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FREIGHT TRANSPORTATION INFORMATION SYSTEMS AND THEIR IMPLICATIONS FOR R&D POLICY

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16. Abstract

The current use of computerized management information and control systems in intercity freight transportation is examined. Each of the four modes (railroad, motor carrier, maritime and air cargo industries) is investigated. In each case, computer information systems can help improve the operational efficiency of the mode and provide management (and regulators) with more accurate data for decision making. The intermodal data standard and exchange problem is also discussed. Appropriate recommendataions for DOT research and development policy are made. These include development of a national railroad management system, development of terminal control systems for railroad yards and intermodal terminals, support to development of a maritime industry information system and increased effort in the area of data facilitation.

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PREFACE

During FY 72, the Systems Concepts Directorate of the Transportation Systems Center undertook a series of studies in order to assist the Office of Research and Development Policy, Department of Transportation in the development of improved policy positions on research and development to improve the efficiency of intercity freight transportation systems. This report documents that portion of the study dealing with the use of computerized management information and control systems by the industry. The objective of the study was to survey and assess the current status of information and control system applications within each mode of freight transportation: the railroads, the motor carriers, the maritime industry and the air cargo industry. Implementation of these systems is a relatively low cost, high payoff method of bringing about improvements in customer service and industry financial stability. In addition to an overview of each mode's information system status, several common problems are discussed and specific recommendations are made as appropriate.

The author wishes to thank those who provided information, access to reports, and comments on the material in this report. In particular, the author acknowledges the assistance and critical review by several TSC colleagues: J.K. Pollard, Martin Costello, Robert Reymond, and David Rubin. Many industry officials provided important information; these include: Clifford Buys, Fred Coleman, Robert Curry, E.A. Guilbert, Robert McKnight, Richard Schoppert, Charles Taylor, Earl Trantham, and Robert Walker. Finally, the author gratefully acknowledges the tireless efforts of his proofreader and editor, Brenda.

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1. SUMMARY AND CONCLUSIONS

1.1 SUMMARY

In spite of steady increases in traffic volume, the freight transportation industry has problems, which, for national economic reasons, warrant government attention. These problems include poor service by many carriers (particularly railroads), poor equipment utilization (particularly by maritime companies and railroads), obsolete and inept government regulation of all modes, inadequate costing techniques by all modes and choking volumes of shipping documentation within all modes (particularly critical in intermodal transportation). Computer information systems can help solve some of these problems by improving the operational efficiency of each mode and providing management (and regulators) more accurate data for decision making. These systems have been successfully applied by a limited number of individual railroads, several large trucking companies, and the airline passenger industry. Further improvements are possible in national systems tying together all railroads and all maritime companies, systems for controlling intermodal freight terminals, and in the standardization of computer inputs and outputs to automate the documentation phase of transportation. The report provides an overview of the application of computerized management information and control systems to each mode and describes possible government efforts to stimulate further improvements in operational efficiency.

1.2 CONCLUSIONS

1.2.1 <u>Railroad Management System</u>

- Railroads need national system
- FRA is planning development program
- High priority in DOT is warranted

The operational complexities of the railroads have created serious problems for the industry. Generally speaking, the service that railroads provide is extremely unreliable.[1] Improved management control of operations, utilizing computer information systems, can help solve the service problem.[2] Although many information systems exist on individual railroads, they are incompatible with each other. Because of this incompatibility and the railroads' national system structure, the railroads require a national rolling stock management system. The railroad industry has sponsored several developments of national information systems, but these systems have only scratched the surface in controlling operations and improving rail service. Therefore, the Federal Railroad Administration is currently planning a program for further improvement to the national railroad information system. It should be given high priority within DOT and should include intermodal transportation requirements.

1.2.2 Railroad Terminal Control

- Terminal congestion causes unreliable service
- A limited number of terminal control systems exists
- Demonstrations of computer controlled terminals are recommended

By far, the most serious cause of unreliable service is the railroad yard. Two types of computer systems have particular application in controlling yard and terminal operations and improving overall yard efficiency: process control and management information. A number of both types of systems have been successfully implemented by various railroads. However, the application is not widespread. DOT-sponsored demonstrations of computer

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[1]"The American Railroads: Posture, Problems, and Prospects" Richard J. Barber for the US Senate Committee on Commerce, August 28, 1972, p. 51-59.

[2]"Rail Freight Service Quality: Comparisons with Other Modes and Prospects for Improvements", J.K. Pollard, Transportation Systems Center, October 1972.

controlled rail terminal systems with concomitant improvement in associated hardware, i.e. switches, retarders, wheel sensors, etc., would be of value by improving railroad operations and relieving terminal congestion. When coupled with a national management system, the terminal control system can significantly improve rail service to customers.

1.2.3 Intermodal Terminals

- Intermodal terminal operation is the chief deterrent to future intermodal traffic growth
- Present intermodal facilities are inadequate
- Demonstratations of intermodal terminal control are recommended

Intermodal transportation involving containers (or trailers) is becoming increasingly important to all of the modes. The intermodal terminal is currently the major bottleneck and the chief deterrent to further intermodal traffic growth. Improved intermodal transfer facilities are required in order to exploit the advantages of each mode involved in a shipment. Intermodal facilities are often inadequate, particularly where railroads interface with trucks and marine shipping.[3] Computer systems have great potential for operational control in intermodal terminals.[4] Several systems are currently being implemented by carriers. In general, however, the intermodal terminal problem would benefit greatly by DOT-sponsored demonstrations of intermodal control systems coupled with improved container handling facilities. Of particular significance would be a demonstration of a terminal involving rail, truck, and maritime modes.

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[3] "An Evaluation of Alternative Railroad Terminal Container Handling Systems", Robert Reebie and Associates, Inc., March 1971.

[4] Proceedings of the 1972 IEEE Conference on Decision and Control, Dec 1972. This author's paper on "Freight Management" discusses terminal control systems.

1.2.4 Maritime Control Systems

- An industry-wide information system is being developed by MARAD
- A St. Lawrence traffic control system is being developed by DOT
- The two efforts must be closely coordinated

Efficiency improvements in operations planning and carrier/shipper communications are necessary if the maritime industry is to maintain its competitive position and exploit the advantages of the container. Two applications of computer information systems offer improvements to the maritime industry: an industry-wide information and communications systems and a traffic control system for the St. Lawrence Seaway. Both of the systems are in the early stages of development under government sponsorship: the Maritime Administration (MARAD) is responsible for the former, while DOT is a joint sponsor (along with Canada's Seaway Authority) of the latter. Close coordination of the two efforts is essential, particularly if the St. Lawrence system is to succeed.

1.2.5 Data and Documentation

- Data standards and documentation transfer are major problems
- Demonstrations of computer data exchange are recommended
- Tariff simplification and computerization is recommended

Data and documentation represent a major intermodal problem in transportation. The Transportation Data Coordinating Committee (TDCC) plays a key role in development and promulgation of data standards. Government efforts in this area have been modest except for support to TDCC in code developments. Computer-to-computer data exchange and computerized shipping data transfer are key industry goals which depend upon adoption of data standards.

Unfortunately, the inherent operational differences among the modes impede the adoption of standards as well as computer data exchange. Tariff computerization is a problem of importance to both carriers and shippers, but is greatly impeded by the complex operations and split jurisdictions of the three regulatory bodies--the Interstate Commerce Commission, the Civil Aeronautics Board, and the Federal Maritime Commission. DOT-supported demonstrations of computer data exchange and billing, and of tarriff simplification and computerization would be of significant value in promulgating data standards within the industry and in improving intermodal freight transportation.

2. INTRODUCTION

2.1 INTERCITY FREIGHT GROWTH

The transportation industry must be capable of effectively handling an estimated 50% increase in the volume of intercity freight by 1980.[5] (Figure 1) In its present form, the industry may not be able to respond to the projected growth. The railroad segment of the industry, in particular, is in dire financial condition. While certain western railroad companies are very profitable, six railroads, including the nation's largest, are bankrupt and another twelve are dangerouly close to bankruptcy. Railroad shippers are very often dissatisfied with the service they receive.[6] Because service is relatively better by air and motor carrier than by rail, shippers are increasingly shifting to these modes (Figure 2), even though they have higher unit costs than rail.[7] Motor carrier traffic, for example, has grown steadily despite the fact that motor carrier rates have risen at a much higher pace than rail rates.[8]

The increasing de-emphasis on highways in the U.S. and the increasing highway congestion may limit the growth potential of the motor carrier industry.[9] This underscores the importance of revitalizing the railroad industry and suggests an increasing trend toward intermodal containerized freight movement. Operational efficiency of each mode and, more important, in intermodal transfer, is necessary for the transportation industry to meet its

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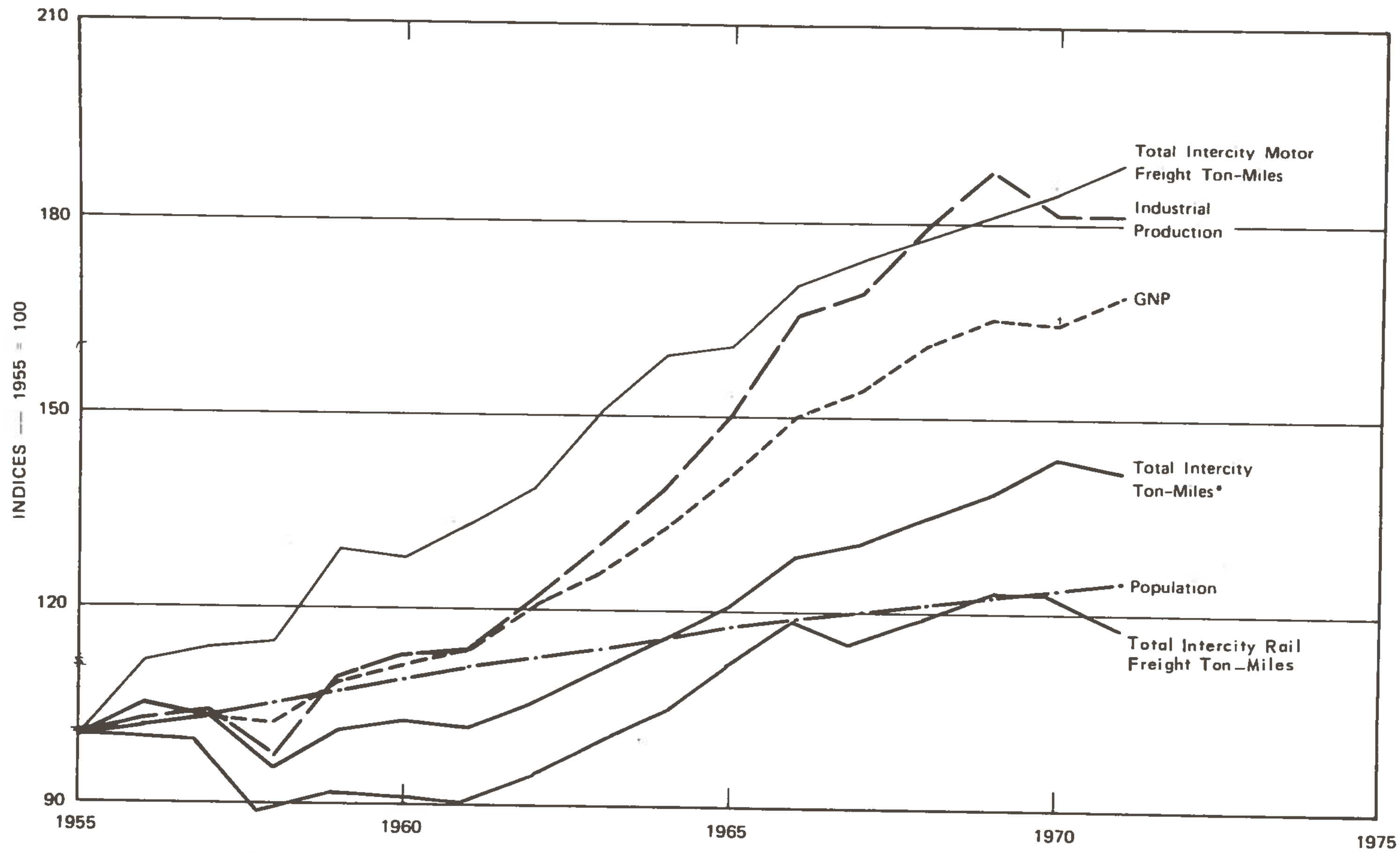
[5]Goods Transportation - Treads and Implications, D.R. Meier, General Electric Company, June 1971, p. 5.

[6]Barber (Commerce Committee), op cit, p. 51.

[7]National Transportation Report, DOT, June 1972, p. 263.

[8]Ibid p. 71. (It should be noted, however, that the growth in motor carrier and air freight is not totally due to the decline of rail service.)

