SRI International

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Technical Status Report Number 1
for the Period from April 24, 1978 through June 3, 1978

TRANSPORTATION ENERGY CONSERVATION STUDIES

Prepared for:

Department of Energy
San Francisco Operations Office
1333 Broadway
Oakland, California 94612

Contract EC-76-C-03-1176 (as modified)

SRI Project TCU 5419

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DISCLAIMER

I PROJECT STATUS

A. Introduction

This technical status report covers a five-week period from 24 April through 3 June 1978. Subsequent progress reports will generally cover four-week periods.

The program plan described a reporting schedule in which status reports were submitted late in the month following the reporting period. Attempts will be made to shift the submission one or two weeks earlier.

Activity in the first period was concentrated on preparatory work. In the freight task, analysis preceding visits to shippers was conducted. In the passenger tasks, visits were made to various transit officials and arrangements made for further study. Considerable descriptive data for the transit studies were compiled.

B. Project Contacts

1. Meetings

A field trip was made by Mr. Henderson to New York City, in conjunction with other travel. Persons contacted were:

Mr. Louis S. Gambaccini, Director, Rail Transportation
Mr. John F. Hoban, Deputy Director, Rail Transportation Dept.
Mr. Donal T. Smith, Asst. Manager, Rail Development Division
Port Authority Trans Hudson
One World Trade Center
New York, NY 10048

Mr. George Hakailis
Tri-State Regional Planning Commission
One World Trade Center
New York, NY 10048

Local field trips were made as follows:

Mr. Robert H. Miller, Supervisor, Electrification Engineering
Bay Area Rapid Transit District
800 Madison Street
Oakland, California 94607

Mr. Donald S. Larson, Manager, Research and Planning
Mr. Laurence Kurz, Comptroller
Mr. Warren Robinson, Transportation Engineer
Alameda - Contra Costa Transit District
508--16th Street
Oakland, California 94612

Prof. Wolfgang Homburger
Institute for Transportation Studies
University of California
Berkeley, California

C. Work Performed During the Period

Task 2-Modal Shift Analysis

The Task 2 investigation was launched in this reporting period, with major effort focused on Subtask 2.1, reported below. In the conduct of the Subtask 2.1 analysis, certain desireable shifts in direction regarding interview strategy in later steps became evident. These changes were described briefly in the Program Plan. In short, this altered approach is as follows:

- conduct fairly wide-ranging interviews with San Francisco Bay Area shippers in the first round (Subtask 2.2)

- in the subsequent analysis stage (Subtask 2.3), try to distill responses from the first set of interviews into a more structured and specific set of questions for shippers in subsequent rounds (subtasks 2.4 and 2.5)

- Depending upon the results of the first round of interviews, shippers for the second round might be contacted by mail or telephone for the bulk of their response. If this means is successful, subsequent in-person visits to those shippers might be more effective, and it is likely that more shippers can be interviewed in each visit. In fact, two nearby cities might be visited in each round of interviews.

Specific commentary on the subtasks follows.

Subtask 2.1-Identify Candidate Shippers

This activity was largely completed in this reporting period. A set of major industries in which rail and truck services are fairly competitive was defined from Census of Transportation data. A review of this process is attached in the Appendix. Within each of these industries, certain large companies were identified as promising candidates for vists.

The sample of industries includes a number of food-related industries, chemical producers, auto manufacturers, and certain refined materials producers. The sample is strongly oriented toward the midwest, with relatively few industries centered in the south, northeast, or northwest.

Subtask 2.2-Interview first set of shippers

No interviews were conducted within this reporting period, but rather were scheduled to begin shortly thereafter. Promising candidates in the San Francisco Bay Area include Del Monte, Kaiser Aluminum, C&H Sugar, and wine producers. A draft letter was developed for shippers and is included in the Appendix.

Certain ideas for improvements in rail freight energy efficiency and for means of shifting some truck traffic to rail were discussed prior to the first round of interviews. These concepts were reviewed by various SRI professionals outside the project team and valuable comments earned.

Subtask 2.3-Analyze modal shift implications

Some improvements to the Long Run Average Cost and Energy Model were made during the period, particularly with an eye toward anticipating shipper recommendations and evaluating those responses.

