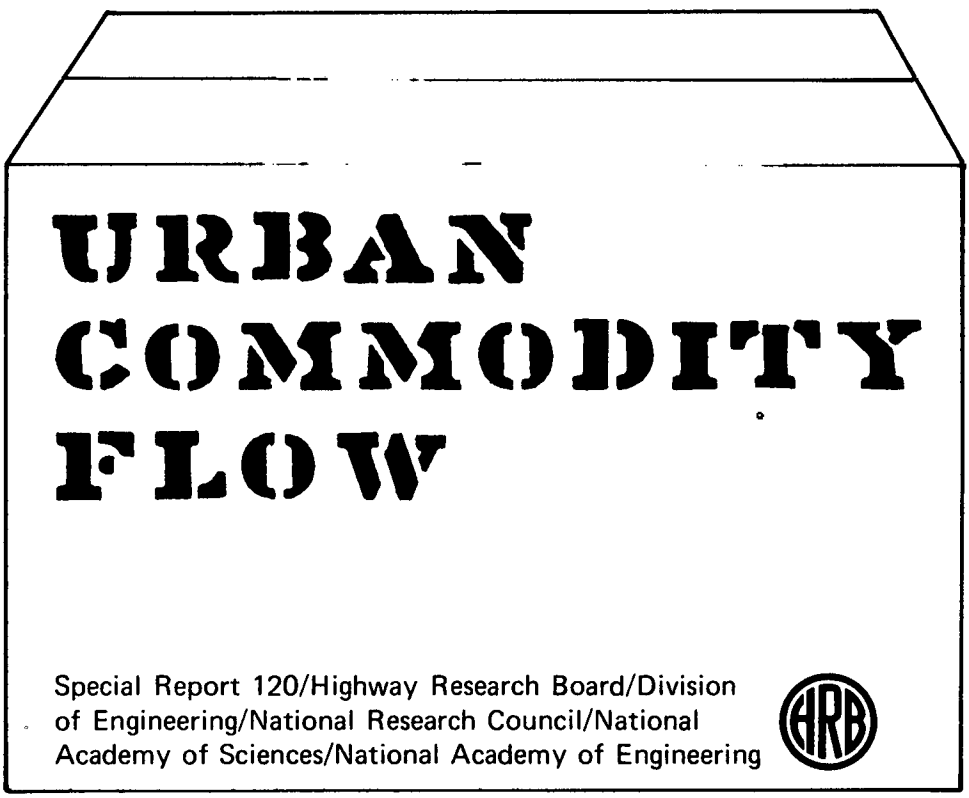

URBAN COMMODITY FLOW

Special Report 120/Highway Research Board/Division of Engineering/National Research Council/National Academy of Sciences/National Academy of Engineering

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FOREWORD

In the past decade, the urban transportation planning process has concentrated on the problems of passenger movement. Efforts have been toward alleviating the growing congestion that has resulted from the suburbanization of the population and the continued growth of office space in the central business district. In recent years, the concern has also been for public transit systems for those who do not have access to automobiles and as relief to peak-hour congestion.

In urban transportation planning, we have generally counted trucks as a multiple of passenger cars when measuring congestion and capacity. In most cases this has been satisfactory. It has not been satisfactory for forecasting long-range demand or for considering technological changes or possible, or rather likely, shifts in demand.

A substantial amount of data on the shipment of goods among cities and regions are available, but relatively little is known of the magnitude and patterns of goods movement in urban areas. Highway Research Board committees have been concerned with problems of goods movement. The U. S. and Canadian transportation agencies asked the Board to convene a conference on urban goods movement.

At the outset the intent of the conference was to develop data sources and demand forecasting techniques to help make more accurate projections of urban commodity flow for use in planning. It appeared that the collection of data and the design of sophisticated demand forecasting models would not be sufficient. Unless they were sensitive to changing patterns within the goods-movement industry and to changing patterns of urban structure, the models would not be valid. One of the problems of forecasting is that models for the future are based on patterns of the past. Although the future will, to a large extent, be predicated on the past, in a dynamic social and political environment, prediction models must also look to the social and economic restructuring process that is going on.

During the early conference planning meetings it became apparent that the problems of urban commodity flow were viewed differently by different "actors." The planner, the shipper, the governmental agency representative, the freight carrier, and the citizen see the problems and their consequences differently. To the planner, freight movement contributes to traffic congestion. To the freight carrier, the cost of shipments to the central business district is several times the cost of shipments to fringe areas. Trucks on the streets are anathema to automobile drivers, and so on.

One of the problems of urban goods movement is the pickup and delivery of small quantitities. An apparent solution is to combine small shipments into batches and thereby reduce the number of deliveries. However, there are institutional problems within the freight industry and government regulation that currently prevent this.

We need to know more about the actual movement of goods as well as the origin and destination of the vehicle in which they move in order to establish patterns and compute costs. In a fiercely competitive industry, such information is difficult to obtain.

The ultimate purpose of collecting commodity flow information is to use it in establishing criteria for future public investments in transportation and in regulating the private sector to protect the public's welfare. These are public policy issues, and they are more complex than the almost insurmountable ones related to locating additional freeways in urban areas. Until we can resolve these public policy issues, we cannot appreciably influence the movement of goods in urban areas. This is probably why so little has been done in planning in this area.