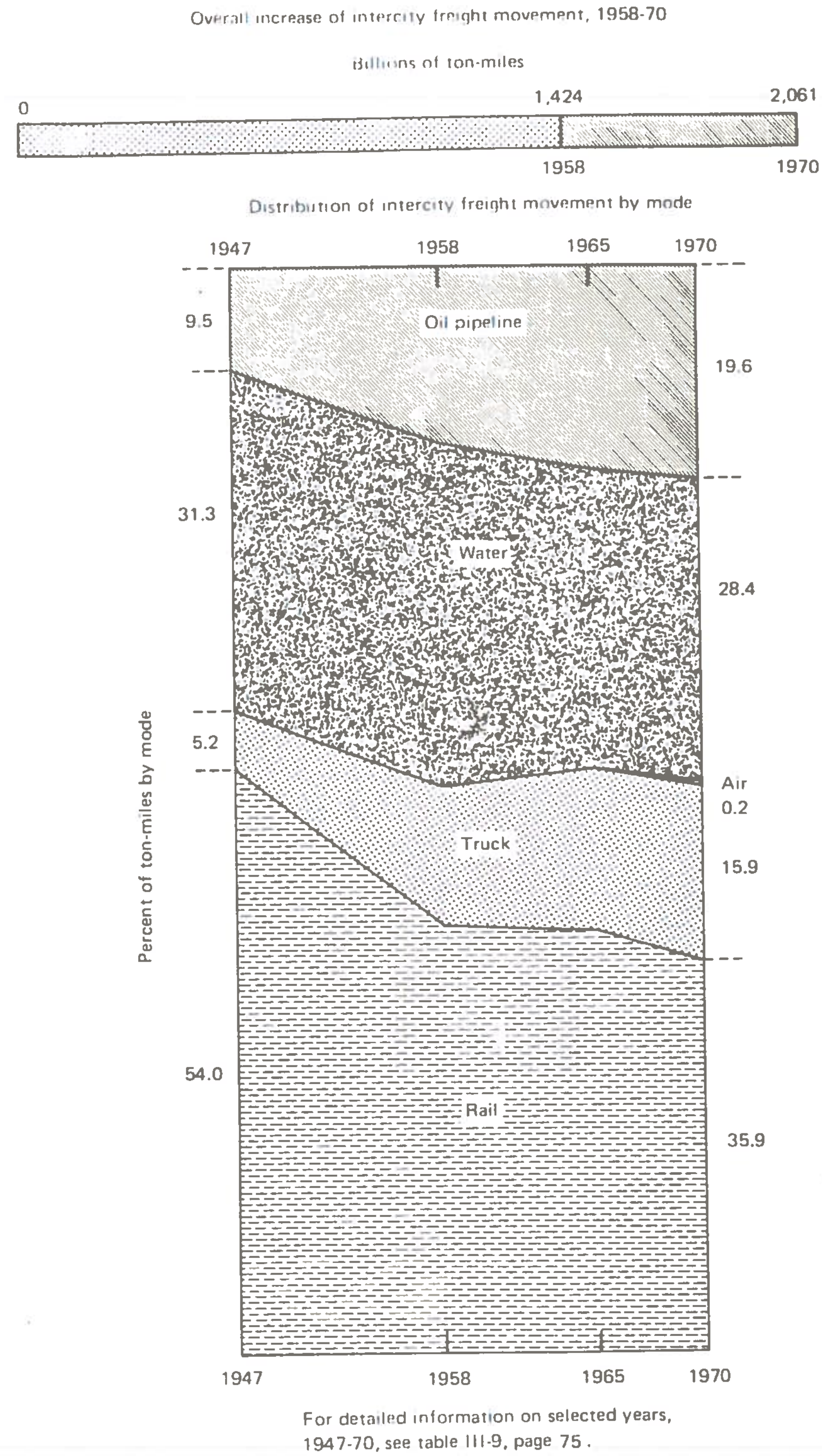
[9]Freight Transportation and Future Highway Requirements, Stanford Research Institute, May 1972, p. 7.



*Includes mail and express and domestic deep sea traffic.

SOURCE: "Freight Transportation and Future Highway Requirements," Stanford Research Institute, May 1972, p. 6. AAR data added for Rail ton-miles.

Figure 1. Growth in Intercity Freight Relative to Growth in the Economy



SOURCE: National Transportation Report, DOT, July 1972, p. 41.

Figure 2. Distribution of Intercity Freight by Mode

future demand. The industry and the public can benefit from a structure which utilizes the inherent flexibility and efficiencies of each mode, especially with regard to intermodal containerization.

2.2 THE DATA PROBLEM

Documentation associated with freight shipment wastes much time and money. Often, freight cannot be delivered because routing documentation has been lost or delayed. Terminal operators cannot anticipate the arrival of shipments because the documentation accompanies rather than precedes the shipment (or, worse yet, is mailed to the terminal). The problem can be particularly critical in air freight where actual cargo travel time may be only a few hours. Many freight cars are misrouted, lost, or delayed because waybills are lost or do not contain correct information.

Accurate and rapidly transferable data play an important role in freight transportation. Data on rates and tariffs are used to determine how much a customer owes. The regulatory agencies require the reporting of traffic statistics and certain financial accounting data. Historical data are used to forecast demand and plan equipment acquisition and allocation. A railroad owns tens of thousands of cars; a trucking company may have hundreds of trucks on the road at one time. The companies must keep track of all of these resources. They must be able to advise a shipper of the status of his goods. Particularly in carrier-to-carrier or carrier-to-shipper communications, accurate and timely data need to be exchanged as efficiently and inexpensively as possible to allow the companies to better manage their operations. Unfortunately, data coding standards have not been widely accepted in the transportation industry. As a result, far too much redundant, time consuming data preparation and manipulation takes place.

2.3 COMPUTERS CAN HELP

The transportation industry began using computers for payroll, revenue accounting, and other administrative functions during the 1950's. This improvement in efficiency saved money and allowed the industry to reduce its clerical labor force. With the advent of second and third generation computers in the 1960's the larger transportation companies began developing extensive computer/communication systems to provide operational information about the status and location of shipments. These systems can help improve the operational efficiency of the various segments of the industry. They cannot, however, solve all of the industry's problems. There are numerous regulatory and institutional problems which need to be solved, but consideration of these problems is beyond the scope of this report. The important point is that information systems can help the industry regardless of what regulatory or institutional changes might occur. They can, in fact, create an environment for change which has not previously existed, by providing transportation management with a more intimate understanding of their operations. The information systems can help the industry further by improving service to shippers and by assisting in improving documentation transfer. This report examines the current status of computer information systems used by the various modes and makes recommendations oriented toward facilitating improvement in the efficiency of intercity freight transportation.

3. INFORMATION SYSTEMS IN TRANSPORTATION

3.1 A TRANSPORTATION DELUSION

> It is possible now to foresee the day when the computer will link together in electronic networks all of the nation's major shippers and regulated carriers. Each will know precisely where every load of his consigned cargo is at any given moment, and each, to the extent of his legitimate interests, will have instant access to the others' salient shipping data. In short, pertinent transport information will be committed to electronic memory warehouses and drawn upon automatically as needed.[10]

So states an American Trucking Associations public relations pamphlet on data processing. Transportation companies are important computer users. One could extrapolate from various related developments (data standards, national railroad information systems, shipping operations systems, intermodal container transportation, increased industry cooperation for legislation, etc.) that such an integrated information network will soon come to pass. This does not, however, appear to be the case, without certain institutional changes within the industry and without the encouragement and assistance of the Department of Transportation. The industry's approach to intermodal freight transportation bodes ill for information cooperation and transfer. Intermodal cooperation is acknowledged to be necessary, but the degree of cooperation, particularly with regard to information about carriers' operations, is questionable and will not be adequate to bring about the dream described above. Each mode is examined below to support these conclusions.

3.2 THE RAILROADS

3.2.1 The National Railroad System

The railroads constitute, physically at least, a truly

[10]American Trucking Associations, <u>Data Processing in the Trucking Industry</u> (undated pamphlet, Washington, DC)

national transportation system. There are 334,000 miles of track in the U.S., 1.76 million cars, and 27 thousand locomotives.[11] The freight cars need not and do not stay on the owner's railroad or under his control. Since no one railroad goes coast to coast, there is a good chance that in going from its origin to its destination a car will travel on other railroads. Some 52% of freight cars move interline.[12] This fact alone makes railroad operations much more difficult to control than motor carrier or ship operations. Management of the freight car fleet, then, is a complicated problem which is greatly facilitated by sophisticated computer systems which keep track of the cars and keep shippers informed of the status of their shipments. Even though there are 68 major highly competitive railroads, car movement information and control must be coordinated as if these 68 carriers were one system, if the system as a whole is to operate efficiently.

3.2.2 Inherent Efficiencies but Poor Service

The railroads have four characteristic advantages over other modes, particularly trucks: exclusive rights of way; inherent guidance; steel on steel support (as opposed to rubber on concrete); and narrow right of way per unit of capacity. These advantages result in lower labor requirement per unit of output, less land use per unit of capacity, less fuel consumption per ton mile, as well as the possibility of reduced highway congestion and less air pollution. The advantages translate directly into lower unit costs per ton mile.[13]

Unfortunately, the railroads, in part because of their system-wide operational complexity, have not been able to exploit these advantages. Poor service has resulted.[14] The railroads

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[11] Yearbook of Railroads Facts, Association of American Railroads, 1972, p. 3, 46. 50

[12] "AAR Task Force on a National Car Information System", April, 1972, p. 1-3.

[13] National Report, op. cit., p. 263.

[14] Barber, op. cit., p. 4-5 and p. 51-9.

have found that low unit cost and line haul efficiency are not enough. Poor service has driven disgruntled customers to other modes, which accounts to some extent for the decline in railroads' mode share noted in Figure 2. A major factor in the railroads' poor service performance is unreliable service.[15] The customer needs reliable service in order to conserve inventories and resources. A rail user has only a 33% chance of on-time service compared with 95% for a truck user.[16] Figure 3 clearly illustrates this problem.

Inefficient yard and terminal operations severely affect service. Inefficient resource control and allocation result in car shortages to some shippers while elsewhere cars stand idle in railroad yards. Poor freight car utilization and control are closely related to poor service reliability and to shipper dissatisfaction. Freight car shortages have been a problem for many years, and have recently been the subject of much discussion in Congress. In 1969, car utilization (defined as the percentage of time a car is moving in a train) was 11.4%: 6.7% under load and 4.7% empty.[17] In 1971, the overall figure declined slightly to 10.9%.[18] This low utilization has a dramatic adverse effect on railroad costs and the railroads' ability to meet customer requirements for cars. The railroads say they need more freight cars, but lack capital with which to make purchases. The ASTRO

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[15] A section of the 1972 Proceedings of the Transportation Research Forum is devoted to this subject p. 475-523. MIT has a contract with the Federal Railroad Administration to study the problem. See Bibliography.

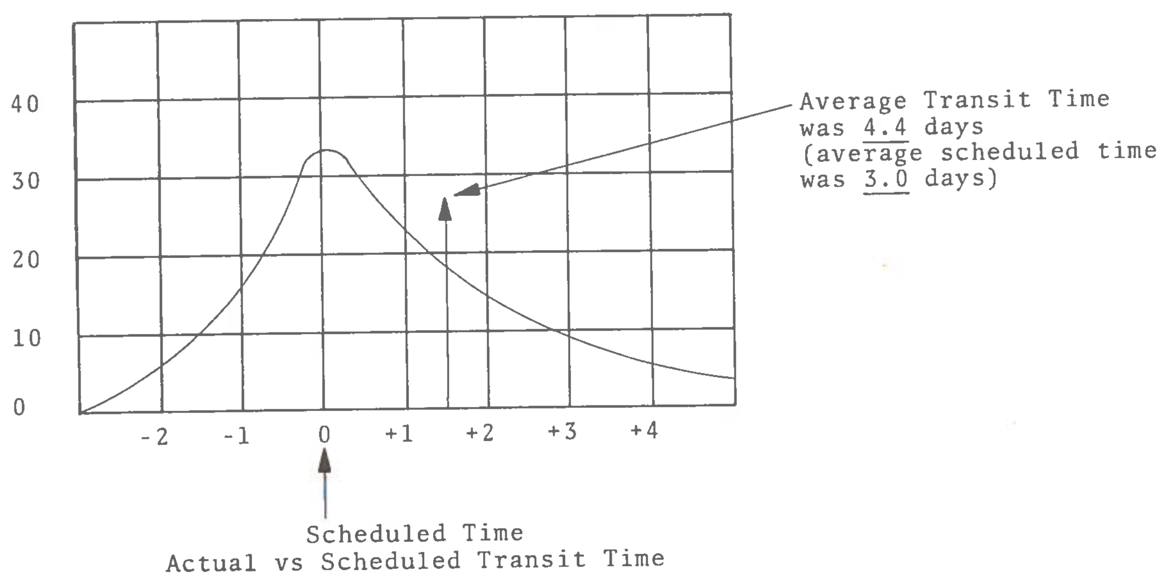
[16] Charles D. Baker "Public Interest Implications of the Introduction of Advanced Cybernetic Techniques to the Railroad Industry" Proceedings of the Third International Symposium of Railway Cybernetics, Tokyo 1970, p. 29.

[17] Yearbook of Railroad Facts, AAR 1970, p. 48, 49, 52, 55 (average daily car mileage ÷ average train speed per 24 hours = % time moving).

[18] Idem, 1972 edition, p. 43. Also Barber, op. cit. p. 51-9.

Movements were:

2 Days (or more) early	5.2%
1 Days Early ------------	14.6%
On Time ------------	33.3%
1 Day Late ------------	21.4%
2 Days Late ------------	12.2%
3 Days Late ------------	7.7%
4 Days or More Late ------------	5.4%



Source: Task Force I to the Labor Management Committee, based on 5 companies, 34000 carloads, 1968

Figure 3. Rail Service Reliability

report, for example, called for a $17 billion investment in freight cars by 1980[19], in order to increase the size of the car fleet by 24%. The savings potential of improving utilization (in lieu of buying cars) is therefore extremely large (about $15,000 per car) even with modest increases in utilization (e.g. a 10% increase is equivalent to 170,000 cars or about $2.5 billion). The 1970 Yearbook of Railroad Facts noted that more effective use of freight cars was a major industry need, and that computer/telecommunications systems would aid in improving utilization.[20]

3.2.3 Computers on the Railroads

Railroads have been using computers since the 1950's for reducing accounting costs and producing statistical reports more quickly. In the early 60's, as the computers became faster and more reliable, most high volume clerical functions were converted to computer processing. It was fairly easy to document the savings from the computerization of these functions, so the application became almost universal.