Task 3 - Total Energy Demands

Partial first drafts have been prepared for BART and PATH. Material covered includes history, routes, equipment, and services. In addition, a first draft has been prepared for three alternative PATH programs which treat upgradings of existing commuter rail lines vs a PATH extension.

Data have been collected on the principal direct energy demands for both systems. Principle elements of economic data needed for system descriptions and for estimates of indirect and capital energy demands have been collected. Economic data have not yet been analyzed.

Task 4

A partial first draft has been prepared for Alameda-Contra Costa Transit District bus services. Material covered includes history, routes, equipment, and services. Data have been collected on diesel fuel energy demands but not for other classes of direct demand. Principle elements of economic data have been collected but not yet described or analyzed. Estimates of indirect and capital energy demands have yet to be made.

Data have been obtained on modes of transportation used to gain access to BART and PATH. Preliminary drafts have been written.

Attention has been given to the identification of possible choices among alternatives for which energy economy studies would be useful and to methods suitable for conducting such studies.

D. Work to be done during the next period

Task 2

During the next reporting period, subtask 2.2 - Interview first set of shippers - should be completed along with some or all of subtask 2.3 - Analyze modal shift implications. Preliminary contacts with shippers for the second and third round of interviews (expected now to be conducted more quickly following the more conservative approach to the first round) may have been made by the end of the next period.

Tasks 3 and 4

Data collection, analysis and writing will continue with first priority on completion of the descriptions of BART, PATH, AC Transit and feeder services and to the estimation of direct, indirect and (future) capital energy demands if systems continue without major change.

Data collection, analysis and writing will also be done on possible major changes--i.e., alternative programs.

Work on the description of energy economy study methods will be initiated.

II STAFF HOURS AND FUNDS

A. Funds

Project expenditures in the five weeks ending June 3, 1978 are estimated at $8,773. This figure is based upon weekly tabulations made by internal accounting systems and may not include charges that have not yet been billed

B. Staff Hours

During the period, staff hours in the following categories were expended on the project:

Labor Category	Hours this Period	Project to Date
Supervisory	12	12
Senior Professional	143	143
Professional	78	78
Technical	0	0
TOTAL	234	234
PLANNED	256	256

Planned and actual cumulative project hours are shown graphically in Table 1.

Table 1

Planned and Actual Staff Hours*

		Reporting Period		Project to Date	
Period	Weeks	Planned	Actual	Planned	Actual
4.24 - 6.2	5	256	234	256	234
6.5 - 6.30		236		492	
7.3 - 8.4		252		744	
8.7 - 9.1		236		980	
9.4 - 9.29		196		1,176	
10.2 - 11.3		200		1,376	
11.6 - 12.15		188		1,564	

*Planned figures exclude Task 1 manpower of 152 hours, which was unscheduled when the Program Plan was prepared.

Clerical time is excluded from both planned and actual committment.

APPENDIX

TASK 2

ANALYSIS OF THE ENERGY-SAVINGS IMPLICATIONS OF SHIFTS IN SHIPPERS' MODAL CHOICE FROM TRUCK TO RAIL FREIGHT SERVICES

Movement of freight by railroads generally requires less fuel than corresponding movements by truck, although the rail advantage becomes less or disappears completely in certain circumstances. Despite the lower fuel consumption and generally lower cost of railroad freight shipment, the volume of freight shipments by truck is growing.

Shippers' preference for trucking over railroad, despite the higher cost, is explained by service differences. The shipper finds or perceives that the higher transportation costs via truck are rewarded by faster and more reliable service, which, in turn, allows him to reduce the total cost of physical distribution.

It is likely, however, that there are cases where the railroads can attract substantial amounts of traffic now moving by truck, with a resultant energy saving, by making minor modifications to service. The objectives of this study are to review modal choices in freight transportation and to examine potential energy and cost savings and efficiency improvements earned by shifting the modes used by manufacturers in physical distribution of their products from truck to rail services.

The study is organized around interviews with large shippers to identify opportunities for shifting modes and the potential volumes of traffic involved, evaluation of cost and energy implications, identification of barriers to

implementation, and evaluation of the proposals. The goal of the investigation is a list of opportunities that are ranked in order of fuel saving potential and ease of implementation.

