STRUCTURE AND ECONOMICS OF INTRAURBAN GOODS MOVEMENT

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This presentation is based almost exclusively on urban freight studies that have been performed within the New York City tri-state region (Fig. 1). The techniques of measurement and the methods of analysis should be applicable elsewhere, but the rate of generation of freight and its cost and division by mode vary sharply from place to place primarily because of the kind of work done in the different metropolitan areas. Our first and foremost finding is that urban freight is a much more variable phenomenon than urban passenger movements.

This paper seeks to answer, or shed light on, the following 4 questions: (a) What is the nature of the job being done? Is it basically parcel delivery, food delivery, fuel supply, or what? (b) How much does it cost to perform the various components of the job? (c) How is the system organized and controlled? To what stimuli does it respond? and (d) Who is doing it?

SCOPE AND DEFINITION OF URBAN GOODS MOVEMENT

Urban goods movement is defined as all movement of things within the urban area except fresh water and sewage. Intercity freight is excluded, but many other items and operations, not generally thought of as freight by the common carrier or the industrial traffic manager, are included. For instance, the pickup and delivery operations of local enterprises such as bakeries, apparel subcontractors, print shops, and wholesalers are included. Also included is the movement of garbage and demolition waste as well as that small portion of total waste that is recycled such as paper scrap, metal scrap, fats for rendering, empty containers, and the like. There is also included a large group of trucks primarily owned to carry the tools of a trade and secondarily used for the pickup and delivery of freight. Many trucks owned by contractors fall into this category, as well as those of plumbers, air conditioning and oil burner service men, well drillers, and highway repair and maintenance departments.

There is some difficulty in setting limits to this subject, particularly in the area of fuel and energy. Petroleum and coal move in conventional vehicles and use streets, waterways, and pipelines in their distribution. Therefore, they are considered to be part of the urban goods movement scheme. However, natural or manufactured gas, unless it is liquefied and moved in trucks or rail cars, is not. Neither is electric energy, which travels by wire and which competes with other forms of energy to some extent.

To summarize, and mindful of these questions of scope that cannot be resolved with complete satisfaction, we defined urban freight to include all things moved within the urban area by truck, rail, barge, and oil pipelines by the following agencies: (a) for-hire carriers—contract, common, and special; (b) private carriers—manufacturers, wholesalers, retailers, miners (sand, gravel, and rock), and others carrying their own freight; and (c) government—sanitation, highway maintenance, mail, and other services.

SOURCES OF DATA AND EVALUATION

It should be clearly stated that all the data are less than exact, although we have been able to verify the substantial accuracy of our survey and to check one secondary source

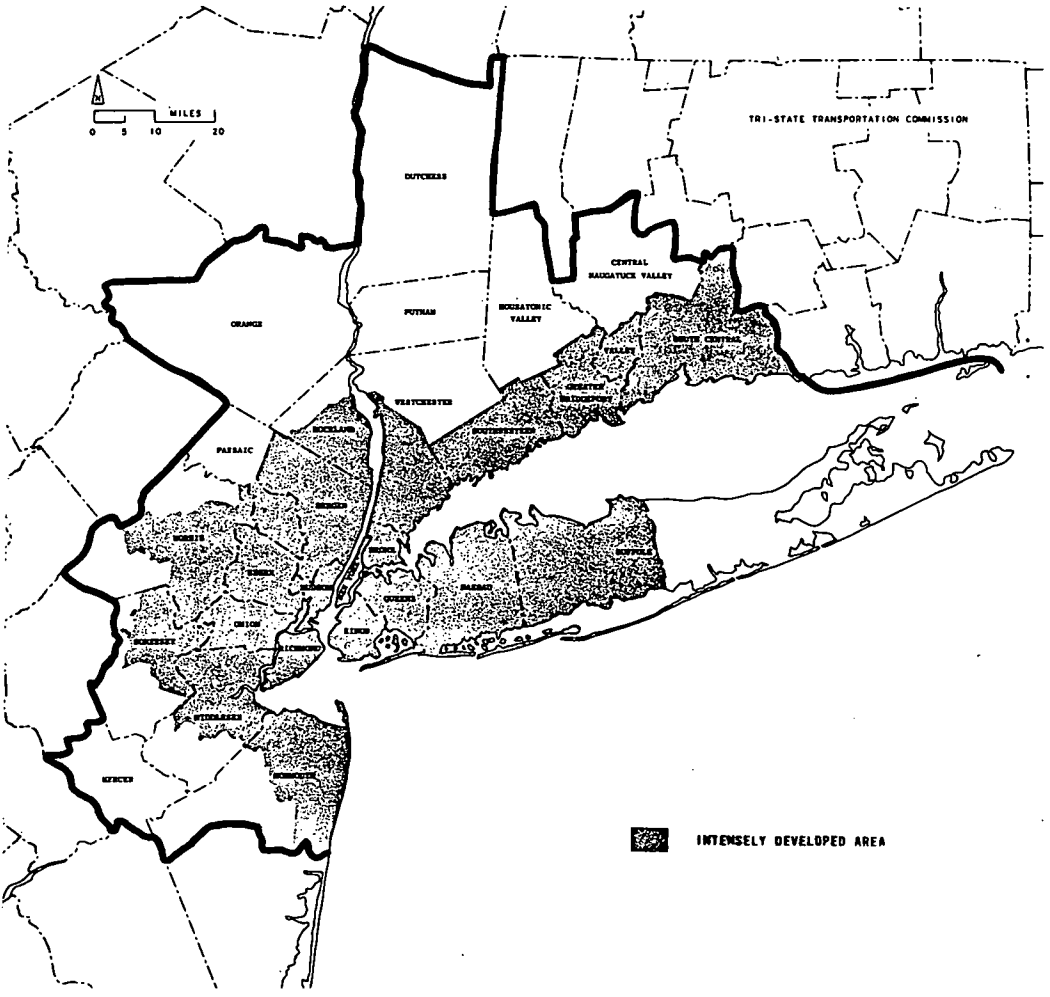


Figure 1. Tri-State region.

against another, at least in part. There are other shortcomings: Our original data were not all from one time period, though they serve as suitable bench-mark data and a basis for forecasting.