It was also during the early 60's that the computer was introduced into operations. A number of the larger, more prosperous railroads began developing on-line car movement systems during this period. The most complex of these systems was adapted by IBM from the American Airlines SABRE system for the Southern Pacific Company. Called Total Operations Processing System, or TOPS, it became the most famous system in the industry and has been purchased by several other major railroads, including Burlington Northern and Missouri Pacific.

Today, the railroads have more than 250 computers in operation and spent $44 million for computer rental in 1971.[21] Most railroads use these computers in information systems for car

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[19] "The American Railroad Industry: A Prospectus", ASTRO, June 1970, p. 13.

[20] Yearbook AAR, 1970, op. cit., p. 48.

[21] Association of American Railroads, Published Data, June 1971.

control and tracing purposes. A 1968 Railway Signaling and Communications survey found that 49 of 53 reporting roads were installing computer systems for mechanized car reporting.[22] Other surveys, evaluations, and reports about specific railroads' systems have been conducted (most notably an Association of American Railroads Survey for the 1970 Cybernetics Symposium), and are noted in the Bibliography. All of these systems have been independent developments, tailored to the individual needs and operations of each railroad. In most cases, development, implementation, and software costs are not available. Two systems' costs, however, are reported in the trade literature: Illinois Central's Mid America Information Network (MAIN) cost more than $15 million,[23] and the Southern Pacific's TOPS cost more than $22 million.[24] System characteristics and the eventual needs of the industry (data base, code standards, etc.) have been discussed at AAR Data Systems Division meetings, but there has been no industry effort to coordinate the development of railroad systems in order to foster compatibility of input and output.

3.2.4 Industry Developments Toward a National System

Despite the lack of coordination of individual systems, the railroads realized that some means was necessary to obtain data on cars moving on other railroads. Two key efforts during the 1960's made significant steps toward better data on car location on a nationwide basis. The first was TRAIN (Tele Rail Automated Information Network), a central computer complex and data bank at the AAR. The second was ACI (Automatic Car Identification), an optical scanning device tied to a computer to provide real time location of all cars (see Technical Report #DOT-TSC-FRA-72-3 Automatic Car Identification - An Evaluation).

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[22] Railway Signaling and Communications, Sept. 1968, p. 21.

[23] Railway Age, May 15, 1967, p. 16.

[24] Modern Railroads, Dec. 1969, p. 47.

TRAIN was developed by the AAR as a central data management tool for use in freight car distribution at a national level by the AAR's Car Service Division. Interchanges of cars between railroads are reported to TRAIN daily. All class I roads (greater than $15 million revenues) report all deliveries as well as receipts from non-participating Class II and terminal/switching roads. The AAR has three WATS lines which it uses to poll each railroad sequentially each day. TRAIN then compiles the data and issues various reports of car locations and inventory by type, owner, and current location (by railroad with current possession only). These reports are used by the Car Service Division, and increase its confidence in the ability of the railroads to follow distribution rules.

The Car Service operation is a manual procedure based primarily on several standing rules (e.g., sending all cars back to the owning railroad, either loaded or empty) and special rules based on seasonal customer requirements and requests (e.g., all covered hopper cars belonging to Burlington Nothern should be sent to Washington for fall harvest).

TRAIN has been of limited value to the Car Service function, because of the incompatiblity of most railroads' computer data systems, and the limited facilities of some smaller roads, the data are quite variable. It takes four days to acquire data on 95% of all interchanges for a single day. The data tend to be historical in nature and are obviously not so useful in car distribution as accurate, real-time data. TRAIN's inventory feature, however, have been beneficial to the railroads by informing them of the location of their cars on foreign lines, and, to some extent, in answering customer inquiries.

ACI was developed to improve the quality and timeliness of the input of car location data by automatically recording the number of a car. Where the optical scanner/data processing system has been used, there have been improvements in data accuracy. However, the implementation of ACI has been slow, primarily because of financial problems within the industry; fewer than half the railroads currently use scanners. Certain improvements in label material and label maintenance as well as wiedspread implementation of scanners will go a long way toward bringing the benefits expected of ACI. The quality of the data base for railroad car tracing for use both at the railroad level and for input to TRAIN will be improved by ACI; this will result in better service to customers and more efficient car distribution.

3.2.5 Computer Applications in Railroad Terminals

It was noted earlier that one of the primary causes of train delay and unreliable service by the railroads is congestion in yards and terminals. The railroads have taken advantage of the computer to accomplish automatic control and management assistance in rail yards or groups of yards. Two types of computer functions are involved in yards: process control, involving mini-computers and analog sensing and control devices; and overall yard operation with medium-to-large scale computers. The process control computer monitors and controls retarder and switch operations as well as the speed of the switching locomotives. The larger computer is the yard's interface with the railroad's information system, keeps inventory, and prepares inbound and outbound lists for the yard.

At least 10 individual railroads have installed computers and scanning devices at existing yard facilities or have incorporated the systems into the construction of new rail yard. Most of them include both the process control and management information functions. Among the new facilities are: Argentine, Kansas (Santa Fe); Calgary, Alberta (Canadian Pacific); Roanoke, Virginia (Norfolk & Western); Peoria, Illinois (Peoria and Pekin Union); and Colton, California (Southern Pacific).[25] These yards allow improved operations and throughput, which favorably affect car utilization, transit time, and costs to the railroads.

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[25] Good summaries of yard and terminal control systems can be found in the trade press, notably Railway System Controls July, 1970 p. 12, and Modern Railroads Sept., 1971, p. 70.

The group of 33 railroads in Chicago is installing a management information system of computers and ACI scanners which will be owned and operated by a non-profit corporation affiliated with the group. The installation will be the largest to date of ACI scanners, 109, will keep track of all car interchanges in the entire Chicago area, the busiest rail terminal in the world. The project is noteworthy for several reasons: a group of railroads realized they had a collective problem and found a solution; the project is an important test of ACI; the system should help relieve the traffic congestion on Chicago railroads; and the group requested and received Federal funding recently from the Federal Railroad Administration.

3.2.6 Computers and Railroad Intermodal Transportation

Trailer On Flat Car (TOFC) and Container On Flat Car (COFC) traffic is severely hurt by the inefficient yard operations noted above and by inefficient intermodal transfer operations. Because TOFC/COFC is a special service on the railroads and because speed and reliability are of utmost importance in keeping and winning new TOFC/COFC traffic, the railroads have taken measures to have TOFC/COFC bypass yards. For example, there are no fewer than 85 all TOFC/COFC trains running on daily schedules non-stop for 400-500 mile trips.[26] However, not all origins and destinations have this kind of service. Such intermodal traffic must travel on conventional trains and pass through one or more yards. The yard improvements described above will thus have a favorable impact on TOFC/COFC. For example, in Chicago, trailers and containers are now transferred between railroads over the streets because of railroad terminal congestion. One of the objectives of the control system project in Chicago is to eliminate that necessity and as a result, eliminate 1,000 trailers per day from Chicago streets.[27]

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[26] "Freight Transportation and Future Highway Requirements", Stanford Research Institute, May, 1972.

[27] Proposal for a "Chicago Area Automatic Car Identification Interchange Information System", Sept., 1971, p. 7, 18.

All trailers and containers are supposed to be labeled and therefore readable by ACI. The ACI computer output lists TOFC/COFC flat car numbers followed by the number of each trailer. This allows trailers to be traced by a railroad information system and also allows introduction of control systems like those described above into intermodal terminals.

One such intermodal system has been built by the Illinois Central Railroad in Chicago. Called the IMX terminal, it used ACI both for movements into and out of the yard by rail, and for tractor/trailer movements into and out of the terminal over the streets. Scanners information feeds the central computer, located in the terminal office, which controls the entire operation of the terminal and provides an added element of cargo security by controlling the tractor/trailer match ups and subsequent departure from the terminal through computer controlled gates.[28]

Intermodal transportation will play an increasingly important part in the future of railroad operations, if the railroads are able to circumvent their service problems, particularly terminal congestion and poor equipment utilization. Note the recent history of TOFC/COFC in Figure 4. The computer can play a key role by helping the railroads manage their operations. It is important that intermodal transportation be party to any computer systems and other industry improvements. This has not always been the case. For example, the recently released AAR national car information system design does not specifically address TOFC/COFC. Yet if TOFC/COFC traffic is to increase, it must be computer controlled as well. AAR officials report that a computer file with information on all trailers is under development and that the TRAIN development will then be able to give tracing reports on trailers. It is hoped that this file can be developed and implemented along with the AAR National Information System.

The all-piggyback trains cited above have demonstrated that it is possible to provide service far superior to normal rail

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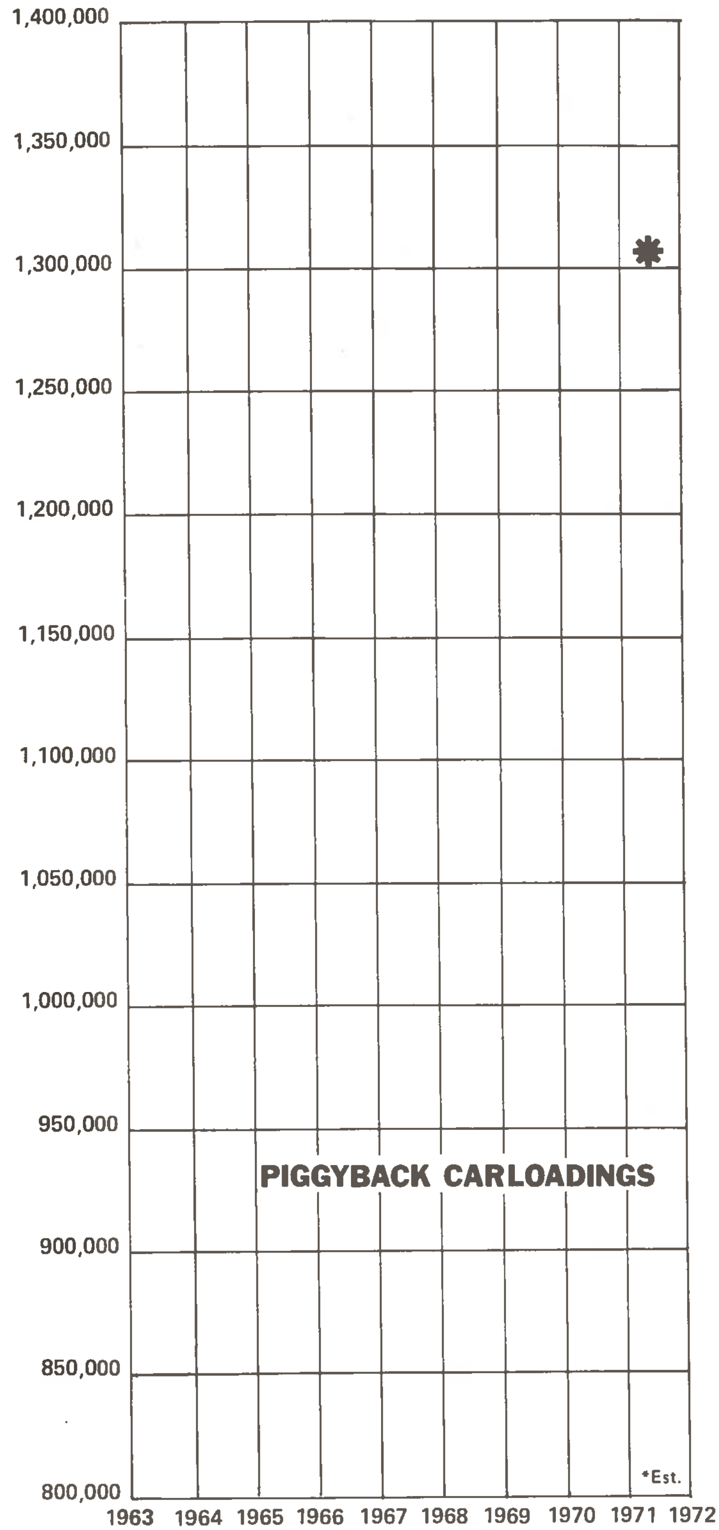
[28] Railway System Controls, Jan., 1972, p. 15-17.



SOURCE: "Reprinted from October 30, 1972 issue of Railway Age by Simmons Boardman Publishing Corporation by permission of Simmons Broadman Corporation. publication 1856."

Figure 4. Piggyback Loadings

service. A TOFC flat car in these trains averages 500-600 miles a day - 10 times the utilization of normal freight cars.[29] If the railroads ever divert truck traffic back to the rails, it will be TOFC/COFC that carries most of that traffic. The diversion potential of truck traffic has been estimated as high as 20%.[30] It has been estimated that from 6 million to 12 million trailers will move on the railroads by 1986. This is 3 to 9 times the numbers now moving.[31] The railroads must improve the efficiency of their operations to accommodate this traffic. They must have computer-aided management control of the movement and location of TOFC/COFC cars and trailers (or containers). They must speed the intermodal transfer of containers and trailers, again with process control and information computers where appropriate.