The work program for the analysis comprises eight subtasks, consisting of the identification of shippers relevent to the study, three rounds of interviews and analysis, preparation of interim and final reports, and discussions with railroads. The results of these activities are described in full herein.

Task 2.1
Indentification of Candidate Shippers

Introduction

The objectives of this activity were to generate a list of shippers whose distribution activities might be selectively examined in order to investegate the extent of potential shifts in their traffic from the truck mode to the rail mode.

The set of shippers to be identified was intended to correspond to a number of controlling factors and yet to exhibit certain other descriptive characteristics. The deterministic framework was designed to ensure that

- shippers selected were large volume shippers, whose distribution activities were varied and whose knowledge of distribution alternatives was extensive. These shippers should have their products marketed nationwide.
- shippers selected had available to them and utilized both rail and truck services. Shippers that were largely captive truck or rail users because of location or product handling characteristics would not be considered in the initial exercise.

At the same time, shippers should exhibit some descriptive representativeness in terms of geographic and product mix balance.

Given the limited and restrictive scope of the selection process, no attempts were made to ensure randomness or statistical consistency in the sample. Nevertheless, it was considered important for the approach to be systematic. Therefore, a hierarchical procedure was developed that would

- permit factoring of the sample to the universe.
- permit adjustment of the selection criteria in order to contract or expand the sample, particularly as the analysis proceeded.
- ensure non-discriminatory sample selection.

The limited approach argued for an emphasis in sampling that would enable maximum benefit. For this reason, the anlaysis was directed toward industries whose volume of shipments was large and tended to be concentrated in large plants. Furthermore, considerably more emphasis was placed on examining industries that used common carrier trucks as opposed to private trucking. These actions do not relate to an implied level of importance for these characteristics, but rather an attempt to keep the study within manageable proportions.

Description of the Universe

The 1972 Census of Transportation's Commodity Transportation Survey provided the basis for the description of the universe and the selection of an industry sample. The census describes, for 24 commodity groups that are aggregated from SIC (Standard Industrial Classification) codes, various shipper characteristics such as modal split, plant size, and distance of shipments, all presented in tons and ton-miles categories. Other volumes in this survey describe commodity transportation characteristics by individual SIC code, although the range of descriptors is more limited. The

Census of Transportation data is compatible with the Census of Manufactures and to the rail Carload Waybill Statistics, all of which use the SIC base. The Transportation Census' limitations, however, generally meant a fairly limited application of results.

The tonnage generated by manufacturing plants in 1972 is highlighted in Table 1. Table 1 reflects the Census' exclusion of plants with less than 20 employees and industries that serve local markets. In Table 1, data is presented for "all plants" and for "large plants". Large plants, which are those with 500 or more employees, account for 43.5% of all traffic.

Table 1 and subsequent tables exclude tonnage in the fuels category. This category includes coal and oil, is distinctive in all respects, and has not been considered for shipper selection purposes.

Table 1 shows that five of the commodity groups account for less than one percent of total non-fuels tonnage by all carriers. The largest industries include, for all plants, stone and glass, prepared foods, and iron and steel, while for large plants, this list is supplanted by iron and steel, motor vehicles, and basic chemicals. A high proportion of production is concentrated in large plants for those industries whose products are more highly manufactured.

Table 2 describes manufacturing tonnage according to modal characteristics, noting the absolute and percentage tonnage in plants accounted for by "surface common carriers" (rail and common carrier trucking) as well as the percentage of tonnage carried in private trucks. Private trucking accounts for 21.3% of non-fuels tonnage in all plants but is particularly high for foods and wood products commodities. In large plants, private trucking is greatly reduced, in tandem with a reduction in short hauls.

