STATE OF RESEARCH AND DATA ON URBAN GOODS MOVEMENTS AND SOME COMMENTS ON THE PROBLEM

Wilbur S. Smith

Even the most superficial survey of the problem of urban goods movements impresses one with 2 startling facts: (a) The problem of urban goods movement has attracted an almost incredibly small amount of attention as compared to the related problem of personal transport; and, (b) the dimensions of the problem are immense and poorly defined. The problem has influenced almost everyone—drivers, deliverymen, merchants, housewives, and traffic engineers—but still unknown, generally speaking, are its dimensions. Progress has been very slow because, for many years, the problem was considered of little importance. Because the truck is so frequently mentioned in factors of road congestion, transportation costs, and urban environments, it is hard to understand why it has been so neglected in research and writings.

It is interesting to note an analysis of urban goods movement published almost 60 years ago. The author (an eminent engineer) had made careful time and cost studies and concluded that the motor truck might save time and money within the area beyond 3 miles from the center of the city. However, within a circle having a radius of 3 miles from the center of the city, the horse was considered without a peer (1). Data are not generally available on the cost of owning and maintaining a horse for drayage, but it appears from current observations that this conclusion may have some validity in 1970 when one contemplates the costs and inefficiencies of urban goods movement!

In discussions in April 1970 (2), one finds the problems cited disturbingly similar to those cited in earlier studies (3). The old study and the new studies tell a sad tale of congestion, duplication of effort, tremendous overtime payments, and other difficulties facing the transporter of goods in the urban area.

Hit-or-miss, empirical solutions to this problem are no longer acceptable. Both public and private costs have become so great that a more fruitful approach must be found. It is indeed gratifying to note that increasing attention is being paid to the issue, but there are surprising gaps in knowledge. Even a casual search will show that "the literature contains no precise quantitative description of the problems plaguing urban goods distribution systems" (4). Some discussions of the problem of urban goods movements and the consideration of the areas in which information is available, or is needed, seem appropriate before the specifics of research and data are dealt with.

THE CITY AND TRANSPORTATION

A frequent error in the past has been the tendency by many to discuss transportation problems, especially those related to goods, in terms of the present and not the future. How the future city will influence urban goods movements will depend on characteristics of the future city. In considering sources of data relative to urban goods movements, one must of necessity consider all of the factors and variables related to the size, shape, form, and functions of the future city or urbanized area. To understand goods movements, one must understand the physical, economic, and social makeup of the city. A search for, and listing of, information of this comprehensiveness is con-

sidered to be beyond the scope of this paper, although a few comments about the future city might be desirable.

All evidence indicates that the city, or at least the urban area, will be even larger, both in population and in land coverage, than it now is; and there will be more metropolitan areas, many of which will merge into one another. But, there are some advantages to goods movements. The number of urban truck trips relates to the urban population. The larger the population is, the fewer the trips per capita will be.

The National Planning Association estimated in 1969 that by 1975 70 percent of the U.S. population will reside in 224 metropolises. Most of the growth is expected to take place in the Standard Metropolitan Statistical Areas (SMSA) that have populations of 800,000 to 1.5 million. The largest SMSA's with populations of over 1.5 million (of which there are 14) contained some 30 percent of the 1966 population. Population growths for the largest SMSA's are not expected to increase so rapidly except for Washington, Minneapolis-St. Paul, Los Angeles-Long Beach, and Houston (5). Thus, what is now often considered to be intercity goods transportation perhaps will be largely intracity by 1980 and entirely urban in character. The urban transportation problem will begin to take on an entirely new character, and the Northeast Corridor will cease to be unique, for there will be many such corridors. As these developments take place, the distinction between urban and intercity movements, which has become increasingly blurred, will be even more indistinct (6, 7). The Federal Highway Administrator recently made these comments on the problem (8):