Our detailed waterborne freight data are from the Waterborne Commerce of the United States, Part 1, 1962, published by the U. S. Corps of Engineers. These were checked against Port of New York Authority data by pier where possible. Figures on cost and length of haul were obtained from the industry. The rail data were obtained from the One Percent Carload Waybill Sample for 1961 published by the Interstate Commerce Commission. These were checked against the Port Authority rail freight data and, in some cases, railroad data by station and adjusted where necessary.

Pipeline volumes were obtained from the companies concerned. Since the 1961-1963 bench-mark period, internal pipeline volume has increased very rapidly because of the completion of the Long Island pipeline to Kennedy Airport and the Newtown Creek fuel oil terminals. The 1961-1963 data shown here are not at all representative of the present level of pipeline data.

There were, and still are, no secondary sources of truck freight volume. Therefore, the Tri-State Transportation Commission carried out an internal truck survey based on a 3 percent sample of all commercial registrations in the developed area of the region

in 1963. In this survey the interviewer went to the address shown on the registration and found out from the driver or the dispatcher where the truck went on the interview date and what it carried. We have been able to verify parts of this survey against other sources, so that we believe that it is substantially accurate. However, it was designed primarily to develop trip origins and destinations rather than freight origins and destinations. The limited objective on freight at that time was to develop total tons moved within the region by commodity. Although we have been able to convert this information into freight origin and destination terms, we have been forced to use rather large clusters, or zones, and the file is hard to manipulate when one is looking for freight origin and destination data.

The nub of the problem is that the origin and destination of the truck is often not the same as the origin and destination of the freight. Figure 2 shows that a truck that leaves its base and goes to points A, B, C, D and back home again, delivering freight at each point, shows one pattern for origin and destinations of trips and another pattern for freight.

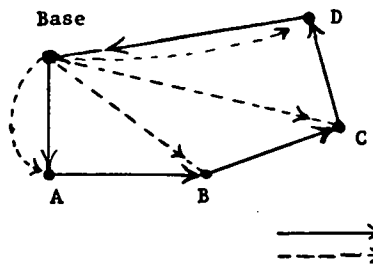
CONSUMER-FREIGHT VERSUS COMMERCIAL-FREIGHT GENERATION

If we could separate the amount of freight generated by business from the amount generated by consumers, we would have a basis for applying part of these findings to other regions, because North American consumers of similar means tend to behave similarly. Unfortunately, our truck survey was not designed so that we can readily analyze the amount of freight delivered to commercial establishments versus the amount going to residences and to those establishments that directly serve consumers. Therefore, in allocating truck freight between consumer-oriented freight and business-oriented freight, we are forced to use the less satisfactory basis of commodity description.

In some cases the basis of the allocation is clear enough. Food is for people, and sand and gravel are for the construction industry. Completed apparel is for consumers, and basic textiles is raw material for fabrication. In some cases the categories have been based on more detailed descriptions. Anthracite coal is for residences, while bituminous is considered to be industrial. Gas and oil moving by truck are considered to be consumer-oriented, while asphalt paving material is for construction activity.

This rough classification indicates that about half of Tri-State's truck freight is for consumers and half is to support business activity (Table 1). The region's 1963 population of 17.9 million people required 95 million tons of freight distributed locally by truck to support its consuming habits, or 5.3 tons per person per year. This statistic should be fairly applicable to other urban areas, though there is no information currently available on this point.

In other modes, which concentrate principally on bulk commodities, sand and gravel can be assigned to commercial activity and food to consumers, but fuel must be divided by use (Table 2). Assuming that all coal or residual fuel oil is for the generation of electricity or for industrial plants, that all fuel delivered at Jamaica Bay is for commercial aircraft, and that the remainder is for local consumer use in automobiles and homes, we get the following rough division: about a third for consumers and two-thirds



Trip	Freight
Base to A	Base to A
A to B	Base to B
B to C	Base to C
C to D	Base to D
D to Base	

Figure 2. Origins and destinations for trips and for freight.

TABLE 1

CONSUMER-ORIENTED AND BUSINESS-ORIENTED GOODS MOVED BY TRUCK IN 1963 WITHIN THE TRI-STATE REGION

Commodity	Consumer Oriented		Business Oriented		Total	
	Millions of Tons	Percent	Millions of Tons	Percent	Millions of Tons	Percent
Nonmetallic minerals (sand and gravel)	—	—	38.5	34.8	38.5	18.7
Petroleum or coal products	27.9	29.2	4.8	4.4	32.7	15.8
Food or kindred products	27.8	29.2	—	—	27.8	13.5
Stone, clay, or glass products	—	—	20.3	18.3	20.3	9.8
Waste or scrap materials	9.5	10.0	4.8	4.3	14.3	6.9
Chemical or allied products	2.6	2.8	5.4	4.8	8.0	3.9
Miscellaneous freight and mixed shipments	1.3	1.3	6.1	5.5	7.4	3.6
Coal	5.3	5.6	0.8	0.7	6.1	3.0
Lumber or wood products	—	—	5.1	4.6	5.1	2.5
Service tools and equipment	—	—	4.4	4.0	4.4	2.1
Primary metal products	—	—	4.2	3.8	4.2	2.0
Pulp, paper, or related products	4.1	4.4	—	—	4.1	2.0
Farm products	3.8	4.0	—	—	3.8	1.8
Fabricated metal products	—	—	3.5	3.2	3.5	1.7
Machinery, except electric	—	—	2.6	2.3	2.6	1.3
Printed matter	1.6	1.7	1.0	0.8	2.6	1.2
Transportation equipment	2.4	2.6	—	—	2.4	1.2
Furniture or fixtures	2.0	2.1	0.4	0.3	2.4	1.2
Basic textiles	—	—	2.2	2.0	2.2	1.1
Workers	—	—	2.2	2.0	2.2	1.1
Electrical machinery	—	—	2.2	2.0	2.2	1.1
Laundry and dry cleaning	2.0	2.1	—	—	2.0	1.0
Containers, returned empty	—	—	1.7	1.5	1.7	0.8
Apparel or related products	1.6	1.6	—	—	1.6	0.8
Miscellaneous products of manufacturing	1.0	1.1	—	—	1.0	0.5
All other commodities	2.2	2.3	0.7	0.6	2.9	1.4
Total	95.1	100.0	110.9	100.0	206.0	100.0