Some of the issues that must be considered if we are to forecast the demand for goods movement and to plan transportation facilities to cope with the demand are as follows:

1. Should government seek to regulate or subsidize the industry?
2. Should the pricing structure be left to the market?
3. Should intermodal carriers be allowed to merge?
4. Should same-mode carriers be permitted to merge?
5. Should governmental policy and regulation be used to influence the location of warehouses and manufacturing plants that generate goods for shipment?
6. Should the government change the structure of the freight industry to force consolidated shipments in congested urban areas?
7. Should the government attempt to regulate the times of delivery of goods?
8. Should the government through subsidy, regulation, or taxation influence modal split or type of carrier (public versus owner-operated vehicles)?
9. Should cities require and enforce adequate delivery parking facilities, either curbside or off-street?
10. Are freight and passenger systems compatible, and should the government continue to require rail freight and passenger service where it is not economic or encourage public transit systems to carry freight at off-peak times?
11. What are the industry and public effects of vehicle size and weight, and to what extent are size and weight affected by governmental policies relating to modal subsidies or regulations?
12. In the transportation of goods, what cost factors should be borne by the shippers and by the freight industry and what costs are in the public interest and should be borne by public subsidy?
13. What are the effects of labor practices on urban goods movement?
14. Should the government attempt to influence the volume of import or export through different ports of entry?
15. What are the potential innovations in the urban movement of freight, and should the government attempt to influence or subsidize their development?
16. What innovations and changes can be made in movements of governmentally controlled commodities such as mail and waste.
17. How can governmental policy improve the documentation of freight to improve the intermodal transfer and reduce loss?
18. What is the balance of "efficiency" among the shipper and the industry and the public good?
19. What type of urban structure do we want to develop, and how should governmental policy toward commodity flow seek to influence the development of the urban structure?
20. How should freight movement be regulated to minimize environmental pollution?

These are some of the issues related to urban goods movement that must be considered before attempts are made to forecast future demand patterns. The greater the change is from the current positions on any of the issues, the less valid will be forecasts based on past patterns. With such issues, practically all institutional, it is little wonder that transportation planners have not made substantial progress in urban goods-movement forecasting. This is not to say that nothing has been done. In fact, a review of the literature made in preparation for the conference indicated that there is a substantial body of information on the subject.

The purpose of the conference, therefore, became one of defining problems and issues; identifying where we are now in terms of research and data collection; evaluating potential technological, economic, and institutional changes that may occur; and considering long-range changes that may occur in the structure of the industry and the urban environment and that will affect goods movement in urban areas.

This Special Report is a compendium of the proceedings of the conference.

—W. N. Carey, Jr.
adapted from remarks made at the Sixth World Highway Conference of the International Road Federation, Montreal, October 7, 1970

CONTENTS

advisory committee report

SUMMARY OF CONFERENCE FINDINGS

1 Goods movement should be given more emphasis in the urban transportation planning process.

Goods movement has not received sufficient attention, particularly when compared to urban passenger travel. Although the movement of people and the movement of goods in urban areas have certain similarities, they also have some important differences in their economic and physical characteristics, transporting, loading and unloading requirements, origins and destinations, transportation and land use relations, and the nature and location of terminals. Consequently, goods movement should receive explicit treatment in the urban transportation planning process.

2 The scope of urban goods movement should be broadly defined.

The scope of urban goods movement should be defined to include (a) packaged goods, dry and liquid bulk, and dry flowables; (b) trash, waste, snow, raw materials, semi-processed goods, and consumption items; and (c) shipments that have only one trip end within a given urban area or that pass through an urban area or that have both trip ends within an urban area.

3 Goods movement should be specifically considered in establishing national transportation and urban growth policies.

Governmental regulation and public policy have a significant influence on the goods movement industry and the structure and balance between the different modes of transportation. The modal interface problem should receive particular attention. Currently urban goods movement is not fully integrated or unified into a comprehensive transportation policy or program. Public policy should consider the costs and benefits that might be achieved both for the industry and for the public through improvements in the intramodal and intermodal transfer of goods. This would include examination of the need for multimodal terminals and greater horizontal and vertical integration of the freight transportation industry.

4 Government policy and programs should encourage innovation in new urban goods systems and technology.

Publicly funded research and demonstration projects should be provided for urban goods movement. Cost comparisons and benefits should be evaluated for different potential systems and an assessment made of the economic, social, and environmental effects of the systems. Proposed new systems should be consistent with the changing patterns of urban growth and not attempt to redirect the structure of the urban environment to conform to the efficiencies of the system. Specific consideration should be given to the

interrelationship between new systems and labor costs and practices. Urban goods movement is a labor-intensive activity whose productivity has not kept pace with increasing costs. However, as part of the introduction of new systems or technology, comparable employment must be found for any labor being displaced. Research and demonstration programs should seek the most efficient movement whether by new mode or by improvement of current systems and should ensure in both cases that efficiency is consistent with the overall economic, social, and environmental needs of the community.

5 Federal, state, and local regulations and programs that affect urban goods movement should be coordinated.

Many federal and state agencies regulate and control segments of the urban commodity flow system. Failure to effectively coordinate programs and regulate carriers may result in conflicting effects on the industry that are not in the best public interest. Size and weight limits; regulation of delivery zones, rates, and services; control of land use; terminal location and restrictions; environmental protection requirements; authorized route structure; and new systems must all be coordinated and be consistent if there is to be a consistent national urban goods movement policy.

6 Public policy should ensure both continued health of the industry and improved service to the public.

Government regulation and control of the industry should be reviewed and revised in light of the realities of today. The changing needs of shippers and the economics of the industry must be considered along with the protection of the public interests in establishing public regulation of urban goods movement. Institutional arrangements need to be reexamined to determine if greater integration of the industry is warranted. Rate making and services offered should be based on demand and costs. There should be a clear definition of what public benefits are being served in restricting or controlling a free and open market. Likewise, neither industry nor labor should be permitted to control or influence the market so as to prevent the introduction of more efficient urban goods movement systems that would be beneficial to the public interest.