> In the two decades from 1950 to 1969, our metropolitan areas (that is, areas with central cities of 50,000 or more population) grew from about 89 million to more than 129 million population. Virtually the entire increase of 40 million persons occurred in the developing suburbs outside the 1950 boundaries of the central cities. Some central cities subsequently registered gains by annexing their adjoining suburbs.
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> The suburbs which had 41 percent of the metropolitan area population in 1950 today account for 55 percent.
>
> Some of our older industrial cities actually have been losing population. During the 1950's, for example, the four-county Cleveland metropolitan area showed a 25 percent gain, but the city itself lost 4 percent.
>
> In the period from 1957 to 1964, St. Louis lost 80,000 population while its suburbs gained 300,000; Detroit lost 60,000, but its suburbs gained almost 450,000. Some major cities, such as Philadelphia, gained, but only slightly. It added 20,000 while its suburbs were adding 450,000; likewise, Washington, D.C. increased by 20,000, but its suburbs gained 560,000.

The rise of the suburbs has been especially troublesome to planners because low density of population is their hallmark. High-density residential zones (greater than 25 persons per acre) attract 65 to 90 daily truck trips per 1,000 persons. Low-density zones (fewer than 10 persons per acre) attract 117 to 167 trips per 1,000 persons (9). Affluent suburban families demand delivery and other services that, with low density of population and the overlap of suppliers, result in startlingly high transport costs.

Cities such as Los Angeles and other automobile-oriented cities devote 40 to 50 percent of their land area to residential use as compared to older, more compact cities that devote only a third. Because the automobile-oriented cities have become dependent on the motor vehicle (and one has the impression that this dependence will continue for some time), planners must take into account the needs of the truck.

Most cities are in a highway-transit spiral where suburban developments encourage automobile ownership and usage. This causes traffic congestion and requires heavy capital outlays for new roads and capacity improvements. Further comments by the Federal Highway Administrator are of interest (8):

> Since trucks and service vehicles share the road with autos, the adequacy and efficiency of urban highway systems have a direct influence on the cost and quality of urban living. Even if all person movements were by any other mode than auto or bus—such as rail, bicycle, sidewalk—an extensive street and road network not much different from that which we now have would still be required to move the freight, groceries, garbage, police, fire, medical aid, and service equipment to maintain life and its amenities.

The city of 1970 is still, in most respects, merely a larger version of the city of 1920, if not 1900. Can anyone doubt that the major urban issues of the years 1970-1985 will be centered around the quality of urban life? In short, transportation of goods, like most urban problems, will be caught up in the press of rising numbers of people, growing concern with the environment and pollution, and other forces outside the transportation system, but nevertheless, influencing it. The truck is often mentioned and is frequently damned with regard to irritations related to vibrations, noise, pollution, and road wear.

Urban life is increasingly complex, and urban residents are less tolerant of any practices that, in their opinion, threaten the tenuous quality of their existence. How long, for example, will they tolerate such outmoded practices as storefront loading or the delivery of flammable cargoes in daylight hours or fumes and noise of many commercial vehicles? Power companies and other suppliers of urban services have discovered that the public is increasingly restive and often irrational in demands. Yet, these demands, irrational or not, will influence, or even control, urban development.

There are some data, although limited, to show how urban factors affect goods movements. The following are examples.