Table 1 Outbound Tonnage Generated by Manufacturing Establishments, 1972 (tonnages in thousands)

	COMMODITY GROUP	ALL PLANTS Total Tonnage All Carriers	ALL PLANTS Percentage of Total	LARGE PLANTS Total Tonnage All Carriers	LARGE PLANTS Percentage of Total	Percentage of Total Production in Large Plants
1.	Meat and Dairy Products	42,616	3.8	13,990	3.2	32.8
2.	Prepared Foods	154,015	13.6	27,206	6.3	17.7
3.	Beverages	57,996	5.1	15,596	3.6	26.9
4.	Textiles	14,209	1.3	5,922	1.4	41.7
5.	Apparel	5,798	0.5	1,674	0.4	28.9
6.	Paper	89,410	7.9	40,676	9.4	45.5
7.	Basic Chemicals	111,853	9.8	44,765	10.3	40.0
8.	Other Chemicals	58,902	5.2	12,314	2.8	20.9
10.	Rubber and Plastics	15,877	1.4	8,351	1.9	52.6
11.	Lumber	79,991	7.0	9,274	2.1	11.6
12.	Furniture	14,371	1.3	3,782	0.9	26.3
13.	Stone and Glass	178,122	15.7	20,182	4.7	11.3
14.	Iron and Steel	139,461	12.3	117,085	27.0	84.0
15.	Nonferrous Metals	29,954	2.6	15,972	3.7	53.3
16.	Fabricated Metals	14,870	1.3	4,741	1.1	31.9
17.	Other Metal Products	23,695	2.1	10,331	2.4	43.6
18.	Industrial Machinery	8,699	0.8	2,939	0.7	33.8
19.	Other Machinery	16,222	1.4	10,139	2.3	62.5
20.	Communications Equipment	2,327	0.2	1,714	0.4	73.7
21.	Electrical Products	13,131	1.2	9,449	2.2	72.0
22.	Motor Vehicles	56,716	5.0	55,039	12.7	97.0
23.	Other Transport Equipment	6,506	0.6	1,763	0.4	27.1
24.	Instruments	1,603	0.1	1,047	0.2	65.3
NON-FUEL COMMODITY GROUP		1,136,355	100.2	433,962	100.1	38.2
9.	Fuels	348,137	(30.6)	212,045	(48.9)	60.9
ALL COMMODITY GROUPS		1,484,492	(130.6)	646,007	(148.9)	43.5

Source: Census of Transportation, 1972

Table 2 Modal Characteristics of Manufacturing Production (tonnages in thousands)

	COMMODITY GROUP	ALL PLANTS				LARGE PLANTS			
		Total Tonnage By		Percentage of Total Tonnage By		Total Tonnage By		Percentage of Total Tonnage By	
		All Carriers	Common Carriers	Private Truck	Common Carriers	All Carriers	Common Carriers	Private Truck	Common Carriers
1.	Meat and Dairy Products	42,616	25,783	39.1	60.5	13,990	9,038	35.1	64.6
2.	Prepared Foods	154,015	109,351	23.0	71.0	27,206	24,186	9.3	88.9
3.	Beverages	57,996	23,836	58.4	41.1	15,596	9,857	35.9	63.2
4.	Textiles	14,209	10,103	27.7	71.1	5,922	4,199	28.0	70.9
5.	Apparel	5,798	4,517	15.6	77.9	1,674	1,408	11.7	84.1
6.	Paper	89,410	71,260	17.9	79.7	40,676	38,073	4.3	93.6
7.	Basic Chemicals	111,853	88,028	12.1	78.7	44,765	37,692	5.0	84.2
8.	Other Chemicals	58,902	45,001	15.7	76.4	12,314	11,206	7.5	91.0
10.	Rubber and Plastics	15,877	13,257	15.2	83.5	8,351	7,424	10.3	88.9
11.	Lumber	79,991	49,594	36.3	62.0	9,274	7,725	15.0	83.3
12.	Furniture	14,371	9,111	34.7	63.4	3,782	3,184	14.9	84.2
13.	Stone and Glass	178,122	123,082	23.7	69.1	20,182	13,966	15.4	69.2
14.	Iron and Steel	139,461	122,865	6.7	88.1	117,085	104,791	5.0	89.5
15.	Nonferrous Metals	29,954	24,862	15.1	83.0	15,972	14,471	7.3	90.6
16.	Fabricated Metals	14,870	10,796	25.1	72.6	4,741	3,940	11.2	83.1
17.	Other Metal Products	23,695	19,169	17.8	80.9	10,331	9,577	6.3	92.7
18.	Industrial Machinery	8,699	6,872	18.9	79.0	2,939	2,495	12.3	84.9
19.	Other Machinery	16,222	12,961	17.7	79.9	10,139	8,861	10.3	87.4
20.	Communications Equipment	2,327	1,803	12.4	77.5	1,714	1,397	11.0	81.5
21.	Electrical Products	13,131	11,069	14.1	84.3	9,449	8,211	12.3	86.9
22.	Motor Vehicles	56,716	54,788	3.0	96.6	55,039	53,553	2.3	97.3
23.	Other Transport Equipment	6,506	2,824	54.8	43.4	1,763	1,569	9.1	89.0
24.	Instruments	1,603	1,358	10.9	84.7	1,047	911	9.7	87.0
NON-FUEL COMMODITY GROUPS		1,136,355	842,290	21.3	74.1	433,962	377,734	8.8	87.0
9.	Fuels	348,137	89,471	8.4	25.7	212,045	39,440	5.4	18.6
ALL COMMODITY GROUPS		1,484,492	931,761	18.3	62.8	646,007	417,174	7.7	64.6