3.2.7 Congress and the Railroads

It was noted above that both TRAIN and ACI have had implementation problems. They have helped, but they have not solved the problems discussed. As a result, car shortages and poor service still exist. These problems, coupled with the Penn Central collapse, have become important Congressional issues. Congress, thus, has begun to address the problems with a series of bills designed to relieve car shortages, assist (or force) the railroads to improve car utilization, and provide guaranteed loans for freight car purchases. The least controversial portion of any of the bills is a $35 million authorization to DOT for R&D related to national and railroad information systems.

The Congressional activity made it clear to the railroads that they needed to act before the government did. As a result,

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[29]Stanford Research, op. cit., p. 55. According to the Yearbook of Facts, the average freight car traveled 53.4 miles per day.

[30]"TSC Economics Program in Intercity Freight Transportation" M. Costello, Nov. 1971, p. 26-32. Also "National Transportation Study", op. cit., p. 266.

[31]Stanford Research, op. cit., p. 55

the railroads have undertaken action in an effort to obviate the need for government activity. The AAR formed a task force, briefly cited above, to conduct a study from October 1971 to April 1972 of an improved national car information and control system to be built upon the present TRAIN system. The study recommends:

a. improvement of railroad input capabilities ($1.5 million in the first year)

b. improved TRAIN system (TRAIN II) covering:

   1. all interchanges
   2. status changes
   3. boundary crossings
   4. regional car distribution

c. data exchange between railroads using TRAIN computer

d. limited shipper access to car location information

e. evolutionary development of such functions as:

   1. exact location of all cars at all times
   2. schedule car movements
   3. performance measurement
   4. demand forecasting
   5. accounting clearing house

The development and implementation costs for the first phase are $300,000 (through Jan 1973) and $2.0 million (through Jan 1974) respectively.[32]

The development of the improved national system by the AAR is a significant step in the right direction by the railroads. The system in its first design will not perform all of the functions vital to relieving car shortages and improving service by the railroads it doesn't treat intermodal traffic as yet. However, it will help, and the design for evolutionary expansion acknowledges the need for other functions.

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[32]Report of the AAR Task Force on National Car Information Systems, April 1972.

3.2.8 DOT Program

The FRA is defining a major federally supported R&D program in freight rolling stock management systems. TSC is assisting in this activity. It is important that a meaningful program be established and that the AAR actively participate to ensure railroad acceptance and the inclusion of the new AAR development in the overall program. Coordination to involve AAR has already been undertaken by FRA. DOT support for this effort will aid the FRA in taking the lead in the necessary definition of future system applications, including treatment of intermodal transportation, and the funding of development and demonstration of various features of the system.

3.2.9 DOT R&D Policy Implications

The railroads represent the major problem area in freight transportation. Aside from safety research, there has been little research related to freight transportation by the railroads. The rolling stock management system cited above is a critical program to the railroads and to freight transportation. It deserves high priority in DOT R&D. As noted, the terminal causes most of the delays in rail service. A program of terminal improvement closely correlated with the management system program is another important area for research. In both the rolling stock management and improved terminal program areas, the railroads have either already conducted or are planning to conduct research and development. Their general financial condition precludes major effort. It is important, however, that DOT research to improve railroad operations be coordinated with the railroads, through the Association of American Railroads. There is significant work that can be performed by DOT to improve the plight of the railroads. Current R&D policies do not, however, facilitate such work.

3.2.10 Summary

The interdependency of the railroads created operational complexities which computers can help solve. Although many information systems exist on individual railroads, they are incompatible with each other. The railroad industry has sponsored several developments of national information systems, but these systems have only scratched the surface in controlling operations and improving rail service. Substantial improvements in efficiency can be achieved by implementation of a national system of car location, scheduling, terminal process control, etc., to properly manage operations. Developments of this type are a potentially lucrative opportunity for DOT research and development. The FRA is currently planning such a development program.

3.3 MOTOR CARRIERS

3.3.1 A Diverse Industry

In contrast to the railroads, the motor carrier industry is very diverse, with many thousands of largely independent companies. There are 19 million trucks registered in the U.S. and more than 15,000 ICC regulated common carriers,[33] the latter representing only 39% of the industry.[34] The motor carrier industry has grown rapidly in recent years due in large part to increases by the non-regulated portion of the industry (in competition with regulated motor carriers and railroads) and substantial government investments in highways particularly the Interstate Highway System.[35] Trucks carry about 20% of freight ton-miles, but, as noted earlier, receive a large proportion of freight revenues (See Figures 1 through 4). This imbalance is due to small shipments - the majority of small shipments (less than truckload

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[33] American Trucking Trends, 1972, American Trucking Associations p. 2-3, p. 10, and p. 36. For a discussion of regulated, non-regulated, and exempt carriers and a summary of the industry structure, see p. 36.

[34] Meier, op. cit., p. 8.

[35] Stanford Research, op. cit., p. 7, 45, and 82.

shipments) are transported by trucks - 84.5% by tonnage in 1964.[36] (See Figure 5.)

Small shipments represent a significant portion of motor carriers' business and increase the complexity of the industry. In 1968, a group of 573 Class I carriers (more than $1 million revenues) transported 272 million shipments, of which nearly 97% were small shipments. This represented 64% of the revenues and 39% of the tonnage carried by that group.[37] When it is noted that 28 million freight cars were loaded in 1968,[38] and that motor carrier small shipments are increasing (by tonnage), while railroad small shipments are decreasing to an insignificant number (Figure 5), the magnitude of the motor carrier distribution, and attendant documentation problem can be seen.

The regulated portion of the industry is restricted in operating routes and rates; nonetheless, there are a number of large carriers which can provide single line haul service coast to coast. Many large manufacturing firms have their own private fleets of trucks. While these trucks have no route restrictions, they can carry only their own manufacturers' products and inbound raw

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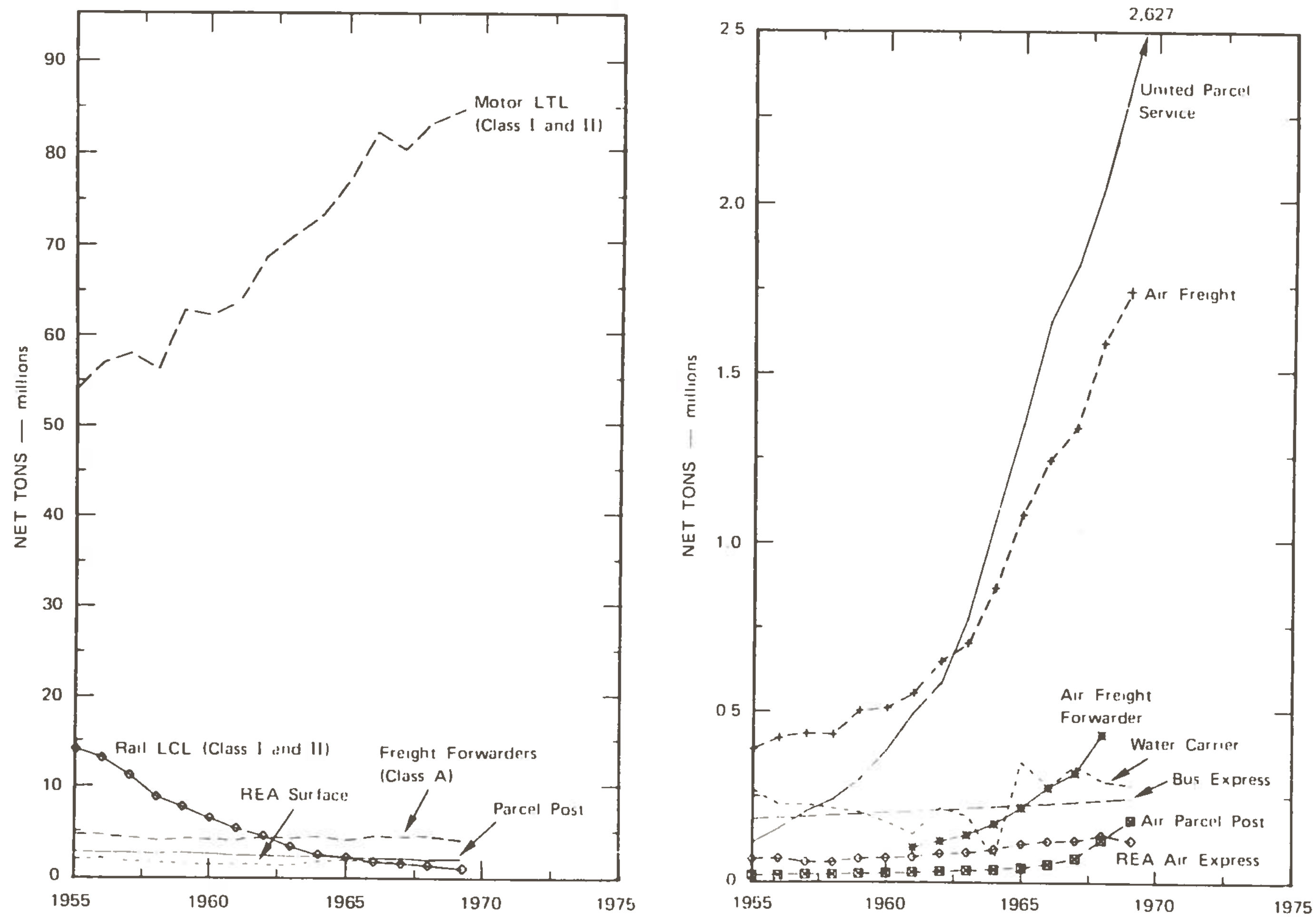
[36] The Role of Regulated Motor Carriers in the Handling of Small Shipments, ICC Bureau of Economics, Nov. 67, p. 6, p. 34 "Small shipment" has had a variety of meanings and is discussed in detail beginning on page 6. The first definition was a shipment weighing less than 10,000 lbs. It was derived from less than rail car shipments. The definition is complicated in trucking because some light weight materials may weigh less than 10,000 lbs. but still fill a trailer. The ICC report used the 10,000 lb. definition but subdivided small shipments into two main groups - small parcels (less than 50 lbs.) and larger shipments (further subdivided in three classes: 50-100, 100-2000, 2000-10000 lbs).

[37] Transport Statistics in the United States, Part 7, Motor Carriers ICC Bureau of Accounts 1968, p. 34.

[38] Yearbook of Railroad Facts, Association of American RR, 1971, p. 23.



(a) CARRIERS OF OVER 500,000 TONS IN 1955

(b) CARRIERS OF UNDER 500,000 TONS IN 1955

SOURCE: "Freight Transportation and Future Highway Requirements," Stanford Research Institute, May 1972, p. 76

Figure 5. Regulated Intercity Small Shipment Traffic

materials. Very small nonregulated for-hire carriers, often called gypsies, are able to carry any cargo anywhere, at prices considerably lower than the ICC regulated carriers may charge. Non-ICC-regulated trucking received 80% of the $64 billion motor freight bill (75% of the total freight bill) in 1970.[39] One of the problems caused by the diversity of the non-regulated versus regulated motor carrier industry is the lack of information, both operational and financial, about non-regulated carriers. In general, they have data and control requirements similar to those of regulated carriers. But, for example, private fleets of manufacturing firms use their own firms' computer services and require little, if any, interface with the rest of the industry. Therefore, the information system needs and uses discussed herein apply primarily to the 3500 regulated carriers with revenues in excess of $300,000.

3.3.2 Motor Carrier Service Advantages

3.3.2.1 Door to Door Service - The motor carrier industry has an inherent advantage over all other modes in its ability to provide door to door service. For truck load shipments, pick up and delivery may be accomplished by the same trailer and crew that performed the line haul service. This allows faster and more reliable service than railroads can provide. Small shipments normally require distribution from a break bulk terminal near the destination. As noted above, most of these shipments are delivered by truck. Here, however, local pick up and delivery trucks, which may belong either to the line haul company or to a local private company, may perform delivery. For the Class I carrier group noted above, pick up and delivery vehicles were involved in six times as many deliveries as line haul trucks (more than 163 million hours).[40] Expeditious pick up and delivery and efficient terminal operations are of prime importance to motor

[39] Fortune, July 1971, op. cit., p. 60-1.

[40] ICC Motor Carriers, op. cit., p. 60-1.

carriers in maintaining their service advantage. The pick up and delivery service takes place primarily in urban areas where trucks both contribute to, and are victims of, urban congestion. The urban goods movement problem thus has a significant impact on the motor carrier industry.

3.3.2.2 Fewer Interline Shipments - The handling of a trailer by more than one line haul carrier (ie. interline moves) is not prevalent in the motor carrier industry, although no statistics are reported by the American Trucking Associations (ATA) or by the ICC as such. (Recall that the railroads have more than 50% of cars moving interline.) This tends to simplify operational control somewhat. Most small shipments travel single line, although as noted above they require unloading and processing through break bulk terminals. ICC Freight Commodity Statistics of 1968 from 934 carriers indicate 8-10% of shipments are interline.[41]

Officials from two truck companies, one large and one small, reported to the author that their companies had 3% and 8% interline moves, respectively. On the other hand, a Wilson Trucking official noted that 50% of Wilson's business consisted of interline freight.[42] The large nationwide carriers tend to have few interline moves, while smaller regional carriers have a greater number. Trailers are interchanged between carriers just as freight cars are on the railroads. The fact that each trailer travels separately simplifies control and location tracing, however. Terminal congestion and costs are still problems which the companies must overcome in order to expedite interline moves. Trailer location information and standard codes and documentation are thus especially important for interline moves.