1. Retail shops generate about 11 daily truck trips per 1,000 sq ft of floor area. Convenience and general merchandise stores generate about 5 trips per 1,000 sq ft, while shops with lower activity have about 3 trips per 1,000 sq ft (9).
2. Destinations of urban truck trips are usually strongly oriented to the city center In medium-sized cities, about 40 percent of total truck trips are within 2 miles of the central business district. A total of 80 percent are usually attracted to zones within 6 miles of the CBD. In many of the truck trips, the trucks are empty; 22.8 percent of trips in a sample of U.S. cities carried no load whatever (10).
3. The "personal use" trucks (vehicles owned and operated in a manner similar to a private car) make up almost 10 percent of total truck trips and account for 15 percent of the total vehicle miles (9).
4. A typical city daily produces about 200 intracity truck trips per 1,000 residents. Excluding the central business district, each developed area of land attracts 1.6 to 1.8 truck trips daily (9).
5. Many trucks are idle from 50 to 90 percent of the day. In some cities trucks are parked most of the day waiting to be loaded or unloaded, or waiting to be used. Other trucks are used for service industries and principally transporting tools and equipment (9). Among these are a great number of trucks used in trash collection and transportation of other solid waste.
6. Studies of traffic impedances caused by trucks have ranked "awkwardness" of the trucks first. Usually, double-parking and illegal curb-parking run a close competition. It is not uncommon for trucks to spend up to 16 percent of travel time in traffic delays. This has produced a concern on the part of truckers about ton-miles per hour (9).
7. The tendency has been to treat the technology aspects of urban transportation on an intensive basis and leave the policy problems to the political scientists or to the sociologists. Technology is important, of course; but the future of urban goods transportation, like the future of urban transportation in general, will be shaped by developments in public policy, which until now has almost ignored urban goods movements.
8. Many light trucks are used extensively for personal transportation. In northeastern cities, the range is from 12 to 13 percent of the truck trips; but in the mountain states and on the West Coast, about half of the light trucks are used for personal transportation.

In summary, these random observations seem to suggest that, even though the urban area may change in both its physical shape and its concept and more attention will be paid to the quality of life, the transport problems will become even more intense. Unrelated factors must be related and studied before a sound solution can be devised. Also, because the carriers largely make the decision on levels and quality of services offered, they must assume a major responsibility in total urban transportation planning.

MAJOR GAPS IN KNOWLEDGE

Virtually all goods in urban areas are moved by trucks. Urban goods movements are made by thousands of firms, each acting in what appears to be his own interest. Most of these operations are concentrated in the hours from 9:00 a.m. to 5:00 p.m., 5 days per week. Little information exists as to how much change might be made—changes that would benefit both the public interest and the private interest. How many myths surround the urban goods transportation system? How many practices are accepted by both those who engage in transportation and those who make the plans for the urban system?

Movements by trucks in cities are highly diverse. Little is known about their true dimensions. It is certain that the movements are more complex than person movements. Correct information is difficult to obtain because of the natural reluctance of businesses to reveal information that might be of value to their competitors.

Many, if not most, commercial establishments have little knowledge of their actual delivery costs. They have assumed that it was necessary in the conduct of their businesses and perhaps in many cases their reasoning was correct. At any rate, for many years these costs were relatively small, and problems were usually overlooked. Consequently, those who operate urban goods vehicles have had little incentive to examine their costs closely. This practice is changing, and it will change more in the future. Myths must not continue to prevail.

Progress in formulating rational policies for urban transportation has been slow, not only because for many years there was no admission that they were needed but also because there was a deplorable lack of information.

To really attack the problem in a meaningful fashion, we must know more about at least the following: What is the daily volume of goods flow in the metropolitan area, and how is it distributed over the 24-hour period? What is the composition of flow among the various goods? What sizes and weights are involved? What is the time factor? Is the load perishable, or is a time constraint, such as in newspaper delivery, involved? Is there a real constraint on scheduling, i.e., morning, noon, or night, or are so-called constraints merely entrenched customs? What costs are involved in making meaningful changes? What is the value of the cargo? Is the routing followed specific or random, and who determines it? What stops must be made and what facilities are available? How is the truck loaded or unloaded? Is the load pumped out or unloaded by hand or truck? What vehicles are used and who owns them? What is the legal framework? What laws require trucks to use certain streets? How relevant and current are these laws and how adequately are they enforced? What are the labor policies and union regulations relevant to operations of urban trucks? What are the customs of businesses, such as refusal to accept goods other than at certain hours, that bear on the problem? To what degree do the costs, both public and private, of urban distribution increase because of congestion? Is it feasible to eliminate or reduce trucks from city streets by use of subways or by some mode such as tube transportation not now generally thought of as an alternative? How far can cities go in enforcing moving and standing regulations related to trucks? What will be the influences of environmental policies and controls on truck activities? What, if any, special problems are created by trucks for the traffic engineer, the road designer, and others? Are urban trucks too large and cumbersome for the task at hand? Should there be more or less government control? How does it relate to subsidies, mergers, and pricing? What are the effects of local, state, and federal regulatory practices? Can more effective zoning and land use plans change patterns of goods movements by controlling the termini of trips? What innovations will have the greatest impact on urban goods movements? Can trucks, passenger cars, and buses be accommodated on the same streets, from the standpoint of the traffic engineer and the economist? If they cannot, what costs, both economic and social, will be incurred in reaching a solution?