TABLE 2

CONSUMER-ORIENTED AND BUSINESS-ORIENTED GOODS MOVED ANNUALLY BY WATER AND RAIL FROM 1961 TO 1963 WITHIN THE TRI-STATE REGION

Commodity	Consumer Oriented			Business Oriented			Total
	Water	Rail	Total	Water	Rail	Total	
Food	0.6	0.3	0.9	0	0	0	0.9
Sand and gravel	0	0	0	15.0	1.5	16.5	16.5
Coal	0	0	0	9.0	0.0	9.0	9.0
All petroleum	20.4	0	20.4	15.1	0.2	15.3	35.7
Residual petroleum	0	0	0	10.7	0.2	10.9	10.9
Aviation petroleum	0	0	0	4.4	0	4.4	4.4
Other petroleum	20.4	0	20.4	0.4	0	0	20.4
All other commodities	5.2	1.0	6.2	5.2	1.	6.2	12.4
Total	26.2	1.3	27.5	44.3	2.7	47.0	74.5
Percent			37			63	100

Note: Amounts are in millions of tons.

for business uses. This proportion should be expected to show a very wide variation between cities, depending on the amount and type of industry present.

DIVISION OF WORK BY MODE

Internal freight distribution is performed by truck, supplemented by other modes. Trucks, almost without exception, perform the last step of the distribution process.

Barges and, to a much lesser extent, rail perform an intermediate role in moving bulk commodities to a point near concentrations of activity for final distribution by truck. In a few cases, such as fuel carried to electric utilities, the bulk movement extends all the way to the point of consumption. Local pipelines have become more important in bulk movements since this survey.

Trucks account for 73 percent of all tons handled internally in the region and 97 percent of the cost (Tables 3 and 4). (Cost means the cost of performing the service except for rail freight where the charges to the shipping public as reflected in the waybill sample are used. Truck cost figures are arrived at by applying to survey data the ICC's cost factors for common carriers of general freight in the Middle Atlantic Region for 1964. These cost factors were adjusted downward by 20 percent for single units and 10 percent for tractor semi-trailers to reflect the very high proportion of small, 4-tire single units, which represent 56 percent of all internally registered trucks, and the fact that internal operations are nearly all either private or nonregulated carriage.) Waterborne freight is a quarter of the internal tonnage, but it accounts for only 2 percent of the local distribution cost. The difference in cost per ton or per ton-mile between modes is accounted for by the difference in the kind of work done as well as by the differing characteristics of the vehicle used. The average truckload is composed of about 7 consignments that weigh 2½ tons and take a driver most of the day to deliver. The destinations of these shipments tend to be about 5 miles from the origin point of the load. On the other hand, bargeloads weigh thousands of tons, are often moved in tows of 5 or 10 barges at a time, and move about 40 or 45 miles on the average. One is mass production of ton-miles, and the other is a personally conducted tour.

The cost per ton of internal distribution varies tremendously among commodities (Table 5). Fuel costs about $1.30 per ton for each movement, and mail costs nearly $25. Because fuel is typically moved twice and mail at least three times, total cost per ton is indicated at about $2.75 for fuel and $75 per ton for mail, at a minimum.

Nearly all waste, reused, and recycled materials are handled by trucks, though there are some such as scrap iron and scrap rubber that are moved by water and rail to piers for pickup by ocean vessels. Service equipment such as TV repair tools and plumbers supplies is moved to the job site by truck. The massive barge-mounted cranes, with lifting capacities of up to 100 tons, and other waterborne equipment were not considered in this survey effort.

The commodities shown in Tables 3, 4, and 5 were chosen because the trucks that move them tend to specialize in them and not carry anything else. Therefore, these tonnages are directly connected with the vehicle-miles and vehicle-hours required to distribute them. A small portion of each commodity is mixed in with the "All Other Commodities" category.

FRAGMENTATION OF RESPONSIBILITY

Nearly everybody moves his own freight. This is a well-known fact, but it deserves repeating here because it is even more true in intraurban freight than in intercity freight.

For local trucking, less than a quarter of the tonnage is moved by for-hire carriers. Construction and manufacturing handle 17 to 18 percent each, and the retail and wholesale segments handle from 10 to 12 percent each (Table 6). Construction companies handle about half of the sand and gravel, and the public administration segment handles about half of the mail; but, that is the nearest thing we find to specialization of one agency in the carriage of a particular commodity. Even in the carriage of scrap, waste, and empty containers the reponsibility is split, with government agencies carrying less than a third. Add to this picture of divided responsibility the fact that a third of the region's trucks are in single-truck fleets, and it becomes very clear that the internal trucking function is carried out by very small units of enterprise in a highly competitive environment.