7 Demand forecasting techniques should be developed for urban goods movements for all modes of transportation.

Forecasts of urban goods movement should include consideration of (a) changing patterns of urban development and structure; (b) location of terminals and transfer points; (c) land use patterns; (d) changing economics and costs of the goods movement industry; (e) labor practices within the industry; (f) potential technological innovations in goods movement; (g) effects of governmental policy, financial aid, and regulation on the movement of goods; and (h) social and environmental considerations. Demand forecasting should portray the interrelationships among industry location, interindustry transactions, terminal interfaces, freight flow, mode choice and packaging, and urban transportation network.

8 Means of reducing congestion, noise and air pollution, and other costs caused by the movement of goods in urban areas should be explored and evaluated.

Because of the necessity of pickup and delivery of goods, trucks contribute to urban traffic congestion. Greater efforts should be made through government financial and planning assistance and through regulation to control truck parking for the pickup and delivery of goods. This will require a more careful analysis of freight movement

requirements for different land uses and the need for off-street loading and unloading facilities. Special consideration should be given to zoning for freight terminal areas, access requirements, and traffic control.

9 The existing information and sources of data on urban goods movement should be synthesized.

A number of studies of goods movement have been conducted or are in progress in several countries. There are a number of federal, state, and local agencies collecting data that are relevant to urban goods movement. The methodology and findings of these studies should be assimilated into a state-of-the-arts report on urban goods movement. The existing sources of data should be documented for urban goods research.

SUMMARY OF CONFERENCE PROCEEDINGS

Lester A. Hoel

The movement of commodities in urban areas represents a complex process that is poorly understood. Although urban transportation planning has become a well-established, decision-making tool with clearly defined procedures and methodologies, the principal focus of most planning efforts has been concerned with the movement of persons and automobiles. Goals and objectives for urban transportation are usually stated to include both the movement of goods and persons, but while they may appear equal in rhetoric they are unequal in expended effort. In fact, very little is known about the movement of urban commodities and the effects of commodity flow on the urban environment. The study of urban commodity flow has been neglected by the transportation profession partly because goods movement is not an organized activity in a way similar to that of the movement of persons. Few records exist of the transactions and related movements of commodities within the city that are of uniform quality and useful in describing the dimensions of the problem.

The Conference on Urban Commodity Flow brought together a group of persons who have been involved in professional areas related to urban goods movement. Through a process consisting of formal papers, panel discussions, workshop sessions, and informal meetings for a period of 2½ days of uninterrupted and intensive activity, the group developed a consensus concerning the issues involved in urban commodity flow and suggested a course of action that will create a better understanding of the urban commodity flow process and will result in improvements to the present means of transporting goods within cities. The stated goals of the conference were to (a) define the issues and alternatives involved in urban commodity movement, (b) synthesize and evaluate information already available relating to commodity flow, and (c) develop approaches to forecasting the demand for urban commodity flow.

In the course of the conference the attendees discussed many issues including the relationship between urban commodity flow and the environment; the impacts this relationship has on the urban community; and the effects of changes in the amount and type or urban freight facilities on the location of industry, on the growth of suburban shopping centers, and on residential locations. The attendees also considered how regulations, labor practices, and new technology will affect the volume and patterns of urban goods movement. The conference was a joint effort of the Canadian Ministry of Transport and the U.S. Department of Transportation.

This summary of the conference proceedings is divided into 5 sections. The first section discusses the various elements of the urban commodity flow problem, the second section discusses public policy issues and the role of government in urban commodity flow, the third section describes the data requirements for urban commodity flow, the fourth section discusses the implications of urban commodity flow on the transportation planning process, and the fifth section describes research and demonstration programs that are recommended. The many points developed by the conference attendees and summarized here are discussed in greater detail in the papers and workshop reports that follow in this Special Report.

THE URBAN COMMODITY FLOW PROBLEM

Urban commodity flow can be viewed as the result of human activity that occurs within a defined space. To maintain that activity requires that materials be imported

for consumption and processing and that manufactured goods be exported. In the process of importing and exporting commodities, an urban metabolism occurs. In the tri-state region in and around New York City, for example, it is estimated that each person annually accounts for 210 tons of fresh water, 7 tons of fuel, 4 tons of general freight, 1 ton of food, and 1 ton of disposable waste.

Intercity Versus Intracity Problems

The movements that are required to transport urban commodities are created by shipments between the urban area and external sources, distribution and deliveries within the urban area itself, and transfers at the interface between external flows and internal distribution systems. Commodities that move between cities and external sources are transported by truck, rail, air, water, and pipeline, usually in large quantities. Commodities that move within the urban area are transported almost entirely by truck. Accordingly, the most visible problem in urban commodity flow is the internal movement of goods by truck both at the terminal points where intercity shipments are transferred and in local pickup and delivery. Some commodity movements into and out of an urban area are concentrated, requiring large-capacity vehicles and special loading and unloading facilities. Internal commodity movements, on the other hand, are more widely scattered, difficult to predict, and utilize many specialized vehicles. Thus, intercity freight problems differ from intracity commodity flow problems because the truck is the exclusive urban mode of commodity transportation. However, intercity freight flows have an impact on urban commodity flow because freight terminals are located within cities and require large acreages in areas of high land values.

Externalities, Efficiency, and Impact

Urban commodity flow problems may be considered in 3 categories. These are problems dealing with externalities such as noise and air pollution; problems dealing with the efficiency and productivity of transporting commodities within an urban area such as reducing interference, consolidation, new technology, labor, and industrial management; and problems dealing with the impact of urban commodity flows on land use and urban development such as new town development and suburbanization. Furthermore, the urban commodity flow problem is an economic and social one created by inefficient transfer between modes and carriers, interference between freight and passenger vehicles, inefficient use of valuable land, and creation of undesirable environmental effects. The economic problem is to determine when resources may be used more efficiently such that the commodities required for consumption, processing, and manufacturing may be transported at lower internal, out-of-pocket, and time costs and with reductions in pollution, congestion, and noise. Quite clearly then, the urban commodity flow planning process should assess the implications of each transportation alternative for moving freight within an urban area, determine the costs and the benefits of each alternative, and advise decision-makers concerning the appropriate strategies for allocating resources for transportation-related activities and facilities.