Workers in the field will need no reminder that the answers are hard to find. However, some impressive progress has been made. The Organisation for Economic Cooperation and Development has published the results of some highly interesting and encouraging studies that may point to new techniques and demonstrate that European groups

are thinking far ahead on this problem (11). If all or at least most of the answers to these questions were known, what shape would the urban transport policy take?

Most of the efforts so far have dealt with problems of simplifying transportation networks; less attention has been paid to simplifying spatial arrangements. This is because it is usually easier to change the network than to control land use. Perhaps future policy should attempt to remedy this situation. Some confusion has existed between the economic problems and the technological problems. Very little information exists with regard to the real private and social costs of present systems. The system of user charges has been constructed over the years on an ad hoc basis and, therefore, is not reliable as a guide. It would be of great interest to see the results of studies revealing the full costs of the present system not only to society but to users as well (12, 13, 14).

The policy toward intercity vehicles makes at least a crude attempt to relate user charges to use of the vehicle. This is to say, intercity trucks normally pay fees and taxes that are based on weight-size-use (miles operated) and that in some way force the operator to make rational decisions. Granted, this arrangement is not very accurate, but at least it is an approximation of the problem. In contrast, the policy toward intracity vehicles makes no distinction as to use. Vehicles may be used intensively throughout the day, at peak traffic hours, or at night; and no penalties or incentives are built into the system. Such a system would be immensely complex and difficult to administer, but some thought might be given to it. According to Carey (15), "We must look at the long-range changes in the structuring of the industry and the urban environment that will affect the flow of goods."

The development of trucks designed to fit particular uses in terms of both body and chassis seems to have considerable merit. It would be a means of minimizing labor costs and providing a higher level of loading and unloading services; but these applications are only beginning. Much needs to be known and much research will be necessary to understand urban goods movements and how to best provide for them in city and metropolitan planning. There are many who predict a revolution in the demands and patterns of commodity flow. Likely, most of these will not occur rapidly, and evolutionary procedures will be adequate to meet the changes.

INFORMATION SOURCES

This paper has had much to say about paucity of data in the field. While the purpose is to discuss research and information available in the areas of urban goods movements, it is recognized that an equally important concern is to find out what it is that we do not know, both in the data measurement fields and subject sectors of urban goods movement structure. One must remember that vast amounts of data have been collected and repose in files and data banks. Many of these data, though not collected with urban goods movements in mind, may be useful. There are doubtless numerous points of departure in existing studies for fruitful research.

The long-awaited census data with regard to trucks have only recently become fully available, and they will be increasingly valuable. As more information becomes available on both the concept of the modern urban area and the transportation per se, it will be possible to formulate the problem and measure its dimensions. Up to now, lack of data was only one facet of the problem, and it is doubtful that much benefit would have come from the possession of more factual information in the past because the urban goods movement problem was so poorly defined. Now, it seems some progress is being made toward at least defining issues. Perhaps the decade of the 1970's will see real advances in the problem of urban goods movement.

Major Data Sources

In searching data sources, broader elements that are receiving new emphasis in urban planning must be considered. These include social impacts; urban environments; major travel generators such as airports and air cargo; new technology in traffic flow, terminals, and vehicle hardware; multiple land uses, especially in heavy transport corridors; and transportation centers such as major terminals. Obviously,

these and other new items, such as staggered hours, traffic restraints (especially in the CBD), containerization, piggybacking, terminal aids such as improved goods-handling techniques, specialized transport equipment, energy conversions, and labor demands, greatly broaden the opportunities and needs for data sources and research in urban goods movements.

