum by an auto-oriented society has helped create an energy crisis. Domestic oil production can no longer supply our growing energy needs. Lesser developed countries' energy needs will grow even more rapidly than the developed economies and therefore, create a world-wide petroleum shortage by the mid 1980s. Moreover, ecological concerns have accelerated the energy problem by creating a need for cleaner fuel for industrial purposes. A switch from coal to petroleum has resulted. Auto emission controls have also increased consumption of gasoline. The development of nuclear energy has also been slowed, because there have been concerns for safety as well as its by-product of heat pollution in our lakes and streams. Moreover, a shortage of nuclear fuel may exist by the turn of the century in spite of work on fast-breeder reactors. Energy created by geo-thermal (ground), sun, wind and tides will fill but a small portion of our energy needs. Therefore, an effort the equal of our space program, must be launched to develop new sources of energy such as that created by controlled nuclear fusion if an increased world-wide standard of living is to be supported. Energy conservation in personal and public transportation also is a must. We can only hope that our nation's attention will be focussed on this most crucial energy problem which affects transportation as well as other industry. A world-wide depression and political conflict would surely result from our neglect. Witness the Middle-East's many crises. Over-dependence on foreign energy sources subject the Western World to the most flagrant forms of political and economic blackmail.

TRANSPORTATION IS A SERVICE INDUSTRY WITH UNIQUE QUALITIES

Transportation is a service. Consequently, it has some of the characteristics of other service industries. For example, it must be located where there is demand, and is largely a derived demand by nature. That is, demand for transportation is derived from demand for other goods and services.

Transportation also has some special characteristics shared only by public utilities. For example, transportation performs its activities over a special area. When the movement ceases, transportation no longer exists. Other services attempt to change a product or make it perform better; transportation does not. In fact, if goods are changed (broken, lost or stolen) during a movement, transportation companies have failed to adequately perform their duties. On the other hand, the automobile service station will add gasoline, oil, tune-up the engine, etc., to (hopefully) make the car operate better. Transportation is also unique in that it may serve any level in the distribution channel from the mouth of the mine to the ultimate consumer.

TRANSPORTATION CREATES UTILITIES

Utility represents the added usefulness of a product after some economic process has occurred.

The basic economic utilities are form, time, place and possession. Transportation is involved in two of these utilities. Changing something to a more useful form is in the purview of manufacturing, providing ownership (possession utility) for the person who needs or wants a good is the function of marketing. Place utility and time utility (i.e. having something at the right place at the right time) is performed by transportation and storage. Generally, the primary function of transportation is that of place utility although time utility is critical in terms of delivery performance and speed.

MODES OF TRANSPORTATION

The modes of transportation used for inter-city freight movements are generally defined as water, rail, pipeline, motor and air. This listing is given in order of their historical development. A brief synopsis follows.

Water transportation preceded historical man. Commerce was carried on along coastlines, in harbors, up rivers, on lakes, etc. The sailing of Columbus marks the historical epoch of across-the-ocean sailing for Western Man. Trade generally grew, sailing ships improved, and with the advent of steam power in the middle 1800's, reliability, efficiency and speed increased. Inland water transportation in this country followed an early and later development pattern. Steamboats on the Mississippi increased traffic on that great river and its tributaries from the early 1800's until the Civil War. After the Civil War, Mississippi steamboats never regained their previous glory. Canal building also began in the early 1800's and peaked in the 1830's being gradually replaced by the steam locomotive. A resumption of inland water transportation has occurred in the United States in the 20th century with the building of locks along rivers and the development of powerful tugs and large barge tows in the rivers and intra-coastal waterways. Great Lakes traffic built with the development of the Mesabi Iron Range in Minnesota. The St. Lawrence Seaway has opened these bodies of water to international commerce in the last 15 years for eight months of the year.

Major developments of the railroads occurred during the second half of the 19th century. It reached its mileage peak in 1915 and has been on the decline ever since. Rail still provides the backbone for the volume land movements in the United States. Nothing has surpassed rail for transporting goods overland at maximum efficiency since little friction occurs from steel wheels moving on steel rails.

Highway transportation began as a force in the 1920's and air transportation in the 1930's. See tables 1 and 2 for an overview of transportation development in recent years.

The tables show an interesting, but complex picture. It should be noticed that the ton-miles (tons multiplied by miles) shows rail first, oil pipeline second, truck third, inland water fourth and air a distant fifth. The importance of each mode to freight transportation is clearly indicated by Table 1 with the possible exception of air transportation. Its importance will be seen in the next table. Table 1 also shows the growth patterns in terms of share of ton-miles carried by each mode of transportation. While the numbers of ton-miles carried by rail has more than doubled since 1939 (just as we were pulling out of the depression), it has only increased by 23.6 percent since 1946. Moreover, its share of total transportation ton-miles has dropped from 62 to 39 percent. Motor carriage continues to grow but has retained a fairly stable share of market for the past ten years. Pipelines continue to grow in share of market reflecting our increased reliance on petroleum while inland water carriers have remained in a relatively unchanged position for the past thirty-two years.

The amount of money spent on transportation services provides another measure of a mode's worth to the economy (Table 2). Here highway transportation is clearly first with approximately 65 percent of the value of domestic transportation. This figure shows that highway transportation is high cost on a per ton-mile basis since its share of the ton-miles is only about 24 percent. It's speed, availability, reliability and flexibility have clearly compensated for its greater out-of-pocket cost. Storage costs have been reduced and customer service quality has improved as a result of the switch to truck.

Rail is next in value. This mode moves goods in volume over longer distances than does motor at a cheaper line haul-cost. Goods of lower value (where storage costs are less important and transportation costs are a greater portion of the goods total price) are generally hauled by rail. Rail also has high terminal costs due to the large switching yards in center cities, than does its chief rival motor transportation. Therefore, rail has a lower over-all cost than truck only over long distances or for large volume.

Water transportation also carries bulk commodities over relatively long distances. Its low transportation costs are not enough to overcome its slow speed and unreliability for high value goods.

Pipeline is generally the cheapest and slowest mode of all. It is very limited, however, since it carries only commodities which are demanded in large quantities in one location. Goods must also be liquified or be capable of being suspended in a liquid to be carried. Recent pipeline developments have included emulsified coal, iron ore and wood chips. A sulphur pipeline also exists from the Gulf of Mexico to the Midwest where it is processed into fertilizer.