In other modes, the situation is quite different. Rail freight is, of course, common carriage. The one large pipeline now operating within the region is a common carrier. In waterborne freight, most bulk carriage is by for-hire agencies with the towing company owning both barges and tugs. The exception is the distribution of gasoline and

TABLE 3

TON-VOLUME OF GOODS MOVED ANNUALLY FROM 1961 TO 1963 WITHIN THE TRI-STATE REGION BY MODE AND COMMODITY GROUP

Commodity	Truck		Rail		Water		Pipeline		Total	
	Millions of Tons	Percent	Millions of Tons	Percent	Millions of Tons	Percent	Millions of Tons	Percent	Millions of Tons	Percent
Sand and gravel	35.3	13	1.5	1	15.0	5	0	0	51.8	18
Fuel	35.6	13	0.2	—[a]	44.5	16	0.1	—[a]	80.4	29
Food	30.3	11	0.3	—[a]	0.6	—[a]	0	0	31.2	11
Mail	2.9	1	0	0	0	0	0	0	2.9	1
All other commodities	79.7	28	1.6	1	9.9	4	0	0	90.6	33
Scrap waste and empty containers	16.8	6	0.4	—[a]	0.5	—[a]	0	0	17.7	6
Service equipment	5.7	2	0	0	0	0	0	0	5.7	2
Total	205.7	73	4.0	1	70.5	25	0.1	—[a]	280.3	100

[a]Less than 50,000 tons or 5 percent.

TABLE 4

DOLLAR-VOLUME OF GOODS MOVED ANNUALLY FROM 1961 TO 1963 WITHIN THE TRI-STATE REGION BY MODE AND COMMODITY GROUP

Commodity	Truck		Rail		Water		Pipeline		Total	
	Millions of Dollars	Percent	Millions of Dollars	Percent	Millions of Dollars	Percent	Millions of Dollars	Percent	Millions of Dollars	Percent
Sand and gravel	36.1	1	0.9	—[a]	11.5	—[a]	0	0	48.5	2
Fuel	70.5	3	0.5	—[a]	34.0	1	—[a]	—[a]	105.0	4
Food	455.3	18	1.4	—[a]	0.5	—[a]	0	0	447.2	18
Mail	70.9	3	0	0	0	0	0	0	70.9	3
All other commodities	1,034.1	43	6.0	—[a]	7.6	—[a]	0	0	1,047.7	44
Scrap waste and empty containers	131.8	5	0.8	—[a]	0.4	—[a]	0	0	133.0	5
Service equipment	600.0	24	0	0	0	0	0	0	600.0	24
Total	2,388.7	97	9.6	—[a]	54.0	2	—[a]	—[a]	2,452.3	100

[a]Less than $50,000 or 5 percent.

TABLE 5

COST PER TON OF GOODS MOVED ANNUALLY FROM 1961 TO 1963 WITHIN THE TRI-STATE REGION BY MODE AND COMMODITY GROUP

Commodity	Truck	Rail	Water	Pipeline	Total
Sand and gravel	1.02	0.60	0.77	—	0.94
Fuel	1.98	2.50	0.76	0.30	1.31
Food	14.70	4.67	0.83	—	14.33
Mail	24.50	—	—	—	24.50
All other commodities	13.07	3.75	0.77	—	11.51
Scrap waste and empty containers	7.85	2.00	0.80	—	7.51
Service equipment	105.26	—	—	—	105.26
All	11.61	2.40	0.77	0.30	8.75

heating oil, which is performed by the private fleets of the individual petroleum companies. It is quite clear that the companies active in this bulk carriage are far larger and far fewer in number than in local trucking. It can be noted that it is where these large-scale enterprises exist that improvements are taking place in local distribution.

Table 7 gives the costs of goods distributed by trucks, and Table 8 gives the cost per ton. We saw in the previous comparison that the cost per ton varied greatly for a particular commodity, depending on what mode handled it. There is much less variability within the trucking function as between industries. Retail food distribution cost per ton is about 2½ times the average, but this reflects the large number of very small deliveries required. There are other such differences from the average, but commodity seems to be much more important than industry in influencing truck cost.

TABLE 6

TON-VOLUME OF GOODS DISTRIBUTED BY TRUCK IN 1963 WITHIN THE TRI-STATE REGION BY COMMODITY AND INDUSTRY

Industry	Sand and Gravel		Fuel		Food		Mail		Other Commodities		Scrap Waste and Empty Containers		Service Equipment		Total	
	Millions of Tons	Percent	Millions of Tons	Percent	Millions of Tons	Percent	Millions of Tons	Percent	Millions of Tons	Percent	Millions of Tons	Percent	Millions of Tons	Percent	Millions of Tons	Percent
For-hire carriage	5.68	2.8	2.13	1.0	7.77	3.8	1.02	0.5	31.86	15.4	1.02	0.5	0.05	—[a]	49.53	24.1
Construction	17.04	8.3	3.93	1.9	—[a]	—	0.00	0.0	12.21	5.9	2.24	1.1	2.12	1.0	37.54	18.2
Manufacturing	3.68	1.8	2.50	1.2	8.83	4.3	0.11	0.1	17.29	8.4	1.91	0.9	0.10	—[a]	34.42	16.7
Wholesale	0.04	—[a]	7.90	3.8	9.00	4.4	—[a]	—[a]	5.70	2.8	2.18	1.1	0.13	0.1	24.95	12.1
Retail	1.12	0.5	12.95	6.3	2.53	1.2	0.01	—[a]	4.34	2.1	0.32	0.2	0.22	0.1	21.49	10.4
Utilities and communication	2.39	1.2	5.26	2.6	0.01	—[a]	0.01	—[a]	2.95	1.4	3.04	1.5	1.26	0.6	14.92	7.3
Public administration	0.50	0.2	0.08	—[a]	1.67	0.8	1.61	0.8	1.46	0.7	5.08	2.5	0.76	0.4	11.16	5.4
Business, repair, and personal service	0.05	—[a]	0.81	0.4	0.41	0.2	0.08	—[a]	2.91	1.4	0.77	0.4	0.86	0.4	5.89	2.9
Agriculture and landscape gardening	4.76	2.3	—[a]	—[a]	0.11	0.1	0.00	0.0	0.08	—[a]	0.11	0.1	0.19	0.1	5.25	2.6
All other industry	—[a]	—[a]	0.00	0.00	0.01	—[a]	0.01	—[a]	0.42	0.2	0.12	0.6	0.01	—[a]	0.56	0.3
Total	35.26	17.1	35.36	17.3	30.34	14.7	2.85	1.4	79.22	38.5	16.79	8.2	5.70	2.7	205.71	100.0

[a]Less than 5,000 tons or 0.5 percent.