As one searches the literature, it is interesting to note that there have been few instances in which important sources of data have evolved, even though the data in most instances have not been analyzed with particular reference to urban goods movements. It is significant but not surprising that most of the work done in the field of urban goods movements has been produced by a relatively small number of organizations.

Urban Area Transportation Planning Studies—Goods that are transported on the highways have been recorded in the majority of comprehensive urban area transportation studies. These surveys use an interview sample selected from commercial vehicle registrations. The sample size generally ranges from 10 to 33.3 percent, depending on the number of registrations in the sample universe. These interviews are either conducted by direct interview with the operators or obtained from manifest records maintained by the trucking firms.

Origin and destination of each truck trip are generally obtained as well as the following data regarding each trip: land use at origin or destination, trip purpose, time of trip, commodity carried according to BPR code, and load, usually estimated as a percentage of capacity.

In addition, the following data are collected regarding the specific vehicle making the trip: vehicle type such as pickup-panel, 2-axle single rear tire, or semitrailers with 3, 4, and 5 axles; industry of truck; business of truck; total mileage on day of interview; registered gross weight; make and year of manufacture; and name and address of owner.

Many urban transportation studies also conduct surveys of special generators such as airports, ports, and special industrial areas. These surveys normally sample from 50 to 100 percent of all commercial vehicles entering or leaving a facility, and additional information is obtained regarding the commodities carried, weights, volumes, and movement of goods.

External interviews at the study boundary record similar information regarding truck travel and commodities. Generally, these are merged with the internal interviews for analysis of present conditions and projections to the future.

Traffic projections for truck travel are usually made by light and heavy trucks without regard for the commodity or specific type of goods transported. Trip-end models and trip-distribution models are calibrated separately and applied to future conditions to determine individual trip matrices of both light and heavy trucks for all travel within, into, and through urban areas.

The information on trucks, commodities, and trips available from the urban transportation studies can become especially useful because it can be tabulated in many combinations and in relation to many other basic factors of land use, planning, population, economic levels, and all other trips. This constitutes important data banks.

Current Activities—There are some current activities that will provide interesting information about goods movements in urban areas. In most instances, however, the data are not very extensive or in depth. On the other hand, all of these sources must be considered because the composite of facts in this area can often produce significant measures of needs, operations levels, and correctives.

National Highway Functional Classification and Needs Study—Over the years, highway needs studies have been conducted in many states, and there is currently under way throughout the nation a National Functional Classification and Needs Study. These studies are concerned with the characteristics of travel on various segments of the highway system and the projected requirements for highway improvements in the future 20 years. Highway improvements are largely determined by obsolescence factors as well as capacity deficiencies. Vehicle classification counts are examined to determine the proportion of trucks in the traffic stream to permit determination of existing capacity and future requirements.

Traffic Operations Program for Increasing Capacity and Safety (TOPICS)—In the usual TOPICS study, the existence of trucks in the traffic stream is recognized as part of classified counts made to calculate roadway capacity. Normally, no attempt is made to determine origin, destination, or type of goods carried by the trucks. Special problems relating to ingress and egress at major truck terminals would fall in the scope of a TOPICS study, but only as the problem affects capacity and safety.

Major Travel Generator Studies—These studies often produce information on trucks. At airports, particularly those that are air cargo centers, trucks may constitute a significant proportion of the vehicle traffic entering and departing the airport. Studies have shown that at major airports 5 to 15 percent of the traffic stream is composed of trucks. A total of 2,500 trucks entering and departing a major air terminal on a busy day is not uncommon. Trucks not only deliver and pick up cargo and mail at airports but also serve airport concessions, deliver aircraft fuel, perform aircraft support functions, and serve numerous other maintenance and supply purposes at the airport. They range in size from pickups to large vans, tractor-trailer combinations, and fuel tankers. At major airports with substantial truck traffic, it is almost imperative that the trucks be provided separate access and egress roadway facilities to maintain continuity of stream flow. This is becoming a necessity at smaller airports without an expressway type of circulation system to minimize intersection conflicts. With the traffic volumes being experienced at major terminals, ensuring compatibility of vehicles in the traffic stream can provide substantial improvement in traffic flow characteristics. Therefore, some of the current airport studies record interesting facts on existing and projected truck movements.