3.3.2.3 Flexibility - Trucking plays a key role in much intermodal transportation and is being increasingly recognized for its flexibility in complementing each of the other modes. Break bulk

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[41] Freight Commodity Statistics, ICC 1968, p. 9.

[42] "Interline Claim Settlements is Vexing Problem for Carriers", Transport Topics, March 27, 1972, p. 18.

cargo by all modes is normally delivered by truck. Trucks are used for pick up and delivery of virtually all air cargo container traffic. (The carrier may be an air freight forwarder, the airline itself, or the consignee of the cargo.) Maritime container movements from containerships vary by mode with the port: Halifax moves about 80% of its containers by unit train; Boston and New York, conversely, move 80-90% of containers by truck.[43] In either case, pick up and delivery at origin and destination are almost always by truck. Furthermore, motor carrier involvement in maritime container operations is increasing.[44,45]

Discussion in Section 3.2 stressed the importance of piggyback operations to the railroads. Here again, trucks provide virtually all of the pickup and delivery service. TOFC Plan I (Shipment of trailer by railroads at motor carrier rates with motor carrier pick up and delivery) is particularly advantageous to motor carriers, if railroads can provide acceptable transit time and represented 10% of TOFC traffic in 1970.[46] The other TOFC plans vary; in all cases, however, trucks perform pick up and delivery.

In summary, freight service provided by the trucking industry is far superior to rail service. With higher costs and rates, the truck must provide better service in order to win and keep business. The door to door service is one positive factor. Service reliability is another. Because so much of the freight shipped is single line and because the service is so reliable, the truckers have fewer problems to report to the shipper. Shipment tracing is much easier than with railroads because the driver is normally with each

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[43]Remarks by Prof. E. Frankel, Ocean Engineering, MIT, Cambridge, MA.

[44]Containers - Land, Sea, Air, American Trucking Association pamphlet.

[45]85th Annual Report of the Interstate Commerce Commission, 1971, p. 39, Domestic container use remained constant in FY 71, but international container use increased to 300,000. The report estimates a doubling by 1975.

[46]Ibid.

shipment while it is on the road. Still, small shipments require one or more terminal stops and without proper control, shipments can get "lost" or misrouted. The key role trucks play in most forms of intermodal transportation make intercarrier communications important.

3.3.3 Computers in the Trucking Industry

Computer information systems play an important role in helping a trucking company manage its operations. Many large companies use computer systems for shipment scheduling and truck dispatching, shipment and empty equipment location, vehicle maintenance scheduling, demand forecasting and other sales analyses, and communications with shippers. As with railroads, the systems produce a variety of reports which are used by various levels of management to more efficiently plan operations, improve equipment utilization, reduce terminal congestion, and improve customer service.

Like railroads, truckers need to provide shippers with information on deviations from delivery schedules. In addition, computer assistance in the computation of truck freight rates is desirable from the shippers' standpoint because of the number of shipments that go by truck.

3.3.4 No Need for National System

The motor carriers do not need a national information system for equipment location and distribution. The heterogeneous character of the companies and preponderance of single line moves make such a system unnecessary. It should be noted that not all motor carriers have requirements for computers of their own. Computer service firms have been formed (often as subsidiaries of larger trucking companies) to provide data processing services to a number of truckers. The services include accounting, dispatching, equipment location, operations planning, maintenance scheduling, etc. An element of standardization is introduced by the use of the computer service companies. Standard codes, language, inputs, and to some extent, outputs result. Each trucker still has his own particular computer requirements and management reports, but the environment for data standards is better than if each trucker had his own system.

3.3.5 Importance of Data Standards

Even though motor carriers do not need a national system, certain data standards and carrier-carrier and carrier-shipper communications are still quite important. The transmittal and processing of freight bills is a significant problem for motor carriers particularly because of the number of shipments. The computer/communications systems existing in the industry can solve the problem, if they are able to communicate with one another. Communications with shippers for billing, shipment status, and equipment orders are important. In order to computerize the processing of freight bills, the industry needs to implement standard codes and formats.

Data standards are particularly important for the trucking industry because of the industry's prime complementary role in intermodal container transportation described above. Documentation coordination with the marine shipping lines is important because of the motor carriers' growing place in marine containerization. Direct contact between the motor carriers mostly local trucking companies and the railroads in the various TOFC plans necessitates intermodal cooperation and standard coding. The motor carriers' flexibility in complementing all the modes requires cooperation and communication for which data standards are a necessity.

3.3.6 DOT R&D Implications

Compared with the other modes, trucking offers few opportunities for change and improvement. The diversity of the industry makes it difficult for computer-oriented research and development to have an impact on motor carriers. The one exception is data and documentation. The issues and recommendations relating to this problem will be discussed in detail in Section 4. Improvements in these areas can allow the motor carriers to participate more efficiently in intermodal transportation. The industry's heterogeneity does not lend itself to implementation of data standards or widespread computer systems. Developments of this kind would have relatively little effect on the single mode operations of most individual trucking companies. The industry is too diverse to warrant or use a national information system. There is no question that the computer systems can be of value to the operation of individual companies; but the design characteristics needed in the systems vary greatly with company size and operation. Federal support of intermodal transportation will have a favorable impact on many companies in the trucking industry. In general, however, research and development related to the trucking industry does not seem warranted particularly in view of certain of the problems of other modes discussed herein.

3.3.7 Summary

Motor carriers are less interdependent than the railroads. Control of operations is less difficult because, in general, trailers do not transfer from one carrier to another and because a driver accompanies each trailer. The predominance of small shipments creates documentation and data transfer difficulties for which computer assistance is possible. Larger motor carriers have information systems which include dispatching, trailer location, and shipper cargo tracing. Smaller carriers who cannot justify the expense of individual computer systems obtain all computer operations services from one of several firms established in the industry for that purpose. The motor carriers, however, do not need a national information system. DOT can provide some measure of assistance to the industry through support of data and documentation research.

3.4 THE MARITIME INDUSTRY

3.4.1 Marine Containerization

One of the important transportation stories in the last decade has been the development and use of containerized shipping by the

U.S. Merchant Marine. Containers account for more than 60% of maritime shipments in the important North Atlantic and U.S. - Far East Pacific shipping lanes. Containerships, container handling terminals, and containers themselves required significant investments from financially unstable shipping companies. Foreign flag competition, particularly in the North Atlantic, severely hurt the regulated U.S. companies. To enhance competition against foreign companies, the Maritime Administration (MARAD) of the Department of Commerce supports the maritime industry through subsidization and significant research and development activities.

3.4.2 Inland Intermodal Connections

Maritime companies have two significant intermodal contacts with inland ground transportation: trucks-pick up and delivery, and line haul; and railroads, inland line haul, the so-called land bridge/mini bridge program. The terminals at which these inland connections are made have proven to be significant problems for the industry. As noted above in Part B, the intermodal connection depends on the port. Regardless of the mode involved, swift transfer of containers is important to shipping lines. The container significantly improves turnaround time on ships in and out of port compared with conventional ships. At $10,000 per day for laying up a containership,[47] there is substantial incentive for efficient terminal facilities which maximize facility utilization and minimize loading and unloading time.

3.4.3 Marine Terminal Control

The Maritime Administration is sponsoring the development of a terminal control system which uses a computer/communication system tying together a group of ACI scanners located on cranes and at strategic points throughout the terminal.[48] Each container

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47"Cooling the Rate War on the North Atlantic", Business Week, April 29, 1972, p. 51.

48"Design and Development of a Pilot Terminal Control System (TCS) with Automatic Container Identification", Computer Identics Corp. and Trans-ocean Gateway Corp., May, 1971.

will have an ACI label compatible with those used on the railroads. A pilot system is being installed at Howland Hook Container Terminal, Long Island. As with terminal control systems for railroads, improved utilization of facilities, better planning of operations, improved security, and improved service to customers will result from the system. The pilot project is significant because of what it will do for the marine terminal operations, but is also of great importance to intermodal transportation because of the use of the ACI system. In a similar terminal control program, Sea Land, Inc. is labeling all 50,000 of its containers with 3 standard ACI labels each. At its Elizabeth, New Jersey, container terminal, Sea Land will install two scanners to record inbound and outbound tractor/chassis movements. The data from these scanners are correlated with freight bill information and then used in the preparation of ship loading plans. A complete inventory of containers parked within the terminal is taken by mounting a scanner to a light truck which drives by each container location. The scanned information is recorded on a cassette tape and then physically transferred to the computer. A scanner is also located on the Sea Land crane, as at Howland Hook, in order to verify the correct loading of containers against the loading plan. If an incorrect container passes the scanner, the crane operator receives a warning and corrects the error.

3.4.4 Maritime Industry Information System

The use of computers in the maritime industry is not so extensive as within the railroad industry, primarily because operations are less complex and intercompany dependency is less prevalent. Aside from the terminal problem discussed above, the major applications for computerized information in the maritime industry are origin to destination freight billing, ship location, schedule tracking, shipper inquiries, and container inventory control. A centralized system within the industry is now under development with MARAD sponsorship[49].

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[49]MARAD RFP, dated March 13, 1972.

The development is significant for its scope as well as for the MARAD role vis-a-vis the maritime industry. In contrast with the railroads/FRA relationship, this program has been initiated by MARAD with industry cooperation and enthusiasm. Again, the rationale is primarily one of meeting foreign competition. Even so, there seems to be little or no fear of government intervention or threatened nationalization on the part of the companies; this attitude in the maritime industry is in sharp contrast to that in the railroad industry. One of the purposes of the system is to provide "a comprehensive, dynamic, descriptive data base from which MARAD can extract for its needs."[50] Such a concept would be met with unanimous opposition by the railroad industry.

The Shipping Operations Information System will be a global industry operated computer-based system of software service and communications for use by U.S. shipping companies, U.S. import/export shippers and consignees, and the government, all on a <u>subscription basis</u>. The system will provide the communications network via synchronous communications satellites, data relay terminals, etc. and offer a wide range of applications software to provide such services as:

a. ship availability profiles
b. multimodal bookings
c. automatic freight billing
d. cargo tracking and control
e. ship scheduling and weather routing
f. corporate financial planning
g. maritime information reporting to government

Rather than industry interdependency as with the railroads, the rationale for cooperative system development is that the cost of computer software development, while staggering to a single company, can be shared within the industry at a significant savings. It also "opens new avenues for government support as well."[51]

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[50] <u>Ibid</u>., Scope of Work - <u>Background</u>.

[51] <u>Ibid</u>.

The Phase I requirements analysis, a 9 month contract, was started in June 1972 by Computer Sciences Corporation. Subsequent phases lead to full scale implementation of the system.

The Maritime Administration is also sponsoring a pilot version of an intermodal information system. MARAD received, and intends to fund, an unsolicated proposal from the Port of San Francisco, in conjunction with 3 shipping companies, 2 motor carriers, 2 railroads, and several other interested parties, for a "mini" demonstration of such an information system.

3.4.5 St. Lawrence Seaway Control System

In a development related to, but separate from, MARAD activities, the St. Lawrence Seaway Development Corporation (DOT) and the St. Lawrence Seaway Authority (Canada) are developing and implementing an integrated Marine Traffic Information and Control System (IMTIC) for the Seaway. TSC performed a requirements analysis and program definition in conjunction with the two organizations.[52] Honeywell of Canada has been selected to perform the development and implementation of the first phase of the evolutionary program.

The purposes of the system are to assist the Seaway Authority and the Development Corporation in traffic control, to relieve Seaway congestion during peak traffic periods, and to generally improve the level of safety within the Seaway. Eventually the system would provide near-real-time master planning and scheduling control as well as shipping documentation transmission, etc. The first phase will provide administrative message switching within the various control sectors. The full system implementation with automated traffic control is planned for 1976.

Presently, the system uses plot-board displays (in most cases manually operated) for centralized traffic control. This control system was implemented during 1966-68. Traffic control is advisory in nature and will remain so after the implementation

[52] "Fourth Coast - Seaway Systems Requirements Analysis", Report Number DOT-TSC-SLS-72-2.

of IMTIC. Ship masters are advised to take certain actions or to indicate expected schedules or location information. These advisory orders are somewhat "regulated" by a punitive fine which Canada applies. In addition, ships are inspected at Montreal and the masters must agree to follow operating rules before they are permitted to enter the Seaway.

The initial phases deal primarily with the region of the Seaway from Montreal to the Port Weller control section in mid-Lake Erie. Subsequent phases will expand the traffic control capability into the Upper Great Lakes and will provide information for improved cargo movement and improved demand prediction.

3.4.6 DOT R&D Implications

The computer information system needs of the maritime industry seem to be well in hand. The two key central information system developments - MARAD's Shipping Operations Information System and DOT's portion of the St. Lawrence Marine Traffic Control and Management System - are well planned and organized in detail. Close coordination between the two developments is extremely important. The TSC requirements analysis for the Seaway (cited above) noted that integration of the two systems would maximize effectiveness. The data and documentation problem is critical to the maritime industry, particularly in the intermodal exchange of containers at marine terminals. This problem will be discussed in Section 4. DOT should confine its activities to the ones noted here with particular emphasis on coordination and cooperation with MARAD.

