Increasing Efficiency and Reducing Transportation Costs

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Introduction

By way of introduction, I would like to briefly describe the relationship to the Texas Transportation Institute and its function as a part of the Texas A & M University System. The Texas Transportation Institute is a branch of Texas A & M University and a part of the College of Engineering. The Institute is basically a research agency for the University in all areas of transportation. We are somewhat unique in that we receive no state appropriated funds and are, therefore, funded entirely through contract research with both private and governmental agencies and organizations. As a research oriented organization, the Institute is in a unique position to contribute both to technical and managerial aspects of the multiorganizational approach to a research effort. The prime mission of the Institute is to conduct research relating to all facets of transportation and distribution utilizing a multidisciplinary team approach.

In a period of rising food prices, rising fuel prices, rising wage rates and rising everything else, the transportation sector offers potential for substantial cost savings to the food distribution system.

Objectives

The objectives of this paper are (1) to examine some sources of inefficiencies that exist in our transportation system; (2) to demonstrate the use of one technique that has potential for reducing transportation inefficiencies and, therefore, costs; and (3) recommend areas for further research.

Transportation Inefficiencies

Transportation is only one segment of the total food marketing and distribution system as it functions today. Recent estimates indicate that the transportation function alone accounts for approximately 7 percent of the total cost of food marketing and distribution, Table 1.

Table 1. Selected Components of Food Marketing Costs

Labor	51%
Packaging	12%
Transportation	7%

Source: USDA, ERS, Marketing and Transportation Situation, MTS 198, August, 1975, p. 17.

When compared to labors' portion of the total marketing bill of approximately 50 percent, this may seem to some to be a small and insignificant figure. This simply is not the case.

The National Commission on Productivity and Work Quality, for example, has estimated that maximum use of backhauling by motor carriers throughout the nation would produce a potential savings as high as 250 million dollars a year (1) (Table 1). This is probably an overstatement since every truck will not be able to arrange for a backhaul on every return trip, however, substantial savings are to be gained by arranging backhauls at little or no additional expense to the carrier, reflecting reduced cost to the entire distribution system. The problems of initiating many backhaul movements are not so much the unwillingness of carriers to locate loads for backhauls as that of regulatory constraints of the Interstate Commerce Commission, Federal Trade Commission, and in many cases, as in Texas, state regulatory agencies. The Task Force on Railroad Productivity states that the Interstate Commerce Commission's policy of prohibiting rates by regulated motor carriers which just cover the incremental costs of implementing a backhaul movement is to refrain from "allowing something in the nature of a nationwide system of competitive trucking which would erode the existing structure of discriminatory rates"(2). The Commission finds it necessary to prevent such rates thus causing common motor carriers to run a large number of empty miles which could be used productively as a backhaul.

In terms of marketing and food distribution and all areas of rail transportation, the railroad industry can also make great strides in productivity and utilization efficiency. The Task Force on Rail Productivity reports that the average rail car handles only 14 revenue loads per year or one load every 26 days, Table 2. The Report also points out the fact that the average freight car moves (loaded and empty) about 17,500 miles annually (as compared to 60-100,000 miles annually for motor carrier trailers). In addition, the average rail car moves under load only 25 miles per day or an average of 1.25 hours per day (3).

As is the case with both carriers, innovations and improved quality of service in the transportation industry is severely hampered in many cases by institutional constraints. As a result, both the trucking industry and the railroad industry operate at approximately 50 percent of capacity (4).

Table 2. Sources of Transportation Inefficiency

- Regulatory and Institutional Constraints to Motor Carrier Backhauls.

- Average Rail Car is Loaded Only 1 Time Every 26 Days or Handles Only 14 Revenue Loads Per Year.

- Average Freight Car Moves Only 17,500 Miles Annually (Motor Carrier Trailers Average 60-100,000 Miles Annually).

- Average Rail Car Moves Only 25 Miles Per Day (1.25 Hours Per Day) Under Load.

Results: Both Trucking Industry and Rail Industry Operate at Approximately 50% of Capacity.

Source: Improving Railroad Productivity, A Final Report of the Task Force on Railroad Productivity; A Report to the National Commission on Productivity and the Council of Economic Advisors, Washington, D.C., November 1973.

The cost to society are of two types as outlined in the Task Force on Rail Productivity Report (5) and Table 3. These are (1) direct costs from idle resources which are estimated to be as high as 5.7 billion dollars annually for the railroad and trucking industry combined, and (2) a misallocation of traffic between the various modes, to the point of favoring trucks over rail service in intercity freight movements even on long distance hauls exceeding 200 miles at an annual cost to society of approximately 500 million dollars.

Table 3. Costs to Society for Transportation Inefficiency

- Maximum Use of Motor Carrier Backhaul Costs Society as Much as $250 Million Annually.
- Direct Costs of Idle Resources in Terms of Rail and Motor Carriers is as High as $5.7 Billion Annually.
- Misallocation of Traffic Between Modes Cost Society About $500 Million Annually.
- Net Cost to Society of ICC Regulation is Approximately $5.6 Billion Annually.