PUBLIC POLICY AND THE ROLE OF GOVERNMENT

Almost all of the foreseeable improvements in urban goods transportation are within the present state of the art. However, the implementation of improvements will require incentives for testing and evaluating proposed programs and for creating a market for new urban commodity flow systems. Government plays a vital role in urban goods transportation by encouraging innovation in the application of new technology, regulating the transport industry, constructing highways, and enacting legislation that controls the use of urban space.

Provincial, State, and Local Interests

Although improvements in the technology of urban commodity flow are important, the extent to which urban goods transportation receives attention as part of the overall

urban transportation problem will depend on developments in public policy. The resolution of problems created by the internal movement of commodities can only be achieved through some unit of government that is larger than the typical local or city government. Historically these larger governmental units have not been concerned with urban commodity flow for several reasons: At the state and provincial level highway departments have been primarily responsible for highway construction and maintenance outside of urban areas; suburban areas of cities have been growing while central cities have been remaining at a constant level of population; a number of larger metropolitan areas extend across state lines, and there has been little coordination of effort as it relates to urban commodity flow; and individual cities have not had the capabilities to make comparative studies of how their transportation problems compare on a national scale with those of other cities. As a result, it is essential that emerging public policy directed toward urban growth and development include urban commodity flow as an explicit variable.

Coordination of National Transportation Policy

The formulation of transportation policy at a national level in the United States has been unsystematic and uncoordinated and has resulted in uneven approaches to various aspects of policy and programs. One example is the policy of the Interstate Commerce Commission concerning commercial zones and terminal areas; this policy should be reexamined. There should be greater flexibility through initiating actions that will embrace new and important traffic points by motor carriers and shippers to bring individual actions that often result in protracted proceedings. Suburbanization and the formation of large contiguous metropolitan regions create new conditions that require extensions by the Interstate Commerce Commission of commercial zones between 2 metropolitan areas, for example, Washington, D.C., and Baltimore, Maryland. If this were accomplished, motor carriers between these points would be free of economic regulations, and the Commission and other interested parties could observe the results of such operations to determine if there are benefits to the public under such conditions. An innovative action of this kind would furnish a test of economic efficiency in a limited area and would provide valuable information that would be useful for evaluation by other large metropolitan regions that have developed to the point where an intracorridor operation exists and the extension of the commercial zone boundaries is being considered.

Role of the Federal Government

The role of the U.S. Department of Transportation as it relates to urban commodity flow centers around the basic questions of whether the total urban system is being dealt with in a systematic way and whether federal policies and programs within the department are consistent with these objectives. An important aspect of these questions is the organization and responsibility for urban commodity flow within the department. One approach is the creation of a modal administrator for urban freight transportation whose primary function would be to focus on the many problems in urban commodity flow and to implement urban freight demonstration programs, technical studies, and capital grant programs.

DATA REQUIREMENTS

Urban commodity flow data are severely lacking. However, the gathering of data for data's sake alone is to be avoided, and data requirements should emerge from the needs of specific research projects and studies. As part of the ongoing transportation planning activities, information for commodities and vehicles should be collected at the national, provincial, state, and local levels; and the preparation of a data base of urban commodity flow should be coincident with urban commodity flow demonstration projects.

Organizing Existing Data

The knowledge that already exists concerning urban goods movement and its technology should be made available and included in research and other urban studies. To

begin with, an annotated bibliography of urban commodity flow studies should be compiled that indicates the specific contribution to knowledge that has been made. For example, one method of organizing the information and data sources is through a national institute of urban commodity flow that would act as a focal point and intermediary among government, industry, and the research community. In addition to acting as the depository for reference material and related data concerning urban commodity flow, the national institute could also be responsible for coordinating research and planning efforts. The contribution of industry in furnishing data concerning urban commodity flow should not be overlooked, and means should be developed whereby industry could keep records and furnish information concerning the flows of trucks and commodities within the city.

Classification of Commodity Flow Information

A suggested classification of urban commodity flow information for evaluation purposes combines vehicle type with the purpose for which the vehicle is being used. The categories include vehicles that pick up and deliver packaged goods primarily; bulk-haulage vehicles such as dumptrucks hauling sand, gravel, and construction material; single-product, special vehicles such as concrete trucks and tank trucks; service vehicles in which persons and goods are moved together; general cartage trucks that move manufactured goods, farm produce, and household furnishings; automobiles that transport goods; and trucks that transport people.

THE PLANNING PROCESS

The urban commodity flow planning process should be capable of evaluating the full range of consequences created by the various alternative plans for improving commodity movements. Present methods for urban transportation planning in the passenger transportation sector should be evaluated, and the focus of urban transportation planning should be broadened in order to provide inputs concerning the impact that urban commodity flow will have on the metropolitan region. Planning of intrametropolitan highway networks must include provisions for intraurban and interurban goods movement, and greater attention must be given to access of urban goods to the central city. The evaluation of changes in urban form and new developments in communications, which may potentially have an impact on urban goods movement, should include not only the effects on persons movement but also the effects changes in the freight system might likely have on development within cities.

Commodity Flow: An Element of the Urban Transportation Planning Process

The planning process for urban commodity flows should not be an afterthought consideration but should be viewed as a primary factor in the satisfaction of many urban needs. A reevaluation of the 1962 Federal-Aid Highway Act, which called for urban transportation planning of a comprehensive and coordinated nature, should include the subject of urban commodity flows and should determine how effective the planning process has been in achieving more balanced transportation as related to the interfaces between urban freight and urban passengers. Because urban commodity flows affect environmental factors, specialists involved in the transportation planning process should be in a position to assist elected officials in understanding the impacts that planning and urban commodity flow have on the environment.