3.4.7 Summary

Terminal operations, vessel traffic scheduling and control, and documentation transmittal are important problems facing the maritime industry. Computer information systems can help solve these problems. The Maritime Administration and the Department of Transportation are addressing these problems by sponsoring several developments of an intermodal terminal control system, an industry wide information system, and a St. Lawrence Seaway traffic control system. The documentation problem is especially critical in intermodal exchange at container terminals. Close coordination between the Maritime Administration and DOT is necessary to achieve maximum effectiveness from the various developments. Support of research in data and documentation exchange would also be beneficial to the maritime industry.

3.5 THE AIRLINES

3.5.1 Market Share

Air freight shipments made up only 1.3% of total US domestic and international freight revenues in 1970.[53] In ton miles, the percentage was even smaller - 0.18%.[54] Further, air freight is not a major part of most airlines' business. For example, 1971 freight revenues for US truck airlines plus Pan American were only 5.14% of total operating revenues. United, the largest freight carrier, received 7.2% of its revenues from air freight; for Pan Am, on the other hand, the figure was 1.8%.[55] Most of the 12 major trunk lines carry their air freight on passenger flights. All but 3 of these airlines do have all-cargo operations which provide 20% - 60% of freight revenues (43% for the group), but each airline lost money on all-cargo operations in 1971.[56] There are three all-cargo airlines: Flying Tiger, Seaboard, and Airlift International; and numerous air freight forwarders, including Emery and Airborne.

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[53] Transportation Facts and Trends, July 1972, p. 4.

[54] Ibid., p. 8. For 1971, the percentage was the same (.18%).

[55] "Air Freight: A Changing Market", Airline Management, August, 1972, p. 11 and "Cost Cutting and Fourth Quarter Traffic Surge Help Trunks Show 1971 Profit", Air Transport World, May, 1972, p. 53.

[56] Airline Management, op. cit., p. 11.

3.5.2 Air Freight Growth

Over the last 5-10 years, air freight has grown at an annual rate of 17.1%.[57] (Figure 6) International operations have grown considerably faster (19.1% in 1971) than domestic operations (12.7%).[58] This difference is primarily due to surface competition cost advantages for domestic freight transportation. During the 1964-69 period, domestic operations by US trunk airlines grew by 152.1%. International operations, on the other hand, increased 258.9% over the same period.[59]

During the 1960's air freight consisted mostly of small shipments with a high value per ton. Overnight delivery was offered and many shippers used the service for emergency shipments only, as the cost was about 3 times that of common carrier trucks. The airlines invested in automated terminals and warehouse space during this period in order to quickly sort and distribute the air freight at its destination. All-cargo and cargo/passenger convertible aircraft were purchased in order to better serve the potential market for the fast but expensive service. The fastest growing international market during the 1960's was the North Atlantic route. Here the only intermodal competition was from containerships - and travel time difference played an important role in the growth of air freight on this route. The 1970-71 recession severely hurt the airline industry and its air freight operations. More importantly, though, the widespread use of the container changed the character of air freight operations and will significantly affect future growth.

3.5.3 Air Freight Containerization

Containers have been used for some time by the airlines for air cargo. In the early days, the containers were filled by the

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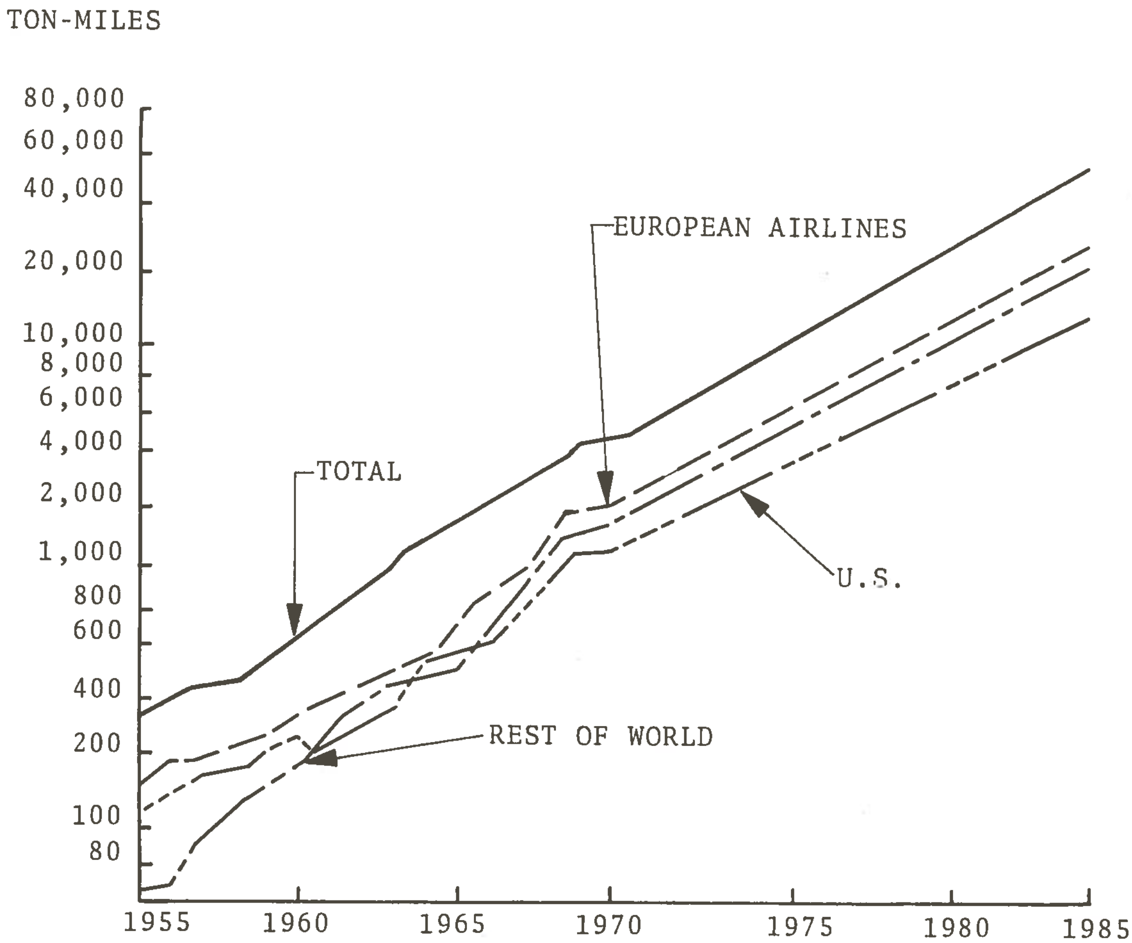
[57] "How Lockheed Views the Future of Air Freight", Air Transport World, June, 1972, p. 34-5

[58] Ibid.

[59] "Cargo Heads for First $2 Billion Year", Air Transport World July, 1970, p. 35.



SOURCE: "How Lockheed Views the Future of Air Freight"

Figure 6. Air Freight Growth

airlines with small shipments in order to facilitate the loading and unloading of planes and to reduce cargo damage. These containers were then unloaded at the cargo terminal and the shipments were sorted for distribution to the consignee. The freight forwarder business took advantage of this concept by pre-packing small shipments and delivering containers by truck to the airline. At destination, the forwarder picked up his container and did shipment distribution from his own warehouse facility. This greatly simplified airline operations. Airlines began offering special container rates. Shippers began loading containers at their own facilities for delivery to the airport. Shipment size increased and air freight operations began to change.

Container handling is much simpler for the airlines than small shipment handling. Little or no warehouse space is required because containers are waterproof and can be stored outdoors (depending on the contents of course). Shipment sorting is greatly decreased as well. The automated terminals of the 60's are being torn down and replaced by mechanized terminals using container "raceways" (converter belts or rollers) and shuttle cars to move containers to truck loading docks. The new wide body jets allowed the introduction of larger containers and the lifting of more cargo per passenger flight than with conventional planes. All-cargo flights, particularly those with convertible air planes, decreased in importance.

In conjunction with the new emphasis on containers, the airlines are offering a 48 hour service which, the airlines say, can be provided at rates that are highly competitive with trucking.[60] One factor contributing to the lower rate is that cargo costs are less for daylight flights aboard passenger aircraft than for overnight all-cargo flights.

3.5.4 Air-Truck Intermodal Connections

The airlines' intermodal connections are almost exclusively with trucks at the origins and destinations, where the shipment is

[60] Airline Management, op. cit., p. 11

small or containerized. Containers used for air freight are not so compatible with truck tractors or chassis as marine containers are. Several different sizes are used and the containers are designed to fit various aircraft interiors. They are somewhat smaller than 20' marine containers, e.g. 8' x 8' x 10'. This allows them to be transported inside truck trailers either for delivery to the consignee or to the freight forwarder.

3.5.5 Airline Passenger Reservation System

The airlines were one of the first industries to employ real-time computer information systems. American Airlines pioneered this usage with its SABRE system. Pan Am's PANAMAC and Delta's DELTAMATIC followed closely behind. From these systems, IBM developed a Programmed Airlines Reservations Systems (PARS) which is now used in some form by most major airlines.[61] Aeronautical Radio, Inc. (ARINC) is an industry-owned firm which provides a message switching service for passenger reservations of every scheduled airline.[62] This system serves to unify the industry from the customer's standpoint and greatly facilitates his origin to destination flight planning. Eastern Airlines developed a baggage tracing system which provides service to 34 other airlines as well as Eastern. The system includes a central file which detects repetitive and fraudulent claims.[63] Most other airline computer applications are confined to individual carriers and include maintenance planning, marketing statistics, and flight planning (Figure 7).

3.5.6 Advantages to Air Freight

The passenger reservation system and ARINC message switching service make scheduling information and deviations readily available

[61] "The Nervous World of Airline Computers", Airline Management, August, 1970, p. 14-43.

[62] JW Germany, AAR Data Systems Division Annual Meeting, Sept., 1971.

[63] Nervous World, op. cit., p. 25.

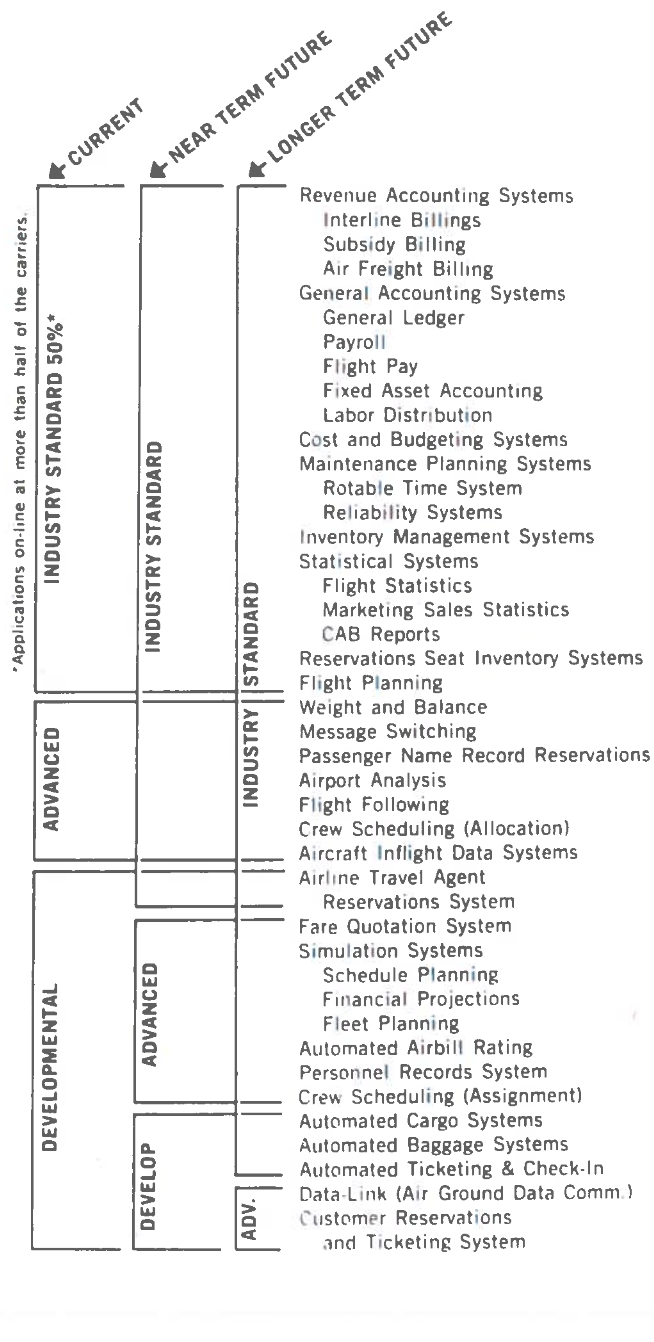


Figure 7. Airline Computer Application

to all airlines and airline users. There is an obvious benefit here for the air freight shipper, particularly since airline schedule reliability is fairly high. Schedule notification to the shipper and consignee is important because the airline controls the actual flight scheduling and because pick up and delivery service is critical to the overall door to door speed of air freight. Shipping documentation transfer is especially important here because of the shipment speed. This transfer operation must be efficiently controlled so that shipments are not held up for lack of appropriate paperwork or routing instructions.

3.5.7 Air Freight Information Systems

In 1970, American Airlines implemented an information system dedicated to air freight operations. Basic shipment information is extracted from incoming documentation and is input to the computer. The system transmits the airbill information to the destination terminal and to accounting for processing. Shipment tracing and control are possible in real-time and allow improved service to customers.[64] Several of the other major airlines have freight operations information as part of their computer systems. Here again, the primary objectives are providing scheduling and billing information at the destination, and notifying customers of cargo arrival.