Source: Census of Transportation, 1972

About seven-eights of non-fuels tonnage in large plants is by rail and common carrier trucking. Whereas large plants account for 38.2% of total tonnage by all modes, they contribute 44.8% of all common carrier tonnage.

The proportion of total distribution undertaken in private trucks corresponds closely with the proportion of shipments under 100 miles - distances under which rail transportation is rarely cost or service competitive. Furthermore, while private trucking at large plants is only 8.8% of total distribution, more than one quarter of that tonnage is from the meats and beverages industries, where private trucking is relatively important. Private trucking has been excluded from extensive analysis primarily because of its correspondence with short-haul shipments. Nevertheless, long-haul shipments in private trucks are considered prime candidates from which rail might shift traffic if service or other rail improvements were made. The lack of descriptive data of this sector does not contribute, however, to its direct analysis here. Where reference is made later to trucks, it assumes common carrier vehicles only.

The modal split between the rail and motor carriers is presented in Table 3. In large plants, rail contributes 56.1% of outbound tonnage, although the proportion varies extensively by shipper group. Shippers that appear captive to truck include textiles and apparel, industrial machinery, and communications equipment, while the rail captives consist of paper and lumber. Table 4 shows the distribution of total common carrier tonnage by commodity group. More than a quarter of large-plant tonnage is accounted for by iron and steel, with lesser contributions by motor vehicles, paper, and basic chemicals.

Table 3 Surface Common Carrier Modal Split at Manufacturing Plants (tonnages in thousands)

COMMODITY GROUP	ALL PLANTS Surface Common Carrier Tonnage Rail	Motor	Modal Split	LARGE PLANTS Surface Common Carrier Tonnage Rail	Motor	Modal Split
1. Meat and Dairy Products	8,012	17,771	31.1	3,022	6,016	33.4
2. Prepared Foods	78,086	31,265	71.4	16,378	7,808	67.7
3. Beverages	8,931	14,905	37.5	4,476	5,381	45.4
4. Textiles	1,378	8,724	13.7	764	3,435	18.2
5. Apparel	493	4,024	10.9	275	1,133	19.5
6. Paper	46,225	25,035	64.9	29,327	8,745	77.0
7. Basic Chemicals	54,361	33,668	61.8	24,352	13,340	64.6
8. Other Chemicals	22,265	22,736	49.5	5,948	5,258	53.1
10. Rubber and Plastics	3,874	9,383	29.2	2,990	4,434	40.3
11. Lumber	36,636	12,959	73.9	6,751	974	87.4
12. Furniture	3,162	5,950	34.7	1,577	1,607	49.5
13. Stone and Glass	39,009	84,074	31.7	4,319	9,647	30.9
14. Iron and Steel	60,944	61,921	49.6	51,283	53,508	48.9
15. Nonferrous Metals	15,456	9,406	62.2	8,817	5,654	60.9
16. Fabricated Metals	2,573	8,223	23.8	1,759	2,181	44.6
17. Other Metal Products	8,720	10,449	45.5	6,767	2,810	70.7
18. Industrial Machinery	1,705	5,167	24.8	411	2,084	16.5
19. Other Machinery	4,299	8,663	33.2	3,751	5,110	42.3
20. Communications Equipment	303	1,501	16.8	293	1,104	21.0
21. Electrical Products	4,596	6,474	41.5	4,205	4,006	51.2
22. Motor Vehicles	33,633	21,155	61.4	33,299	20,254	62.2
23. Other Transport Equipment	1,269	1,555	44.9	917	652	58.4
24. Instruments	335	1,023	24.6	290	621	31.8
NON-FUEL COMMODITY GROUPS	436,815	405,975	51.9	211,773	166,108	56.1
9. Fuels	33,769	55,702	37.7	20,144	19,296	51.1
ALL COMMODITY GROUPS	470,584	461,677	50.5	231,917	185,404	55.6