TABLE 7

DOLLAR-VOLUME OF GOODS DISTRIBUTED BY TRUCK IN 1963 WITHIN THE TRI-STATE REGION BY COMMODITY AND INDUSTRY

Industry	Sand and Gravel	Fuel	Food	Mail	Other Commodities	Scrap Waste and Empty Containers	Service Equipment	Total	No Load
For-hire carriage	7.24	8.40	54.46	21.55	408.36	6.42	5.83	512.26	19.37
Construction	17.99	8.16	0.14	0.00	71.91	8.01	240.58	346.79	86.80
Manufacturing	3.55	3.87	132.90	5.22	140.52	23.55	15.23	324.84	54.24
Wholesale	0.08	13.81	142.46	0.08	108.44	21.80	6.76	293.43	26.28
Retail	1.95	33.46	96.20	0.48	125.03	12.34	45.59	315.05	67.72
Utilities and communication	0.91	1.47	1.10	0.38	18.59	22.38	86.26	131.09	16.07
Public administration	0.59	0.40	2.68	38.32	8.80	29.16	33.84	103.79	22.77
Business, repair, and personal service	0.32	0.96	11.97	3.35	141.06	4.35	142.71	304.72	77.53
Agriculture and landscape gardening	3.43	—[a]	2.20	0.00	3.61	1.60	31.41	42.25	12.81
All other industry	0.10	0.00	1.20	1.49	7.80	2.14	1.79	14.52	11.34
Total	36.10	70.53	445.31	70.87	1,034.12	131.75	600.00	2,388.74	394.93

Note: Amounts are in millions of dollars.
[a]Less than $5,000.

TABLE 8

COST PER TON OF GOODS DISTRIBUTED BY TRUCK IN 1963 WITHIN THE TRI-STATE REGION BY COMMODITY AND INDUSTRY

Industry	Sand and Gravel	Fuel	Food	Mail	Other Commodities	Scrap Waste and Empty Containers	Service Equipment	Total
For-hire carriage	1	4	7	21	13	6	117	10
Construction	1	2	—	—	6	4	113	9
Manufacturing	1	2	15	47	8	12	152	9
Wholesale	2	2	16	—	19	10	52	12
Retail	2	3	38	48	29	39	207	15
Utilities and communication	—[a]	—[a]	110	38	6	7	68	9
Public administration	1	5	2	24	6	6	31	9
Business, repair, and personal service	6	1	29	42	48	6	166	52
Agriculture and landscape gardening	1	—	20	—	45	15	165	8
All other industry	—	—	120	149	19	18	179	26
All	1	2	15	25	13	8	105	12

[a]Less than 50 cents per ton.

OPERATING CHARACTERISTICS

No internal truck survey made so far has taken adequate account of the great number of different ways in which local truckers go about their work. The major trip patterns are as follows:

1. Single shipment loads that tend to be large, often taking up the entire capacity of the truck;
2. Single origin with multiple deliveries, which is by far the most common pattern;
3. Multiple origins with single delivery, as exemplified by a garbage truck; and
4. Simultaneous pickup and delivery at each stop, as with a beverage truck delivering full cases and picking up empties.

Single shipment loads account for 21 percent of the vehicle-miles but nearly 70 percent of the tonnage. Multiple stop loads generate 55 percent of the vehicle-miles and 30 percent of the tonnage. Service calls and empty movements accounted for 23 percent of vehicle-miles. Although there is a clear tendency for larger trucks to more likely make trips and to make longer trips, the smaller trucks account for 90 percent of truck trips.

The carriers that handle the most freight do not generate the most vehicle-miles. For-hire carriers generate nearly a quarter of the tons but own just fewer than 11 percent of the trucks and perform 15 percent of the vehicle-miles. However, they own nearly half the tractor-trailers and run just more than half the tractor-trailer miles. In a word, they own bigger vehicles and load them more heavily. On the other hand, manufacturers, wholesalers, and retailers generate relatively more vehicle-miles than freight. They own smaller vehicles and carry smaller loads, but the loads are made up of many small shipments that are delivered to a large number of different destinations. At the other extreme, the construction, the utilities and the business, repair, and personal service industries own many vehicles that tend to be specialized equipment, make one trip per day to the jobsite, and sometimes even stay on the jobsite overnight. Sometimes the vehicles are so specialized that they are used only a few days a year, for example, snow-removal equipment.

THE SYSTEM IN ACTION

The fact that intercity freight has been getting more efficient has been noted. We find the same thing in the distribution of bulk freight within the region. Traditionally,

Figure 3. A square mile in downtown Brooklyn.

fuel has tended to come into the Port of New York and to be redistributed via barge. But we find 2 things happening: (a) There is an increasing tendency for fuel to go directly to its destination, as in the case of new electric plants, or to a redistribution center nearer the ultimate destination, as in the case of Northville Docks near Riverhead, Long Island; and (b) the redistribution process itself is being modernized through the installation of new pipeline capacity, larger barges, and larger coastal tankers.

However, in the most expensive area—local truck freight—we seem to be at a standstill or getting worse, squeezed between rising wage rates and increasing demand. Figure 3 shows a slice of the region. a square mile of downtown Brooklyn, with no freight service except by truck. This is a part of a dense old urban downtown area with varied development. About 15 percent of the land is residential, 11 percent is commercial, and another 11 percent is public buildings. Manufacturing and utilities account for 5 percent. The biggest single segment of land use is devoted to streets, 36 percent.