Likewise, air freight forwarders, led by Emery, use computer systems to assist in their operations. Scheduling of shipments is somewhat more difficult for forwarder than for airlines and shipment tracing is more important because cargo travels on combination or all-freight airlines' equipment. The forwarder handles pick up, delivery, scheduling, billing, etc. His main tasks are refining ground handling techniques and expediting shipment movement and control. As discussed earlier, the container is an important asset in ground handling. The forwarder has no control over the planes, so he must keep close track of their arrivals and

[64] Otto A. Becker, Transportation Data Coordinating Committee, 1971, p. 16-18.

departures and inform shippers and consignees of expected delivery time.

Emery Air Freight pioneered shipment control and tracing among freight forwarders. Its latest addition is voice output from the Emery computer, EMCON, directly to shippers in response to shipper inquiries. EMCON handles the documentation and record keeping associated with each shipment. Given airbill information, the computer rates the shipment, provides the destination terminal with special instructions, and produces standardized bills.[65]

Freight forwarders handle billing of customers and also have large accounts payable to most of the airlines. Computers play a key role in accurate and timely transactions both with shippers and with carriers.

3.5.8 DOT R&D Implications

The trend toward larger containerized shipments and toward lower rates relative to trucking will help stimulate the growth of air freight. Increased volumes of freight will place demands on the airline and forwarders to continue to improve terminal facilities and the handling of containers and small shipments. The intermodal interface will continue to be exclusively truck. The lack of container standardization tends to complicate the intermodal aspects of air freight. The situation is further complicated by the increasing use of widebodied jets.

As noted, documentation transfer is critical in air freight. The airlines and forwarders can benefit from data standards and data exchange procedures, although there is little incentive for them to adopt industry standards since their only interface is with local trucks. There does not seem to be information system research and development which DOT could perform to impact upon the air freight industry.

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[65] John C. Emery Jr., Traffic World, June 26, 1972, p. 22-27

3.5.9 Summary

Air freight is a small volume business compared with other modes. Containerization has had a significant effect on the type of freight carried by the airlines and may ultimately lead to higher volumes and lower rates for air freight. Containerization has also led to simplified terminal operations and hence simpler information system requirements. Many airlines and air freight forwarders have freight operations information processed by their passenger computer systems. The primary information system functions are providing scheduling and billing information at the destination terminal, and notifying customers of cargo arrival. Improvement of documentation transfer is the only information system research and development which would benefit the air freight industry.

3.6 SHIPPERS

3.6.1 Computers in Physical Distribution

Computer applications to the physical distribution process in major companies indicate the importance placed on this phase of the production process. A 1971 survey by Traffic Management showed that computerizing the functions of physical distribution is an accepted, almost standard, practice.

FORTUNE 500 Sample		General Industry[66]
75.4%	companies with computer distribution procedures	52%
96%	companies planning expansions	82.7%
48%	non-users planning new systems	28%

The new types of traffic and distribution tasks performed by computer in the FORTUNE sample survey included:

66"Computerized Distribution - Where it stands", Traffic Management, June, 1971, p. 36-8.

inventory control[67]
order processing
freight tonnage and cost analysis
shipment routing
billing, rating, payment activities
shipment forecasting
railcar fleet control
tracing
trailer fleet control
claims.

The first six tasks listed are normal distribution functions which the company must perform before turning goods over to the transportation modes. The remaining activities (railcar control, tracing, etc.) are a direct result of the reliability (or lack thereof) of service provided by the various modes. The survey noted that 76.6% of inter-company computer connections were with carriers, primarily railroads. "Carload shipment tracing and expediting, company rail car fleet control and related matters are the major functions, while an important minority works in tandem with truck line computers developing similar information."[68]

3.6.2 Shipper Tracing Systems

From the shippers' standpoint, tracing and control activities are expensive, complicated, and should not be necessary - if the carriers could provide reliable service. Mr. A.S. Lang, as Federal Railroad Administrator, noted in June, 1968 that about 25 major shippers had, or were developing, computer systems for monitoring and forecasting the movement of their shipments by railroad. He said, "There must be scant precedent for a customer going to such

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[67] Ibid., p. 43, Chart 7.

[68] Ibid., p. 37.

elaborate lengths to hedge on a daily basis against the inability of his suppliers' production line to perform."[69]

What the shippers really need is reliable service. It is a key factor in inventory control and in ordering of components and raw materials. Without such service, they seek, as a minimum, knowledge about the whereabouts and expected arrival of their shipments. When carriers don't provide this information, as is often the case with the railroads, the shippers must develop complicated data and procedures to fill the gap. Large volume rail shippers, thus have sophisticated computer systems to do what the railroads often don't do - keep track of their freight cars.

The lack of standardization of the various railroads' systems and procedures makes this an especially difficult task. For example, when Quaker Oats established a system in 1964, it had to compile 80,000 schedules covering its car movements to use as a standard for performance measurement.[70] Since railroads themselves in general don't do performance measurement, this information was not available from a single source. Armour and Company attempted to establish a similar system in 1964, but because of the difficulty of acquiring and reformatting the data from many different railroads, it abandoned the system after three years of testing.[71]

A panel of shippers at the AAR Data Systems Division Annual Meeting in 1967 noted that shippers seek a standard transit time for various origins, destinations, and routes with exception reports to shippers. If this standard time and these reports were available, the panel noted, shippers could get out of the tracing

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[69] Mr. K.L. Vore, Vice President, US Steel quoted Mr. Lang's speech to the AAR Railroad Superintendents. AAR Data Systems Division Annual Meeting, Sept., 1968, p. 107.

[70] J.R. Mann, Vice President, Quaker Oats, AAR Data Systems Division Annual Meeting, October, 1966, p. 452.

[71] H.O. Mathews, Vice President, Armour and Company, AAR Data Systems Meeting, September, 1967, p. 176.

business.[72] The experience of most rail shippers leads them to stress the importance of the railroads establishing a real-time national information system and giving shippers access to such a system.

3.6.3 National Industrial Traffic League Goals

The National Industrial Traffic League (NITL) is a national organization of shippers and groups and associations of shippers, 1700 in all, formed to deal with transportation issues of national importance. The Data and Computer Systems Committee of the NITL has worked closely with carriers of all modes to improve the transfer of data about shipments. One of its major goals, promulgated at its November 1970 meeting is:

> To improve the reliability and economy of rail freight transportation through a centralized, computerized bank of car location and movement control information from which both shippers and carriers can economically obtain timely, accurate car location data as well as deviations from schedules.[73]

The NITL supported and cooperated with the AAR task force on National Car Information Systems. While it should not necessarily be the shippers' responsibility to establish their own car tracing systems, they are willing to do so as long as they have access to standard data from a central system.[74] The AAR task force, however, did not recommend full shipper access (at least in the first stage) to its new national information system.[75] Clearly, one of the problems which any federally-

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[72] "Shipper Computerization Activities and Their Effect on Railroads", Panel discussion, AAR Data Systems Division Annual Meeting, Sept., 1967, Mr. SH Flint, Vice President, Quaker Oats, p. 189.

[73] Mr. C.A. Kelly, Manager Transportation Research and Analysis, ALCOA and Vice President-Planning Data and Computer Systems, Committee NIT League, American Trucking Associations Management Systems Annual Meeting, April, 1971, p. 15.

[74] Mr. J.R. Mann, Quaker Oats, AAR Data Systems Division Annual Meeting, Oct., 1966, p. 45.

[75] Report of the Task Force on National Car Information and Control Systems Association of American Railroads April, 1972 p. 1-14

sponsored national railroad information system development must address is the role of the shipper in the system.

Aside from rail car monitoring and normal traffic management functions, shippers' computer activities center on the areas of computerized rate and tariff application and data standardization. The other two major goals of the NITL computer committee are:

> Rate and Tariff Application A centralized computerized bank of rate and tariff data from which all segments of the transportation industry having need for this data can rapidly and economically obtain the legal, lawful and applicable rate for given, precisely defined shipments.
>
> Data Exchange To develop computerized techniques for exchanging shipment data among carriers, shippers, banks, and regulatory bodies for freight payment, audit, shipment control, tracing, regulation, and analysis.[76]

3.6.4 DOT R&D Implications

Shippers are the ultimate recipients of the improvements which research and development in freight transportation seeks to obtain. Shippers would be a major beneficiary of any service improvements made in railroad or intermodal transportation. Their requirements must therefore be considered in any R&D toward service improvements. Shippers' efforts and costs associated with shipment tracing should be reduced or eliminated through inclusion of their requirements in the design of any national railroad information system. Data standards are particularly important to shippers because of their intermodal perspective. Shippers' activities in the areas of computerized transportation information system attest to the fact that the railroads require the most service improvements to maintain their traffic and/or win new business.[77] These shipper activities strengthen the justification for DOT participation in railroad operations, R&D in general and information systems development in particular.

[76] Kelly, op. cit., p. 17-18.

[77] See Pollard, op. cit.

3.6.5 Summary

Most shippers use computer information systems to assist in the physical distribution process. A primary purpose of these systems is to monitor the service provided by the various transportation modes (particularly the railroads). Shippers seek reliable service, and, if necessary, exception reports if their shipments depart from published schedules. The three major shipper goals set forth by the National Industrial Traffic League are: improved rail service reliability; computerized rate and tariff data; and techniques for computer exchange of shipment data. These requirements strengthen DOT justification for railroad research and dictate consideration of shipper goals in information system developments.

4. DATA AND DOCUMENTATION

A recurring theme throughout the preceding section has been the universal data and documentation problem in transportation. The industry has been pursuing solutions to this problem for several years. Moderate successes have been won, but the problem remains. The four goals in solving the data problem are:

1) standard data codes and formats
2) carrier-carrier and carrier-shipper data exchange
3) computerized freight billing
4) computerized rates and tariffs.

Continued and expanded DOT support of the various industry efforts can contribute significantly to meeting these goals.

4.1 DATA STANDARDS

4.1.1 Standard Code Developments

Various industry groups have been working to develop standard codes since the mid-sixties. Subcommittees of the railroads' Data Systems Division and the motor carriers' Management Systems Committee have pioneered in the development of commodities and geographic location codes (Standard Transportation Commodity Code - STCC and Standard Point Location Code - SPLC). The Transportation Data Coordinating Committee (TDCC) was formed in 1968 to lead the program of code standards and other data system-related activities. Shippers, already active through data processing committees of the National Industrial Transportation League, are also members of TDCC and give it the necessary total view of the transportation data problem.

TDCC is working on a standard patron code to use as part of computerized freight billing. It has endorsed and attempted to adopt the DUNS number of Dun and Bradstreet as the transportation patron code. A modified DUNS file containing 3 1/2 million different company locations was purchased by TDCC on microfiche for $1500 for the first year. This file was subsequently made available by Dun to TDCC member companies for $400 per year with a file update every 6 months. The industry has been slow to accept this patron code, however. The TDCC has received a price quote of $55,000 per year for a modified version of the DUNS number file on magnetic tape. In this case, tapes would be available to TDCC members for $1,000 per year. TDCC does not believe it can afford the $55,000 itself but apparently has not been able to convince any of the carrier associations to use the code and help pay the TDCC cost.[78]

A standard carrier identification code consisting of four alphabetic characters has been endorsed by TDCC. In addition, programs are underway to develop codes to aid in tariff computerization and automated waybill data transfer.

4.1.2 DOT Activities

The Department of Transportation has also been active in the data standards field. The Office of Facilitation was established within the Office of the Secretary to be responsible for standard coding activities. It has worked closely with TDCC on the coding problem. TDCC has received several contracts from Facilitation for Code Standard development - most recently in international standards. As the result of a government/industry coordination meeting of August 3, 1971, the Office of Facilitation was charged with coordinating Federal government and international coding requirements while TDCC was to coordinate industry requirements. Following that meeting, the Office of Management and Budget (OMB) designated DOT as lead agency in "developing those data standards

[78]Remarks by E.A. Guilbert, TDCC President at Management Systems Committee Meeting, American Trucking Associations, April 18, 1972, Proceedings, p. 223-227.

necessary to the automation of freight movement data."[79]

4.1.3 Impediments to Standard Codes

Unfortunately, use of the various standard codes is not widespread. Shippers are, of course, extremely interested in the codes because they must communicate with each mode of transportation. Response by the various carriers has not been encouraging. A standard response is "We are doing fine with out present code - when everyone agrees to use the code, we will use it."[80] If a carrier already has an extensive computer system, it may be a considerable expense for him to adopt a standard code. Mr. E.A. Guilbert, president of TDCC, noted that the purpose of standards is not to force carriers to effect instant change, but to offer the means for interchanging information in compatible codes if the need arises.[81]

4.2 DATA EXCHANGE

4.2.1 Data Redundancy

Standard codes can make automated data exchange between carriers and between shippers and carriers a reality. Improved efficiency and reduced costs to all concerned are possible if automated procedures for exchanging data are implemented. The AAR study of car information systems noted that 61% of car movement data keypunched by railroads is redundant. The estimate of savings potential by eliminating the redundancy is $2 million.

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[79] H.E. Harriman, "DOT Plans for Data Exchange," Third National Forum Transportation Data Coordinating Committee, November 1-2, 1971, p. 25, See also DOT News Release, October 26, 1971.

[80] E.A. Guilbert, "Exchange of Data Between Shippers and Carriers of All Modes", AAR Data System Division Annual Meeting, September, 1971, p. 39.

[81] Ibid.

4.2.2 Railroad Data Exchange

Serious efforts to exchange data have been conducted by small groups of railroads with the mechanization proportional to the compatibility of the computers. Union Pacific (UP) exchanges with 7 other railroads; Illinois Central with 5 railroads. The UP also has a common data base and format effort underway in cooperation with the Southern Pacific.