A Forecasting Model System for Urban Commodity Flow

A framework that consists of 5 separate models is recommended for analyzing urban commodity flows. The models should be flexible in order to perform under varying specifications and thereby provide a variety of information useful to the agency or group studying a particular problem. The models could be considered as micro or macro descriptions of demand; that is, either they could focus on one commodity, one activity, or one building or they could represent an entire urban region and the commodity flows that occur between major industries and concentrations of activity. The

models should be adaptable either for short-term or for long-term perspectives; that is, they could either investigate and describe relationships valid for the present or predict what is to be expected in the future. The models could be either sequential or parallel; that is, either the output from one model could become the input for the next model, or the entire set of models could be solved simultaneously. The 5 models that are suggested include industry location, interindustry transactions, freight flow, means, and networks.

The industry location model defines the location of industry within the urban area and relates it to relevant variables such as location of labor market, rent, quality of transportation facilities, and other factors. The interindustry transaction model determines the outputs of various industries and the demand for commodities that are required from other industries, including the manner in which various industries within the urban area interact with each other. The flow model determines the magnitude of the desired commodity flow over the entire system by using the amount of commodity generation either at the industry level (micromodel) or at the traffic-zone level (macromodel) and the manner in which these units interact with each other. The means model allocates desired flows over the means for transporting commodities between industries or traffic zones. (Although this model is analogous to the modal-split formulation in urban passenger planning, the definition of a mode in urban commodity movement requires additional study and research because the primary vehicle for transmitting urban commodity flows is a truck and the description of the means for transporting commodities should include characteristics of service that reflect distinctions in truck characteristics and methods of handling various commodities.) The network model assigns the means to the transportation system and can be considered as analogous to traffic assignment in passenger transportation planning.

RESEARCH AND DEMONSTRATION PROGRAMS

To improve our knowledge of urban commodity flow and to use this knowledge to develop better transportation alternatives will require increased effort consisting of research, technical studies, data gathering, and investments in new facilities. An urban freight demonstration grant program should be implemented in order to test and evaluate various proposals, suggestions, and ideas for improving urban commodity flow. Without a demonstration program of this type it will be difficult to make generalizations concerning solutions that have merit and that are applicable to other cities. Improvements in commodity flow distribution will yield measurable gains. An estimate of the savings that might be achieved was prepared for the Canadian Ministry of Transport and indicates that streets and traffic improvements could yield an annual gain of approximately $90 per person, consolidation of terminal shipments and pickup-delivery operations could yield annual benefits of approximately $25 per person, improvements in shipping and receiving facilities could yield annual savings of approximately $10 per person, and improvements in commodity flow through new technology could result in annual benefits from $30 to $70 per person. These benefits are not cumulative but serve to indicate the order-of-magnitude savings that would result if greater attention were given to urban commodity flow problems.

Improving Commodity Flow: Short-Term and Long-Term Solutions

Short-term improvements could be attained by better management of the transportation used to move commodities by facility improvements for loading and unloading at warehouses and retail and other local distribution centers. The interference between commodity distribution activity and other urban activities can be reduced either by spatial separation or by temporal separation. Two solutions that have been suggested are evening deliveries and consolidation of commodity shipments. Temporal separation between commodity and passenger flows involves the rescheduling of the delivery of goods to evening or off-peak hours. Commodities are delivered to shops in late evening, requiring that the consignees either remain open to receive the goods or make special arrangements to have goods stored in secured containers. (An experiment of this type was tried in 1968 in London but was beset with many problems that tended to

increase the delivery costs over those experienced during the daytime period.) Consolidation of deliveries and provision of off-street loading facilities for trucking movement appear to have a great deal of potential because buildings generally have insufficient space dedicated to loading and unloading of merchandise.

Long-term improvements in the means of transportation used to move goods in urban areas could involve either adapting existing transportation facilities in urban areas to the transport of commodities as well as passengers or supplementing existing goods-movement facilities with new systems that will not interfere with surface transportation modes. For example, adapting public transit or railroad systems for commodity flow, such as for the removal of trash to land fills in rural areas, has been proposed. Questions that have been raised by planners to this alternative relate to the volume of commodities that would be made available for transport, the freight demands that could impose a high burden on already loaded facilities, the service to dispersed origins and destinations of commodity distribution, the additional physical facilities and cost that would be required for adapting public systems, and the general uncertainty concerning the practicality and acceptability of combining person and commodity movement. On the other hand, there are several significant advantages of using public systems for commodity flow, including the availability of excess capacity during off-peak hours and the potential for additional revenue. For these reasons, the long-term alternative of using public transit systems to move commodities should be carefully considered. Careful evaluations would be required on an individual basis to determine the feasibility of such an approach.

Suggested Programs for Improving Commodity Flow

Progress in urban commodity flow will be made in an incremental rather than in a grandiose manner. Small strides in the process of improving goods movement added up over many groups engaged in study, research, and implementation can make a large impact over time. Programs that could be implemented to determine what early action investments are possible to improve urban commodity flow are listed in the following paragraphs.

The reduction of interference between trucks and automobiles through the consolidation of routes and deliveries should be studied. The project could be implemented by a test program in a pilot city using selected commodities and shipments to achieve consolidation. The pilot effort would also investigate whether techniques, such as cost incentives, would induce shippers to consolidate truck deliveries.

Investigation of the application of after-hour delivery to stores and office buildings should be made in order to determine if staggering deliveries would affect peak-hour movement of persons and trucks and reduce urban congestion. The project would consider the effect on employees who would be required to work off-hours, the desirability and implications of such requirements, and the commodity and land use activities that could effectively operate under such conditions.