The data given in Tables 9 and 10 show better than anyway that I know how the highly competitive, fragmented distribution system works now. Nearly all of the freight tonnage is internal, and most of that is concentrated within Brooklyn and Queens. There is very little over-the-road traffic. Here is the crux: 4,200 trucks are required to handle the daily internal traffic versus only 28 trucks for the over-the-road traffic. The average internal consignment weighs 160 lb, while the over-the-road consignments average 12,400 lb.

Obviously the number of different origins and destinations served by these 4,200 trucks are extremely scattered. The data indicate, though they do not prove, a "filter-down" distribution pattern like the following, for the inner city area:

1. A few large shipments come in over-the-road;

TABLE 9

AVERAGE DAILY INBOUND TRUCK TRAFFIC IN 1963 FOR 1 SQUARE MILE OF DOWNTOWN BROOKLYN

From	For-Hire Carriage				Manufacturing				Wholesale				All Other Inudstry				Total			
	Tons	Trucks	Con-sign-ments	lb per Con-sign-ment	Tons	Trucks	Con-sign-ments	lb per Con-sign-ment	Tons	Trucks	Con-sign-ments	lb per Con-sign-ment	Tons	Trucks	Con-sign-ments	lb per Con-sign-ment	Tons	Trucks	Con-sign-ments	lb per Con-sign-ment
Internal	148	412	1,676	177	400	842	4,667	171	66	709	1,370	96	179	925	1,609	222	793	2,888	9,322	170
Brooklyn, other	85	225	1,415	120	279	503	1,847	302	27	367	952	57	84	554	1,076	156	475	1,649	5,290	180
Queens	—	—	—	—	92	224	1,830	101	16	190	228	140	42	188	313	268	150	602	2,371	126
Manhattan	28	36	72	778	24	78	953	50	19	117	155	245	44	78	78	1,128	115	309	1,258	183
Bronx	3	41	41	146	—	—	—	—	4	35	35	229	9	70	107	168	16	146	183	175
Nassau	—	—	—	—	—	—	—	—	—	—	—	—	—[a]	35	35	—[a]	—[a]	35	35	—[a]
Hudson	23	38	76	605	—	—	—	—	—	—	—	—	—	—	—	—	23	38	76	605
Bergen	7	35	35	400	—	—	—	—	—	—	—	—	—	—	—	—	7	35	35	400
Passaic and Union	2	37	37	108	5	37	37	270	—	—	—	—	—	—	—	—	7	74	74	189
External	47	7	7	13,429	1	4	4	500	—	—	—	—	—	—	—	—	48	11	11	8,727
Southern New Jersey	47	7	7	13,429	—	—	—	—	—	—	—	—	—	—	—	—	47	7	7	13,429
Pennsylvania	—	—	—	—	1	4	4	500	—	—	—	—	—	—	—	—	1	4	4	500
Total	195	419	1,683	232	401	846	4,671	172	66	709	1,370	96	179	925	1,609	222	841	2,899	9,333	180

[a]Less than 50 lb per truck.

TABLE 10

AVERAGE DAILY OUTBOUND TRUCK TRAFFIC IN 1963 FOR 1 SQUARE MILE OF DOWNTOWN BROOKLYN

To	For-Hire Carriage				Manufacturing				Wholesale				All Other Industry				Total			
	Tons	Trucks	Con-sign-ments	lb per Con-sign-ment	Tons	Trucks	Con-sign-ments	lb per Con-sign-ment	Tons	Trucks	Con-sign-ments	lb per Con-sign-ment	Tons	Trucks	Con-sign-ments	lb per Con-sign-ment	Tons	Trucks	Con-sign-ments	lb per Con-sign-ment
Internal	234	304	1,987	236	98	387	3,878	51	1	154	192	10	349	476	2,800	249	682	1,321	8,857	154
Brooklyn, other	57	140	735	155	87	307	3,598	48	1	32	32	63	105	248	2,437	86	250	727	6,802	73
Queens	—	—	—	—	11	80	280	79	—[a]	122	160	—[a]	106	107	144	1,472	117	309	584	401
Manhattan	169	144	1,213	279	—	—	—	—	—	—	—	—	—[a]	43	43	—[a]	169	187	1,256	269
Bronx	—	—	—	—	—	—	—	—	—	—	—	—	1	37	94	21	1	37	94	21
Hudson	8	20	39	410	—	—	—	—	—	—	—	—	137	41	82	3,341	145	61	121	2,397
External	143	12	12	23,833	14	5	10	2,800	—	—	—	—	—	—	—	—	157	17	22	14,273
Illinois	63	4	4	31,500	—	—	—	—	—	—	—	—	—	—	—	—	63	4	4	31,500
Canada	48	4	4	24,000	—	—	—	—	—	—	—	—	—	—	—	—	48	4	4	24,000
Massachu-setts	32	4	4	16,000	—	—	—	—	—	—	—	—	—	—	—	—	32	4	4	16,000
Upstate New York	—	—	—	—	14	5	10	2,800	—	—	—	—	—	—	—	—	14	5	10	2,800
Total	377	316	1,999	377	112	392	3,888	58	1	154	192	10	349	476	2,800	249	839	1,338	8,879	189

[a]Less than 50 lb per truck.

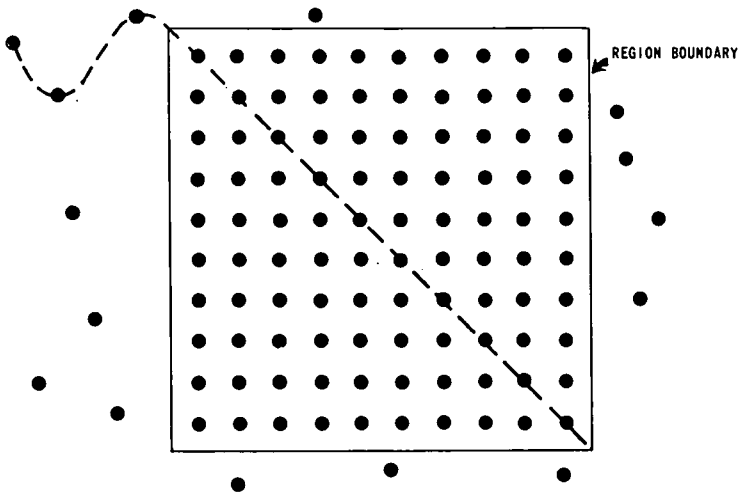


Figure 4. Schematic arrangement of goods movement origin and destination points.