Various subcommittees of the AAR's Data Systems Division have developed data exchange programs and have sought railroad participation. In 1970, four major programs were discussed at the Data Systems Division annual meeting: exchange of per diem settlement data with 30 railroads participating, interline freight revenue settlement records with 9 railroads testing the exchange, car repair billing exchange, and finally, waybill/car movement data exchange.[82] Even so, data exchange is not widespread on the railroads, as is evident from the Alton Associates study of freight car managment systems for DOT.[83]

4.2.3 Impediments to Data Exchange

As pointed out earlier, there is little or no data exchange in trucking. On a very limited basis, there is some physical exchange of magnetic tapes or punched cards. ICC submissions are also made on printouts or tapes in lieu of traditional typed reports.

While less prevalent than in the past, fierce inter-carrier competition (both truck-rail and within industry) tends to discourage the free exchange (and potential availability) of data which many companies think would affect them adversely if they were obtained by competitors. The general financial condition of the industry tends to discourage the implementation of the standardization necessary for data exchange. Shippers and carriers

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[82] R. Hughes, AAR Data Systems Division Annual Meeting, Sep., 1970, p. 114-16.

[83] "Study and Forecast of Freight Car Management Systems", Alton Associates, April, 1971, p. 3-6 through p. 3-26.

alike are hurt by this condition.

4.3 COMPUTERIZED BILLING

4.3.1 Reducing the Paper Work

One of the most promising applications of automated data exchange is computerized billing. Far too many pieces of paper change hands and require administrative labor at all stages of processing. The goal should be the elimination of all paper transactions associated with waybills or freight bills. One labor expense would be involved; keypunching the original billing information into the computer systems. All additional labor, all data redundancy, all associated time delays would be completely eliminated.

4.3.2 Repetitive Waybill Code

The railroads have taken a step toward this automation by developing a "repetitive waybill code" which further reduces the amount of labor and data exchange involved. For shipments of the same commodity between the same origin and destination etc., only variable information concerning the shipment need be key punched. Naturally, a repetitive code is not useful for all shipments. Still, for the railroads, 60-70% of their traffic is repetitive (2 shipments or more per month) and generates 90% of railroad revenues.[84] The important point is that the repetitive waybill code is another useful data standard which can help make automated waybill processing and billing a reality.

4.3.3 Industry Activities

The bill of lading from the shipper is the chief source document in transportation. The initial input to a carrier's

[84] Comments by Mr. R. Walker at American Trucking Associations Meeting, April 18, 1972.

computer system includes the data contained on the bill. Most carriers in all modes make these data available to destination terminals for operations planning and shipper notification. For the sake of regulations and tradition, paper bills are still used for final billing of the customer and for accounting requirements. The elimination of this paper can only follow development of data standards and more widespread data exchange. High speed printers are increasingly employed by the industry to generate required forms for submission to regulatory bodies or for billing of customers. Some customers likewise control the payment of bills. On a limited basis some shippers and carriers have developed jointly automated billing systems. For example, Ford and the Louisville and Nashville (L&N) Railroad set up an automated system serving the auto and truck plants located in Louisville, Kentucky. Even in this case, however, the computer generates 12 copies of a waybill: "seven copies are returned to Ford for their use and the balance distributed within the L&N in the normal manner.[85]

Centralized billing is a step toward automation being taken primarily by motor carriers through the computer service firms noted in the last chapter. While the computer system detects errors, edits and controls bills, and extracts necessary statistical data, paper copies of the bills are still involved.[86] A railroad uses cathode ray tube (CRT) devices to enter waybill information into its computer system and prints waybill documents at the destination terminal and at the central railroad office. The CRT inputs utilize the repetitive waybill code and apply to local traffic only. There are no current plans to eliminate the waybill altogether.[87]

The paperwork of freight bills cannot be eliminated until all shippers and carriers have compatible information systems. This requires data standards and widespread data exchange. In the

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[85]SA Alward, Transportation Data Coordinating Committee, 1971, p. 43-45.

[86]MJ Brough, Ibid., p. 69-72.

[87]J.L. Jones, AAR Data Systems Division, Sep., 1972.

meantime, computer systems are being successfully employed to improve the accuracy and control of freight bills.

4.4 COMPUTERIZED RATES AND TARIFFS

4.4.1 Cumbersome Tariff System

The determination of the applicable charge for moving a certain type of freight between two points is one of the most complicated procedures carried out in transportation. It is a largely manual procedure involving a huge data base. It has been estimated that there are 43 trillion ICC approved rates for various commodities, weights, origins and destinations.[88] People have talked and written about computerizing the rating system for a number of years but the problem has not been solved, primarily because of the magnitude of the task.

The ICC tariff system is a very old one, originating in the early 1900's and remaining essentially unchanged today. Tariffs are revised as appropriate and new tariffs are issued to cover new types of service or rate increases. Obsolete tariffs are not eliminated and revisions are normally not completely new editions as with telephone directories. There are thus millions of "paper rates", obsolete or unused tariffs, still on file at the ICC. This tends to complicate any concept of computerization.

4.4.2 Feasibility of Tariff Computerization

Battelle Memorial Institute conducted an important study for DOT in 1966 and concluded that tariff storage and retrieval by computer was technically feasible.[89] Battelle proposed a structuring of information (derived from tariffs) which determine applicable freight rates. Considering elements in order of priority

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[88] Various sources including Time, May 8, 1972, and Railway Management Review, Vol. 72, No. 1.

[89] "Feasibility of Computer Storage and Retrieval of Freight Tariff Information." Battelle, May, 1966.

simplifies the tariff searching procedure.

The American Trucking Associations funded the logical extension to the Battelle project in 1968. Texas A&M, in conjunction with Battelle, determined that computerization of motor carrier rates was economically feasible if it was included in an already existing management information system.[90] In this study, a manual procedure was estimated to cost 40¢ per shipment (predicted for the early 1970's). Computerized rating by various parties, carriers, shippers, rate bureaus, service systems, was estimated to cost from 18¢ to 38¢ for large volumes of shipments.[91]

4.4.3 Railroad Industry Approach

The railroads attacked the problem as an industry by forming a Joint Railroad Tariff Computerization Committee in 1966. This committee investigated standard rate codes and forms and in early 1970 filed standardized computerized tariffs with the ICC.[92] Two computer programs were developed in conjunction with IBM:

1. Tariff Publishing System, which maintains and updates the tariff data library on magnetic tape.
2. Traffic Profile Analysis System, which allows extraction of selected information from the tariff library.

These standard programs, with standardized data bases, are used by all three of the railroad rate bureaus. Tariffs are continually being converted to computer form in order to expand the data base of possible rates. These tariffs are available both to railroads and shippers. There is currently no railroad effort to computerize rate retrieval, and apparently will not be, until the data base for railroad rates has been computerized.

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[90] "Economic Feasibility of Computer Retrieval of Motor Carrier Rates" Texas Transportation Institute, May, 1969.

[91] Ibid., p. 96.

[92] Railway Age, January 19, 1970, p. 7.

4.4.4 Motor Carrier Approach

The motor carrier approach has been on a more regional or an individual company basis except for the economic feasibility study sponsored by the ATA. Since about 90% of motor freight moves on class rates (commodity classifications and scaled rates based on mileage), the computerization of rates is a more manageable activity.[93] Manual tariff searching and then automatic storage and retrieval of rates applicable to a carrier, shipper, or group is becoming important in the motor carrier industry. Numerax, Inc. markets a computer-produced guide book of current class rates from a given origin (some 500 available) to over 45,000 destination points. This service is available in comparative form for six ground and air modes but railroads are not included because they use few class rates.

At least two motor carrier computer service firms, Transport Data Communications, Inc. and Transportation Management Services offer a central rating service in which all rating is done at a central locations rather than at individual terminals. All arithmetic calculations are done by computer, although the actual search for the rate is done manually. Service firms like these are said to be using the results of the Texas A & M study as a basis for moving into computerized rate retrieval,[94] but no results beyond central rating have been published.

Two motor carriers have reported on fully computerized rate retrieval including tariff searching and computation of the applicable rate for nearly all shipments: St. Johnsbury Trucking

[93] Commodity rates on the other hand are separately negotiated from origin to destination for each shipment. Consequently, there are more commodity rates than class rates. For railroads, 97% of rates are commodity rates. Because of the uniqueness of each commodity rate, a simple table look up approach would not be appropriate.

[94] A. Dewey Williams, TDCC 1970 Annual Meeting, p. 14.

Company (discussed at the 1966 AAR Data Systems Division meeting) and Nestor Brothers, Inc,) discussed at the 1972 ATA Management Systems meeting). A computer service firm, Universal Systems, Inc., has computerized the rate groups and origin-destination points in the Middle Atlantic Conference which it makes available to participating motor carriers as a rating and communications service (discussed at the 1970 ATA Management Systems meeting). The cost quoted at that time was 22¢ - 30¢ per freight bill.

4.4.5 Shipper Activities

Shippers are also quite interested in computerized tariffs. The NIT League Rate and Tariff Goal was discussed earlier. In a 1971 survey of Fortune 500 companies by Traffic Management, 6.3% of the 95 respondents listed tariff computerization as a problem area.[95] Among shippers that have documented use of computer generated tariffs or storage of applicable rates are: Phillips Petroleum (TDCC 1970), DuPont (ATA Annual Meeting 1967), and Western Electric (TDCC 1971).

4.4.6 Quixotic Goal

While total computerization of rate retrieval may be an important goal, there is a consensus in the industry that the goal may be quixotic unless the whole tariff structure is simplified. No computer is capable of storing 43 trillion rates. In any case, an evolutionary form is a mandatory first step toward computer rate retrieval. Railroad activity in this area is significant. Storage and access to oft-used rates by shippers and carriers is another cost saving step in that direction. The Numerax service for class rates is also an important application. In the meantime, the NIT League and carrier committees will continue to seek the expanded data base and standard procedures necessary to attain computerized rate retrieval in the future. Simply ridding the files of the many paper rates would go a long way toward aiding tariff computerization.

[95] "Computerized Distribution - Where it Stands" Traffic Management, June, 1971, p. 44.

4.5 DOT R&D IMPLICATIONS

There is no question that DOT is supporting and should continue to support, all industry activities toward the solution of data and documentation problems in transportation. The Transportation Data Coordinating Committee is the logical vehicle to solve the problems. Unfortunately, TDCC efforts are less research and development than simply education and promotion of certain standardization activities. The Office of Facilitation in DOT is the key government element working with TDCC. It has had relatively modest budgets for research but has supported several of the standard developments. This is an obvious area for continued and increased R&D support. But as pointed out earlier, development of a code does not force its use.

The various central information system developments (shipping operations, railroad national information, St. Lawrence system) which the federal government supports are important avenues for the promulgation of data and documentation standards which can strengthen the work of TDCC and the Office of Facilitation. All systems built with government assistance must be compatible with existing standards. Member carriers would then be forced to communicate in the standard formats if they hoped to derive benefit from the systems. The systems would therefore greatly facilitate data exchange. The problems of data and documentation should be considered in the initial designs of all federally - supported system developments.

A demonstration period with any or all of these systems could be used to promote data exchange and computerized billing. These demonstrations could also serve as vehicles for developing and refining new codes. Intermodal carrier participation in demonstrations would be voluntary. The TDCC would be closely involved in set up, conduct, and industry exposure to the demonstrations. Such demonstrations would be logical extensions of standard code developments and would aid greatly in furthering the use of standards.

Tariff computerization is a problem which is closely related to the regulatory framework governed by the ICC. Tariff simplification and computerization would seem to be a high priority modernization job within the ICC, but this is apparently not the case. DOT established the technical feasibility of tariff computerization and the ATA showed economic feasibility. Yet no programs have followed these studies. Industry attempts at tariff computerization have been hampered by the volume and complexity of the tariff data base. A cooperative development and demonstration program involving DOT and ICC could make great strides toward simplification and computerization of tariffs.

The groups of tariffs applicable to intermodal transportation (particularly truck-rail) could serve as the demonstration data base. Simplification of those tariffs would lead to an optimum data base for computerization. The standard procedures so developed could be applied to all piggyback traffic or perhaps to certain markets, depending on the magnitude of the tasks. If the demonstration proved successful, the technique could then be applied to other groups of tariffs until the entire operation at the ICC would be computerized. The appeal of this type of program is its universal utility to intermodal transportation. (At present, marine shipping and air freight are regulated by the Federal Maritime Commission and the Civil Aeronautics Board, respectively. Computerization of the more complicated ICC operation would presumably lead to similar activities in these two agencies.) In addition, the simplification and computerization would take place and be of value to the industry regardless of what types of regulatory changes might take place in the future.

4.6 SUMMARY

Data and documentation represent a major intermodal problem in transportation. The Transportation Data Coordinating Committee plays a key role in development and promulgation of data standards. Government efforts in this area have been modest except for support to TDCC in code developments. Computer to computer data exchange and computerized shipping bill transfer are key problems which depend upon adoption of data standards. Unfortunately, the inherent operational differences among the modes impede the adoption of standards as well as computer data exchange. Tariff computerization is a problem of importance to both carriers and shippers, but is greatly impeded by the complicated Interstate Commerce Commission operation. DOT-supported demonstrations of computer data exchange and billing and of tariff computerization would be of significant value in promulgating data standards within the industry and in improving intermodal freight transportation.

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