Possibilities for physical separation between persons and goods movement should be studied. Projects that are worthy of evaluation include designating streets for goods-moving vehicles only; designating certain lanes for exclusive use of specified vehicles, including trucks; specifying traffic control regulations that would favor urban goods movement; separating pedestrians by using raised sidewalks and malls; and providing off-street loading and unloading facilities within new buildings or in redesigned older buildings.

Reduction in noise and air pollution created by urban commodity movement can be achieved through existing technology, and study of the operating characteristics of present facilities for moving goods should determine the best alternatives for reducing noise and air pollution. Alternatives such as electric or propane power should be considered.

The efficiency and productivity of the truck-movement system could be improved by the use of modern management techniques including industrial engineering methods and improved material-handling procedures. This approach would encourage introduction of new equipment, better maintenance of older equipment, and means for improved equipment utilization.

Freight terminal location criteria and factors related to selecting terminal sites should be studied. The study should include terminal location factors from the operator's point of view, such as access to markets, employee availability, transportation-related requirements, and other needs. The study should consider the impact of terminals on adjoining land uses, including noise, pollution, congestion, and other environmental effects. Policy-related questions, including tax structure, zoning, and street facility programs, and possible multiple use of terminal areas should also be considered.

Terminal design and operating methods should be investigated. Included in this investigation would be all types of terminals, all modes, and all types of operation, including local cartage, retail store terminal operation, wholesale and distribution terminals, and intermodal terminals. The study would be industry-related and would assist in improving present terminal operations and future terminal design.

Consolidation of commodity shipments and joint terminal operations is a solution that has been suggested as a panacea for reducing congestion in cities caused by truck movements. The solution is more apparent than real. It is difficult to implement and to coordinate, and no successful joint terminal operations now exist. Accordingly, an area of research is to investigate the conditions necessary for creating a viable joint terminal operation, to develop criteria for locating a consolidated terminal, and to suggest possible tax and other incentives for inducing private carriers to participate in a consolidated or joint terminal venture.

Social costs of urban commodity movement should also be studied. Measurements of social costs associated with terminal and vehicle operations should be made to determine the costs of noise, air pollution, visual intrusions, safety hazards, impact of land values, delays to traffic and pedestrians, required additional pavement construction and maintenance, and other disruptions to the community.

A contribution to the knowledge of commodity flow patterns in urban areas would be made by the study of a small unit within the city such as a single commodity, a single commodity category, an activity center, a single office building, an industrial park, or other identifiable units that would be small enough in scale to understand, measure, and analyze. In addition, the study of urban commodity flow for several prototypical cities should be undertaken. To begin with, a city of moderate size should be selected where the problem of data gathering and analysis would be manageable and the urban commodity flow problems are undoubtedly not severe. These would be followed by studies in larger cities and other selected areas where problems exist and changes are under way.

Urban commodity flow demonstration projects should be implemented in selected cities that represent various sizes and types, have different rates of growth, and are located in different parts of the country. In this way similarities and differences in the characteristics of urban commodity flow movement will be identified.

Summary of Research Areas

In summary there are 5 areas of research, study, and demonstration that should be considered in urban commodity flow. These are investigations related to (a) near-term improvements using existing methods and technology, (b) long-range improvements using new technology, (c) investigations concerning the nature of urban commodity flow, (d) considerations of the impact of regulations, pricing policies, zoning, and other governmental actions that could influence the pattern of urban commodity flow, and (e) investigations concerning the social costs of urban commodity flow, such as congestion, noise, pollution, and accidents. The subject is an important one and should be given attention in the coming decades but will require that the Canadian Ministry of Transport and the U.S. Department of Transportation commit themselves to this important area of urban transportation. Only by the involvement of these agencies and their support of research and demonstration programs will the required information, knowledge, and understanding on the part of professionals concerned with urban transportation be obtained. Although industry, labor, and universities are each involved separately in the urban commodity flow problem, a coordinated effort involving support by the federal government will be required.

COMMODITY FLOW AND URBAN TRANSPORTATION PLANNING

D. Grant Mickle

For many years we have been concerned with the problems of transportation in urban areas. The emphasis, however, has been on the difficulties of moving people, and comparatively little attention has been given to the problems of commodity movements in cities. Thus, this conference is a milestone in its recognition of the need for more information and better planning concerning the movement of goods in urban areas.

The final structure of this conference is substantially different from the initial proposals. In the beginning we were primarily concerned with developing techniques and information systems that would forecast the growth of urban commodity movement. The more we delved into the problem, the more we became aware that forecasting models predicated on past historical patterns would not be valid unless they took account of the changes in economic and social patterns occurring in society and the changes in physical structure occurring in cities. The goals of the conference, therefore, were redefined, as follows:

1. To clearly define the issues and alternatives involved in urban goods movement;
2. To synthesize and evaluate the information we already have available relating to urban commodity flow;
3. To consider the economic, social, political, and technological changes that are occurring in the urban environment and that will affect the demand and flow of goods in metropolitan areas; and,
4. To forecast commodity flow.

To advise us on the development of the conference, we invited a number of representatives to a one-day meeting last spring. From the response, it became evident that different groups saw urban goods movement from different points of view. It also appeared that the proposed policies and activities of one group involved with goods movement may be in conflict with those of another group. The discussions also indicated that a wealth of information already exists on the flow of goods in urban areas or, at least, on urban truck movements but that it has not been gathered together or put in a form that is usable by interested parties. Putting all these needs together for a conference program was a milestone in itself.

To understand the current patterns of urban commodity flow and forecast future changes and growth, we must not only consider the current patterns but also examine the reasons for them. To do this we must go beyond the statistics and examine the structure of the freight industry and the effects of government policy on the movement of freight. In addition to looking at the shipping process itself, we must also consider changing patterns and the needs of the shippers and receivers of goods. In our analysis we must include potential technological and procedural innovations that will influence the way we transport goods. We included in the conference program formal papers to address these topics. A panel discussion was arranged to get some perspective of how different ones involved in urban goods movement see the problem.