Source: Productivity: Backhaul in Food Distribution, National Commission on Productivity and Work Quality; Washington, D.C., Improving Railroad Productivity, Final Report of the Task Force on Railroad Productivity; A Report to the National Commission on Productivity and the Council of Economic Advisors, Washington, D.C., November 1973.

A Cost Reducing Technique

The results of the study to be presented are a direct result of previous scheduling and logistics studies and a desire to analyze the efficiency of rail movements in grain distribution.1/ Although this study was made with wheat as the selected commodity, the results hopefully, will provide an indication of the impact of advanced planning and scheduling utilizing available analytical procedures in the transportation and distribution of all food products whether by truck or rail (6).

The study objective was a case analysis of the efficiency of the grain movement patterns by rail. The following analyses were performed: (1) an examination of the existing flow patterns of wheat under the existing rate structure, distance traveled, and transit time; (2) to simulate the optimum flow patterns based on the existing rate structure, minimum distance, and estimated transit time; (3) estimate the potential savings accruing to the sample incorporating turnaround time and loading and unloading times into the actual and simulated alternatives.

The models employed in the analysis of this study included a network model and a transportation linear programming model.

The network model was used to determine the minimum distance between all origins and destinations under two different assumptions. The first distance network was constructed to determine the minimum distance between all identified origins and destinations under the assumption that only the trackage of a single railroad was used. The second distance network was constructed to determine the minimum distance between origin and destination points assuming all trackage could be utilized regardless of the owning line. A matrix of point to point commodity rail rates was assembled and utilized as the rate base.

Estimates of transit times as well as time consumed in loading and unloading functions were derived. The matrix constructed for origin and destinations included 41 origin points and 14 destination points to form a matrix containing 574 cells.

The transportation matrix employed in the linear programming simulation model was altered to analyze the optimal flow under four alternative assumptions:

1. the least cost flow based on the current rail rate structure,

2. the minimum distance flow using only the trackage of an individual railroad,

3. the minimum distance flow using all available trackage regardless of the owning line, and

4. the minimum transit time flow based on estimated transit times derived from sampled movements.

The results of each simulated alternative are compared to the actual movements, Table 4 and 5.

In the interest of time and space the comparisons and resulting savings are presented in the following tables.

Implications for Needed Research

The possibility for extending this type of analysis to other food products and other modes of transportation should be explored. The results of this case study imply that the employment of computer based analytical techniques in conjunction with sound management and accounting procedures will produce substantial savings to the food distribution industry. Support for this thesis was presented by Ballou at the 14th annual meeting of this society. He states that little use is being made of the computer for scheduling of pickup and deliveries. (9)

In conclusion, intermodal coordination among the various segments of the food distribution system and the employment of computerized scheduling of deliveries suggest substantial cost savings and, therefore, a more efficient and effective food distribution system. Note that the case study reported represents one application of the potential cost savings in transportation charges, distance traveled and time in transit that can be realized in other sectors of the food distribution system.

Table 4. Selected Comparisons of Actual Movements and Alternative Simulated Movements (6)

	Actual Movements	Optimal Least Cost Movement	Optimal Distance Solution Individual Railroad	Optimal Distance Solution All Trackage
Total Transportation Costs	$101,260	$96,160	$98,740	$98,970
Average Transportation Costs				
Carload	$ 1,033	$ 981	$ 1,008	$ 1,010
Bushel	$ 0.310	$ 0.295	$ 0.302	$ 0.303
CWT.	$ 0.517	$ 0.491	$ 0.504	$ 0.505
Total Mileage	56,036	--	53,754	47,429
Individual Railroad Mileage	--	53,943	--	--
All Trackage	--	47,563	--	--
Average Car Mileage	572	--	549	484
Individual Railroad Mileage	--	550	--	--
All Trackage	--	485	--	--

Table 5. Comparisons of Total Shipment Car-Days of Actual and Minimum Transit Time Solution with Estimated Loading and Unloading Times (6)

Item	Original Movements1/	Minimum Transit Time Solution2/	Difference
Total Car-Days in Transit	123.92	120.87	3.05
Detention Time			
Loading Time	109.43	89.18	20.25
Unloading Time	173.95	119.13	54.82
In Transit	194.49	188.00	6.49
Total Shipment Car-Days	601.79	517.18	84.61

1/ Average of sample loading and unloading times.
2/ Reduced average loading and unloading times.

FOOTNOTE

1/ My experience in the food distribution industry has been primarily in the movements of bulk grains. The results presented here are those of a case study of rail car utilization employing a network analysis and a transportation linear programming model. This study was conducted during the summer of 1974 at Kansas State University under the supervision of Dr. Leonard W. Schruben (7, 8).

REFERENCES

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3. Ibid., p. 290

4. Ibid., p. 195

5. Ibid., p. 195

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