Source: Census of Transportation, 1972

Table 4 Distribution of Surface Common Carrier Tonnage by Commodity Group (tonnages in thousands)

	COMMODITY GROUP	Surface Common Carrier Tonnage Percentage of Total Production ALL PLANTS	LARGE PLANTS
1.	Meat and Dairy Products	3.1	2.4
2.	Prepared Foods	13.0	6.4
3.	Beverages	2.8	2.6
4.	Textiles	1.2	1.1
5.	Apparel	0.5	0.4
6.	Paper	8.5	10.1
7.	Basic Chemicals	10.5	10.0
8.	Other Chemicals	5.3	3.0
10.	Rubber and Plastics	1.6	2.0
11.	Lumber	5.9	2.0
12.	Furniture	1.1	0.8
13.	Stone and Glass	14.6	3.7
14.	Iron and Steel	14.6	27.7
15.	Nonferrous Metals	3.0	3.8
16.	Fabricated Metals	1.3	1.0
17.	Other Metal Products	2.3	2.5
18.	Industrial Machinery	0.8	0.7
19.	Other Machinery	1.5	2.3
20.	Communications Equipment	0.2	0.4
21.	Electrical Products	1.3	2.2
22.	Motor Vehicles	6.5	14.2
23.	Other Transport Equipment	0.3	0.4
24.	Instruments	0.2	0.2
NON-FUEL COMMODITY GROUPS		100.1	99.9
9.	Fuels	(10.6)	(10.4)
ALL COMMODITY GROUPS		(110.6)	(110.4)

Source: Census of Transportation, 1972

Industry Sample Selection

Given the shipper characteristics introduced above, it is possible to define the sample of industries from which individual shippers can be selected. Table 5 (in two parts) stratifies shipper groups according to modal split differences and volume of shipments. Commodity groups that individually comprise less than two percent of total tonnage and are not considered candidates for selection because they are too small to contribute substantially to an explanation of shipper behavior in the universe are detailed in Category E. These five groups comprise less than 4.7% of all tonnage in all plants and are even less important to common carrier or large plant tonnage. Commodities that are otherwise sufficiently large for analysis but which exhibit abnormally-pronounced modal split preference are described in Category F. This category consists of paper and lumber, and while comprising 15% of tonnage use rail 80% of the time. Category D includes four commodity groups that exhibit abnormal modal preference (all oriented to truck) and also are low in volume.

Categories A through C in Table 5 denote industries according to their modal split preferences. These groups, in aggregate, comprise almost 80% of total tonnage. Table 6 further describes shipper characteristics. The sample of industries in Categories A through C produce 59.5% of all U.S. tonnage. The tonnage on common carriers at large plants amounts to 20.6% of all tonnage.

The different commodities produced within each of the twelve commodity groups noted in Table 5 are quite extensive. The modal split and volume