Five workshop panels were included to consider different facets of commodity flow. The first determined what economic factors affect the location of freight terminals and the collection and distribution of goods. The second considered the needs of a large

urbanized society and reexamined the way goods are moved and the historical attitudes and public policies toward urban goods movement. In the third, the physical structure of the city was considered. Major changes are occurring in cities in response to changes in life styles and economic and social demands. Recent census data indicate that population shifts in urban areas have been more rapid than they were forecast to be. The relocation of population and industrial concentrations dramatically shift the demands for goods shipment. However, there is always a lag between the time problems are perceived and solutions proposed and the time when they are acknowledged by the public and acted upon. In the interim, we must continue to operate under existing constraints and with existing facilities. The fourth workshop directed its attention toward applying existing knowledge and technology to the achievement of maximum efficiency in the movement of goods. The fifth workshop panel attempted to develop a framework for analyzing and forecasting commodity flow.

Considerations during the conference and summarized in this Special Report will be submitted to the U. S. Secretary of Transportation and the Canadian Ministry of Transport. In addition, this Special Report will be given wide international distribution.

To some degree, public policy in the area of urban goods movement in the past has been formulated with little reliance on the logical application of researched facts. Before sound public decisions are made, it is imperative that well-authenticated facts are produced by a thorough examination of the background of public issues and the consequences of proposed alternatives by a wide range of interested professionals. This conference provided one of the first opportunities to share information, points of view, and insights useful in the development of better practices in the area of urban goods movement.

THE INTEREST OF THE U.S. DEPARTMENT OF TRANSPORTATION IN URBAN GOODS MOVEMENT

Ira Dye

The interest of the U. S. Department of Transportation in urban commodity flows developed soon after the department was formed 4 years ago. One goal at that time was (and is) to develop information and relationships so that we could look at transportation from a multimodal standpoint and estimate future demand for transportation on that basis. The total demand for transportation services of all kinds rests not only on individual modes as separate activities but also on their interaction with one another.

The Office of the Secretary sought, therefore, to determine the multimodal nature of the demand for transportation services on the basis of 2 categories: (a) origin and destination and (b) people versus freight. This suggests that, for domestic transportation, we usually consider the demands for intercity passenger travel, intercity freight movements, and urban or intracity passenger demand. One area very often neglected is that of the urban or intracity freight movement of goods.

When we do consider this fourth demand category, we tend to look at it from the standpoint of just truck movements in the city. In other words, when estimating the need for additional highway capacity, we have treated urban goods movements in much the same way we traditionally have dealt with intercity truck movements. When we consider the place of urban freight in the urban transportation planning process more carefully, we find it qualitatively quite different from both intercity freight movement and urban passenger travel. It is much more complicated than our conventional wisdom has led us to believe.

We know that interurban freight movements interfere with intercity passenger and freight flows as well as urban passenger travel. But we have devoted comparatively little effort to examining how this interference might be reduced with existing technology much less with innovation. We know that planning for urban growth requires transportation planning, but we do not know what an efficient urban freight distribution system would be like or what cost savings would be realized or how a city planned for cheaper commodity transportation would differ from the urban forms that we have today. We know that transportation of people and goods affects the environment, but we do not know what reductions in congestion, in air pollution, and in noise might result from different approaches to transporting freight, including comparatively modest proposals such as freight consolidation and centralized pickup and delivery.

What do we hope to accomplish with this conference? First, we hope to have a better understanding of the present goods system within urban areas. All of us engaged in the planning, regulation, and operation of transportation need to know a lot more about what types of goods are moved, how they are classified, what types of vehicles move them, when the goods are moved, and what cost factors are involved.

Second, we hope to enhance our knowledge of the critical relationships between urban goods movement and the environment in which they occur. On the one hand, we need to know how regulations, labor practices, different technologies, and urban form and structure affect the volumes and patterns of urban goods movements. On the other hand,

we need to know more about the impacts of freight movements on the urban community, including the effects of changes in the amount and type of urban freight facilities on the location of industries, residences, and suburban shopping centers. We also need to know the congestion and environmental pollution effects associated with the present rate of growth of urban truck transport.

Third, we hope to receive assistance in defining the proper role of the U.S. Department of Transportation with respect to urban goods movement. Should this role be limited to incremental transportation improvements of an operational nature dealing with restrictions on size and weight of trucks operating on urban streets and highways and with regulations of hours and access; or should more attention be devoted to improvements of a technical nature dealing with handling equipment or vehicle facilities? Is the present federal-aid program with its orientation toward the motor truck the best direction for the future? Should federal aid be provided for things such as tube or pipe delivery systems designed to transport dry solids? What are the institutional arrangements for moving goods? Should the federal government provide matching funds for projects to demonstrate innovations in urban goods transportation as well as urban passenger transportation? Should the Department of Transportation reexamine its relations with other federal agencies that have programs intimately related to urban commodity movement, for example, the urban renewal program of the Department of Housing and Urban Development and the air pollution standards program of the Department of Health, Education and Welfare?

Fourth, we hope to find out where we are hurting the most in this area. What are the gaps in our planning processes and the limitations of our forecasting tools? Where are the data deficiencies? Should the policies of the various levels of government be changed to adequately treat urban goods movements, and if so how?

Finally, we hope to provide a forum in which the varied groups can develop a better understanding of the urban goods transportation problem so that policies and strategies for meeting this problem can be developed.