2. This raw or semifabricated material is processed and distributed to nearby manufacturers, wholesalers, and retailers in small shipments;
3. Manufacturers and wholesalers again redistribute their goods to other manufacturers, wholesalers, and retailers, and the like; and
4. Manufacturers ship a small portion of the end products of this process to other regions.

Schematically, the typical pattern of freight distribution within a metropolitan area looks like the arrangement shown in Figure 4, with each dot representing a possible point of origin or destination or both. There are 3 things to note in this figure:

1. A preponderance of the current demand is for internal interchange;
2. The potential trading points tend to be evenly distributed throughout the metropolitan area, with the likelihood of an actual transaction occurring being less the farther any 2 points are separated; and
3. The points are not organized in any way into efficient trading blocs, units, or enterprises from the standpoint of goods handling or goods flow. Aside from propinquity, there is no reason one point would be any more likely to trade with a given second point than any other point.

Many theoretical proposals for relieving downtown street congestion are based on driving a tunnel through the city to connect, say, 10 percent of the points, or using an existing subway system to make the connection and thereby solve 10 percent of the problem. They assume that there is in fact a concentration of trade in the corridor to be served. But, in this example the tunnel would provide for only 81 potential interchanges out of a total of 9,801—less than 1 percent. A truck would still have to be used between the tunnel and the rest of the customers. Such proposals are, therefore, incomplete. They must somehow deal with the problem of changing the distribution pattern so that goods will tend to both originate and terminate on their system. This may require the redesign of the city.

This square mile of downtown Brooklyn is perhaps a bit extreme as an example of inner city traffic, but not very much so. Only in Hudson and Middlesex Counties, the location of many major truck terminals and important large-scale manufacturing activity, and in the outermost suburban counties does external truck volume reach as much as a third of total truck tonnage. The overwhelming impression is of short-haul, small-shipment, internal distribution.

This intraregional truck distribution picture is getting worse and worse, year by year, as shown by the steady rise in the proportion of the freight dollar that is going to local trucking. It seems immune to the technological improvements that go on all around it. We must find ways to reverse that trend.

ACKNOWLEDGMENT

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INFORMAL DISCUSSION

John Clayton

Do you think there are no technological solutions to the difficulties of urban commodity flow but that an institutional or organizational solution will have to be used?

Wood

I wish that someone would show me some place where technological change is attacking this problem. Five years ago the Transportation Association of America put out a little forecast in which it said it expected a tremendous change in internal distribution because of all kinds of applications of technology. At that time, I would have made exactly the same forecast. I have not seen one such change. Whatever you see going on in intercity transportation—containerization, communication, and automation—it is not being duplicated in the intraurban flow. The technological potential is there, but I think we have to change the means by which we use it.

Donald E. Church

It strikes me that you have to get the organization moving, and then the technology will come in. I think both of them are going to be part of the answer, but not technology first.

Wood

I agree.

Dale L. Anderson

I think there is some applicable technology, but I am not sure you are getting it in the city. Palletization and various types of delivery being used by firms that control their own outlets are 2 examples. If you are going to get these, is there not some sort of city ordinance or restrictive mechanism going to be required?

Wood

I can respond in 2 ways: First, the examples you cited were carried out by people who have private capital available; and, second, in this one area of intraurban freight movement, I have become an out-and-out socialist. I honestly believe that we just have to change the framework of enterprise; it has to be done differently.

Kenneth R. Ketcham

Do you not think a limited-entry approach to the problem would give these people an opportunity to build capital enterprises rather than to dissipate it over so many coolies as you suggested?

Wood

I do think that some kind of limited entry is required, but I do not know what the framework should be. It could be that the government says I will do the job, and you are going to stay out; or that you say you will take this square mile and someone else this square mile and the two of you will work out the interchange between you. I do know that the present system is not working.

Don Maund

Do you have any estimate of what the changes would be if you did have, say, a public utility handling pickup and delivery within the urban region? As I understand it, trucks spend a lot of time parked at the curbside. Would this be different with a big organization?

Wood

I have a hare-brained idea of my own, in which you could change the distribution system through consolidation in local terminals. Perhaps the scheme lies more in changing the communication system so that somebody can communicate his needs for a pickup to somebody who is already on the street and can come in and pick up his freight. They left me all alone out here in this subject area without much competition, and I am not to be trusted that much. I wish more of you would come along and study this area. As I said, I have one idea, and every carrier I have shown it to tells me it is absolutely hare-brained and will not work. Transportation analysts look at it and say it is a great idea and that it is better I than they should get the ulcer trying to put it into effect.

Edward Margolin

You seem to indicate that the pattern you found may be a national problem especially in the larger port areas. Would you say, as a general proposition, that what you have discovered is pretty general throughout the country?

Wood

Back in 1963 there was no information around for comparison. There is some good information emerging now around the country and in Europe. I would say that, looking at different parts of the Tri-State region, what I showed you for Brooklyn is not atypical but a little more typical than usual. If you look at any one of our counties, you will find that by far the majority of freight moves within that county. You get the tremendously overwhelming picture of extremely short-haul, local transportation. I think it is pervasive.

Margolin

Is that a national problem?

Wood

Yes.

Warren B. Lovejoy

Is the majority of local pickup and delivery done by private firms with their own merchandise?