Table 5 Categories of Shippers According to Volume and Modal Split Preferences

COMMODITY GROUP	Percentage of Total Tonnage of All Commodities in all Plants: ALL MODES	Percentage of Total Tonnage of All Commodities in all Plants: SURFACE COMMON CARRIERS	Rail Modal Split of Surface Common Carrier Tonnage: ALL PLANTS	Rail Modal Split of Surface Common Carrier Tonnage: LARGE PLANTS
A. COMPETITIVE MODAL SPLIT (45-55%)*				
3. Beverages	5.1	2.8	37.5	45.4
8. Other Chemicals	5.2	5.3	49.5	53.1
14. Iron and Steel	12.3	14.6	49.6	48.9
21. Electrical products	1.2	1.3	41.5	51.2
SUBTOTAL	23.7	24.1	47.7	49.2
B. TRUCK-ORIENTED MODAL SPLIT (25-45%)				
1. Meat and Dairy products	3.8	3.1	31.1	33.4
13. Stone and Glass	15.7	14.6	31.7	30.9
19. Other Machinery	1.4	1.5	33.2	21.0
SUBTOTAL	20.9	19.2	31.7	34.8
C. RAIL-ORIENTED MODAL SPLIT (55-75%)				
2. Prepared foods	13.6	13.0	71.4	67.7
7. Basic chemicals	9.8	10.5	61.8	64.6
15. Nonferrous metals	2.6	3.0	62.2	60.9
17. Other metal products	2.1	2.3	45.5	70.7
22. Motor Vehicles	5.0	6.5	61.4	62.2
SUBTOTAL	33.1	35.2	64.2	64.2
ALL ABOVE COMMODITIES	77.7	78.5	51.2	54.6

(cont.)

* At large plants

Table 5 (cont.)

COMMODITY GROUP	Percentage of Total Tonnage of All Commodities in all Plants: ALL MODES	SURFACE COMMON CARRIERS	Rail Modal Split of Surface Common Carrier Tonnage: ALL PLANTS	LARGE PLANTS
D. COMMODITIES WITH LESS THAN 2% OF TRAFFIC AND ABNORMAL MODAL SPLIT				
4. Textiles	1.3	1.2	13.7	18.2
5. Apparel	0.5	0.5	10.9	19.5
18. Industrial Machinery	0.8	0.8	24.8	16.5
20. Communications Equipment	0.2	0.2	16.8	21.0
SUBTOTAL	2.7	2.8	16.7	18.3
E. COMMODITIES WITH LESS THAN 2% OF TRAFFIC ONLY				
10. Rubber and Plastics	1.4	1.6	29.2	40.3
12. Furniture	1.3	1.1	34.7	49.5
16. Fabricated Materials	1.3	1.3	23.8	44.6
23. Other Transport Equipment	0.6	0.3	44.9	58.4
24. Instruments	0.1	0.2	24.6	31.8
SUBTOTAL	4.7	4.4	30.0	44.2
F. COMMODITIES WITH ABNORMAL MODAL SPLIT				
6. Paper	7.9	8.5	64.9	77.0
11. Lumber	7.0	5.9	73.9	87.4
SUBTOTAL	14.9	14.3	68.6	78.8
ALL ABOVE COMMODITIES	22.3	21.5	54.0	62.7

Table 6

Characteristics of Production by Manufacturing Plants by Category (tonnages in thousands)

CHARACTERISTIC	NATIONAL TOTAL	GROUP A	GROUP B	GROUP C	GROUPS A-C	GROUPS D-F	FUELS
1. All Plants, All Transport Modes							
a. Tonnage	1,484,481	269,490	236,960	376,233	882,683	253,661	348,137
Percentage	100.0	18.2	16.0	25.3	59.5	17.1	23.5
b. Ton-miles	631,058	83,447	61,486	166,025	310,958	127,747	192,353
Percentage	100.0	13.2	9.7	26.3	49.3	20.2	30.5
c. Average trip length	425	310	259	441	352	504	553
2. All Plants, Surface Common Carriers							
a. Tonnage	931,761	202,771	161,826	296,198	660,795	181,495	89,471
Percentage	100.0	21.8	17.4	31.8	70.9	19.5	9.6
Percentage of all modes (1a)	62.8	13.7	10.9	20.0	44.5	12.2	6.0
b. Ton-miles	396,935	68,369	50,927	146,495	265,791	109,408	21,736
Percentage	100.0	17.2	12.8	36.9	67.0	27.6	5.5
Percentage of all modes (1b)	62.9	10.8	8.1	23.2	42.1	17.3	3.4
c. Average trip length	426	337	315	495	402	603	243
3. Large Plants, Surface Common Carriers							
a. Tonnage	417,174	134,065	31,865	139,479	305,409	72,325	39,440
Percentage	100.0	32.1	7.6	33.4	73.2	17.3	9.5
Percentage of all plants (1a)	28.1	9.0	2.1	9.4	20.6	4.9	2.7
b. Ton-miles	193,622	44,520	16,103	75,676	136,299	45,480	11,843
Percentage	100.0	23.0	8.3	39.1	70.4	23.5	6.1
Percentage of all plants (1b)	30.7	7.1	2.6	12.0	21.6	7.2	1.9
c. Average trip length	464	332	505	543	446	629	300