Some of the studies of ports have attempted to collect and project information on truck movements between the port and the metropolitan area. These studies are usually very limited in scope and obviously relate to a single generator.

Truck Weight or Loadometer Studies—These studies have been carried on by most of the states since about 1936. In these states stations are operated on at least one urban street each year as part of the annual truck weight study. Classification counts are made of all vehicles, and the characteristics and weights of trucks are recorded. Since 1969, types of commodities carried by the trucks have been obtained also.

Special Data Sources

The very fine work of a few agencies constantly comes to the forefront in searching for references on urban goods movements. The Tri-State Transportation Commission has undoubtedly published more than any others in this field. The East-West Gateway Coordinating Council in St. Louis, the Baltimore Regional Planning Council (16), and the Chicago Area Transportation Study have also published reports on freight movement.

Published Information by Category

Considering the questions and information gaps reviewed earlier in this paper, some of the references are related to subject categories. The categories are not comprehensive, and the references under each are not necessarily the most important. No significant references were found under several categories.

Characteristics of Urban Goods Movements—Information on urban goods movements are contained in a recent study by Wilbur Smith and Associates (9) and a study by the Tri-State Transportation Commission and reported by Wood (177).

Costs of the Present System—To some degree, public costs of the present system are understated; but, in other ways, many data exist. The resolution of this seeming paradox is found in the fact that dollar-and-cent costs of projects are well known, while the costs to mental and physical health of the present inadequate system are poorly understood. The magnitude of these costs is only beginning to be understood, and vast amounts of work need to be done here. A rather substantial amount of work has been done in the area of private costs. The work by Flood (17) and also the Tri-State Transportation Commission (18) are 2 sources. The study now under way at the University of Missouri is designed to discover the existing state of the art in management of private carriers. The contrast between public and private cost information is

noteworthy. Obviously, private costs are brought home to the firm, while public costs are apt to fall on a very broad area and go unrecorded, though not unpaid.

Socioeconomic Effects—Probably the most comprehensive study in this area is one by the Battelle Memorial Institute (42). In general, little information seems to be available. In this field, which is going to be increasingly important, continued ignorance will endanger overall success in the entire program of rationalizing urban transport.

Land Use—A very comprehensive study of this subject appeared in Shuldiner's paper (19), and an excellent analysis of British problems is found in the article by Shaw (20). Again, the information is severely lacking in some cases and quite adequate in others.

Regulation and Policy—This is the most neglected area of study. Several general works by Norton (21) and Smerk (22) consider the matter. Reebie (23) has reported a related study.

Technology—A relatively large amount of information has been collected in this area. The proceedings (11) of the Organisation for Economic Co-operation and Development contain typical studies, especially papers by Hallstrom (24) and Lewis (25). Much of the literature related to this facet of the problem is marked by its emphasis on glamorous hardware and its paucity of cost data. Careful consideration must be given to the costs of providing sophisticated facilities, whatever their appeal on the surface.

Effect on the Envoronment—Beaton and Bourget (26) treat the problem of noise, and the California Pollution Control Board (27) has prepared a report on reducing diesel smoke. A good summary of problems is found in the paper by Carey (15).

Traffic Operations—Many studies have been made on traffic operations, but few are conclusive. A recent study in Atlanta (28) considered the problem of truck movements on existing facilities. TOPICS studies, special corridor studies, and transportation terminal studies are all yielding much valuable current information on commercial truck operations. Existing road facilities are apt to be of great importance despite technological advances promised for the future.

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