Wood

There is a breakdown on that in the paper. A for-hire carrier has a slightly larger than average shipment but is doing a minority of work—about 25 percent of the tons with 15 percent of the truck-miles. The wholesalers, manufacturers, and retailers—everybody else who handles his own freight—are running around getting in the way.

Lovejoy

When you talk about changing the organizational pattern for this, are you really talking about change, or just amalgamating common carriers?

Wood

Do not kid yourself that amalgamated common carriers will fix this. It may make it worse because, if you were to damage the delivery pattern in any way, people would go right over to private carriage and you would be worse off than you were before.

James C. Nelson

It seems to me that, whether there is an internal demand for a lot of small shipments that involve a great many deliveries and defy consolidation or whether it is really the type of operation, you can consolidate the shipments into a limited number of trucks. In other words, are the demands such that you have excess trucks or empty trucks or partly empty trucks because of the nature of the demand? If they are, will restriction of firms do very much?

Wood

I do not know. The demand varies tremendously. I could give you examples from our own surveys, but it would take too much time. But one specialized carrier (a textile carrier) told me that one time business was slow and around Christmas time he called up one of the big common carriers he happened to know and asked, "Do you have some business for me?" The guy said, "Sure!" So he went out and picked up a couple of truckloads for delivery, and it made him go broke. He did not know how to find a customer in the top of the Empire State Building. The structure of this thing is murder.

John Rieth

You say that you included everything that was nonpeople transportation. So, therefore, service vehicles would be included in the tables. Where is the service?

Wood

The service is in the "other" categories. As I remember, they account for 11 percent of the miles.

Anderson

Did you get any idea of how many of these people were rack jobbers, stocking shelves along with delivery, or doing sales service? Is there any way you can get to that?

Wood

We did not get beyond the door of the enterprise. We had enough trouble.

Irving Hoch

You stated that movements were inefficient relative to the major hauls. I guess your criterion of inefficiency is the difference in cost. I am not convinced that this is necessarily the case. People are willing to pay for it. You are not going to establish the case yet. I think we have to develop information showing that there is a better way of doing it before you can convince me, anyway, that this is inefficient. I think we

have to worry about the problem of suboptimization. You might improve the efficiency of transportation by cutting cost but reduce efficiency of the system as a whole. I also think you have to specify somewhat more what the elements of this inefficiency are. Is it less than full truckloads? Is it time lost in delivery? That seems to me perhaps to reflect the fact that the cost of time on the street is not taken into account properly. This is inefficiency as a whole. So I have a variety of points here, but I think the crux is that this inefficiency argument of yours really needs some spelling out.

Wood

I could not agree with you more. All I am saying is that, if you go into practically any downtown area, certainly anywhere near our area, and you go down a block, you will find 7 to 10 trucks, half of them double-parked or up on the curb, delivering shipments averaging 200 pounds. Now, looking at this and applying the data, I did try to reinvent that world in this hare-brained scheme of which I spoke. And given the size and putting together the same production, I think I have found a cheaper and better way. I can think of all kinds of reasons why it will not work; but, nevertheless, this exercise shows that it can work. You could reinvent the manner of arranging the distribution process and get the same or better results more cheaply. I wish somebody would prove me wrong.

Charles W. L. Foreman

I may misread you, but I think I see an assumption that the cause lies in correcting transportation. I wonder if you considered that the curb time might be a function of factors other than transportation factors, such as the unit readiness or the inability to get what was to be picked up and the inability to make a delivery. Have you considered these other factors as well as the carrier and what could be done with them?

Wood

I know they are there. As I say, we did not go beyond the door of the enterprise. If you are going to really set out to reinvent this portion, you are going to have to go beyond the door and find what is going to be to the interest of the total, overall operation.

Peter Watson

It seems to me you have another implicit assumption in there. There is something wrong with having cars or trucks double-parked at the curbside. I think what you are saying is that they are double-parked and blocking you. I think we have to come to a decision about what is more important when we have people competing for space. A value judgement has to be made at some stage.

Wood

If you have only one choice between alternatives, then you have to make a kind of value judgement. I would first explore the possibility of doing the job better with what we have—rationalize.

David Glickman

I must take issue with the question and the answer. It is not as simple as that. There are times when both goods and people movement coincide in time and space. A classical area is the garment center. It is impossible to rationalize and to say that you prefer to have goods movement take precedence over people movement when, without the other, it is completely irrational.

James C. Nelson

Do you have any idea as to timing?

Wood

We have a time distribution, and the peak is right around 9:00 to 11:00 a. m. However, in the dense downtown areas, it goes up at 8:00, continues to 4:00, and drops. There is more of a flatness. These trucks work all day.

Paul H. Banner

I do not think that is particularly bad if one considers what is being delivered. Morning deliveries to stores and bakeries are not dense items, but they must be delivered. I would like to go back to your point that the internal deliveries are so much more important than what comes into the city. How much of what comes into the city can be eliminated, and what relief will it give to the necessary movements within the city? Why do you say that they are so small they are unimportant? What is the marginal effect of solving that problem?

Wood

If you stop bringing the things into the city, the city would starve.

J. Douglas Carroll

Are you referring to the over-the-road delivery as opposed to local delivery?

Banner

Yes.

Wood

My point was that it was being handled a lot more efficiently than the local delivery of that same material. We bring in something like 200 million tons per year and a lot of that, such as fuel, is consumed at the point of receipt, but the total amount moved around by truck adds up to 300 million tons per year. There is a lot of double handling. It is a wild system of distribution. I am not really sure I understand what you are asking.

Banner

Your use of the question on efficiency misleads me. You are making a judgment by saying this is efficient and this is inefficient. Which one is needed? We are not going to make all the local deliveries suddenly jump from 150 to 1,500 pounds. They are entirely different types of movements.

Wood

I too think that the delivery of the 150-pound shipment will have to be accomplished. What I hope is that we will find another way of achieving that same service to the customer. I do not know how to do it, although I have an idea.