Source: Census of Transportation, 1972

characteristics of the individual commodity classifications were further examined. Data related to plant size were not available for this exercise. Commodities described as "miscellaneous", those with less than one percent of total production of the groups in Categories A-C, and those that exhibited abnormal preference in modal split were excluded from the sample. At the conclusion of the exercise, 18 commodities were considered suitable for selection. Table 7 presents this list by commodity group and SIC number. These commodities account for 65.1% of the total tonnage by all modes in Categories A-C and 50.6% of all tonnage of all non-fuel commodities.

From corporate directories, a selected set of large manufacturers of these commodities was prepared. This list is presented in Table 8. These corporations are considered suitable candidates for further study in other tasks, and are representative of the shippers whose distribution activity is of interest.

Table 7

Commodities for Modal Shift Analysis

(tonnages in thousands)

COMMODITY GROUP	TONNAGE	PERCENTAGE OF TOTAL	RAIL/HIGHWAY MODAL SPLIT
3: 208 Beverages	49,528	5.6	43.7
8: 284 Soaps	11,732	1.3	29.9
8: 287 Agricultural Chemicals	26,422	3.0	69.2
14: 331 Mill & Rolled Steel Products	114,167	12.9	48.6
14: 332 Iron Castings	12,283	1.4	29.7
21: 361 Electrical Transmission Equipment	14,884	1.7	36.3
1: 201 Meats	31,417	3.6	29.7
1: 202 Dairy Products	10,237	1.2	35.8
13: 325 Clay	19,788	2.2	38.0
13: 327 Concrete, Gypsum	41,717	4.7	26.0
13: 329 Abrasives, Asbestos	20,680	2.3	63.7
2: 203 Canned foods	34,318	3.9	45.7
2: 206 Sugar	11,788	1.3	56.7
7: 281 Industrial Chemicals	79,279	9.0	62.7
7: 282 Plastics	24,427	2.8	50.5
15: 335 Copper, Aluminum Shapes	17,162	1.9	48.5
22: 3711 Motor Vehicles	38,997	4.4	58.1
22: 3714 Motor Vehicle Parts	15,711	1.8	65.4
ALL ABOVE COMMODITIES	574,537	65.1	--
ALL MAJOR COMMODITY GROUPS	882,683	100.0	--

Source: Census of Transportation, 1972

Table 8

Representative Firms for Modal Shift Analysis

Meats	
Swift	Chicago
Armour	Phoenix
Dairy	
Carnation	Los Angeles
Beatrice	Chicago
Kraft	Chicago
Canned Foods	
Green Giant	Minnesota
Campbell	Camden, N.J.
Consolidated	Chicago
Del Monte	San Francisco
Libby	Chicago
Stokely	Indianapolis
Sugar	
G.W.	Denver
Amstar	New York
C&H	San Francisco
Beverages	
Anheuser	St. Louis
Coors	Golden, Colo.
Schlitz	Milwaukee
Miller	Milwaukee
Gallo	Modesto
Masson	Saratoga
Chemicals	
Allied	Morristown, N.J.
Dow	Saginaw
Du Pont	Wilmington
Chemetron	E. Rutherford, N.J.
Goodyear	Akron
Monsanto	St. Louis
Gypsum	
U.S. Gypsum	Chicago
Asbestos	
Johns-Manville	Denver
Steel	
Youngstown	Youngstown
Inland	Chicago
Jones & Laughlin	Pittsburgh
National	Pittsburgh
Copper	
Kennecott	New York
St. Joe	New York
Aluminum	
Alcoa	Pittsburgh
Kaiser	Oakland
Motor Vehicles and Parts	
Chrysler	Detroit
Ford	Detroit
Eaton	Cleveland
Bendix	Southfield, Mich.
Rockwell	Pittsburgh