CANADIAN FEDERAL GOVERNMENT'S ROLE IN TRANSPORTATION PLANNING AND URBAN GOODS MOVEMENT

C. C. Halton

The joint Memorandum of Understanding signed earlier this year by the U. S. Secretary of Transportation and by the Canadian Minister of Transport specifically mentioned collaboration in the field of urban research as one area where a joint approach would be to our mutual advantage. During the time that the Memorandum of Understanding was being discussed by our two governments, a number of very positive steps were being taken in Canada to change the structure of the federal government's role with respect to transportation so that in the future it can be more responsive to the changing national need. During the course of these deliberations, a number of visits were made to Washington to take advantage of the experience that our counterparts in the U. S. Department of Transportation had gained in trying to restructure federal responsibilities. I thought that it might, therefore, be relevant to try to describe the thrust of Canada's planning for urban goods movement within the broader framework of our approach to transport in general.

The National Transportation Act that received Royal Assent in 1967 was the outcome of a long period of review and reflection during which an attempt had been made to resolve this basic question of how important transport is to Canada. The result of that period of review was a general acceptance of the fact that transport is by no means an end in itself but is in fact a mechanism that when properly used can stimulate the growth of the country. Therefore, in its opening preamble, the National Transportation Act defines as a principal objective for future Canadian policy the attainment of an economic, efficient, and adequate transportation system in which all modes of transport play their proper role.

At the national level, two major steps have been taken to try to implement this objective. The first step that followed soon after the passing of the Act was the establishment of the Canadian Transport Commission as a focus for all federal regulatory agencies in the transport sector. The work of the Commission has already demonstrated that expertise and perspective developed with respect to one mode of transport can efficiently be applied to problems that arise in other modes of transport and that research work is frequently relevant to transport per se rather than simply to one particular mode.

But it would be misleading to try to pretend that within the short period of 3 years that have passed since the Commission was established all the problems faced in unifying the regulatory machinery have been resolved. It would, perhaps, be more appropriate to say that we have made most progress in the rail, air, and marine modes and in multimodal research. With respect to motor vehicle regulation, major assessments of alternative ways of regulating intraprovincial trucking have been completed; and, in the field of commodity pipelines, we are confident that the regulatory machinery can keep pace with the development of a mode.

The second major step since 1967 has been a reexamination of the management of the federal government's responsibilities in national transportation. A simple examination of Canadian transport shows that the government has far more than regulatory

control at its disposal. For example, for practically all modes of transport, the operation of terminal and way facilities is a governmental responsibility, although highways are a provincial rather than a federal responsibility.

So far as rail and air are concerned, the federal government is involved through its crown corporations in the operation of the vehicle as well as in the operation of terminal and way; and, by the adroit use of its capital investment and subsidy policies, the government is in a position to influence the rate of development or decay of existing and new forms of transportation.

This management review has led to the suggestion that the most appropriate way of implementing Canada's transportation policy at the federal level is to try to steer the government's responsibilities in transport toward cost recovery, to look for recovery not only from the direct user but also from other beneficiaries, and, hence, through a program of user and beneficiary cost analysis, to try to make an appropriate allocation to all those sectors of the economy that benefit from the transportation services provided. This concept has led to the reorganization of the Minister of Transport's portfolio, and I thought it might be helpful if I were to indicate how the revised structure of the portfolio differs from the one within which we were working previously.

To do this, I would like to remind you that in Canada transport consumes 20 percent of the gross domestic product that amounts to some $12 billion per year. About 55 percent of this is in the private sector, just under 25 percent in the public sector, and just over 20 percent in industry. The automobile together with other forms of road transport, i.e., the bus and the truck, consume just over 50 percent of the expenditures. I believe that about 25 percent of the research budget is spent in the urban sector.

The total number of employees in the federal government is of the order of 460,000. Of these, 123,000 support the activities of the agencies and crown corporations that make up the Minister of Transport's portfolio, but only a relatively small number, i.e., about 17,000, are directly employed within the Department of Transport. Thus, within the departmental structure that we have operated for many years, the Minister has had direct support from his deputy for a small number of his responsibilities, but the crown corporations that make up the bulk of the expenditures and the work force have been the direct responsibility of the Minister without assistance.

It was, therefore, decided that it would be more logical to restructure the portfolio. This so-called ministry system allows the deputy to function as a deputy to the Minister for all facets of the portfolio and identifies a number of administrations that are responsible for the operation of terminal and way facilities in exactly the same manner as the crown corporations take responsibility for the operations of vehicles. With this revised ministry system, the deputy minister is supported by a small ministry staff who provide specialist support primarily with respect to financial control over all aspects of the portfolio and with respect to policy and strategic planning, both of which are essential in trying to chart the future development of the federal government's involvement in transportation.

There are 4 principal objectives that we are trying to achieve. The first objective is that, as a ministry, we can achieve overall coordination with respect to the federal involvement in transportation and, at the same time, we can show that we are responsive to changes in that role. Our second objective is to provide operational systems that provide the service required of the various modes and are also profitable, not necessarily in the absolute dollar sense but in terms of true economic and social benefit to the country. Our third objective is regulatory, and it is to provide an objective mechanism of control to ensure that in the public and private sectors we achieve the correct degree of balance now and in the future. Our final objective is to stimulate the continued development of transportation; for transport to continue to fulfill its mission in Canada, an appropriate mechanism for promoting new concepts and for encouraging innovation must be made available. In the ministry concept this mechanism is the Transportation Development Agency.

The 4 agencies within the ministry family that have specific responsibility in the urban field are the Surface Transportation Administration, the Transportation Development Agency, the Policy, Planning and Major Projects Group within the central ministry staff, and the Canadian Transport Commission (CTC).

As I mentioned earlier, the 1967 National Transportation Act provides in Part III for regulation of interprovincial motor carriers. When Part III is implemented, the CTC will be taking over a responsibility that is currently administered by the provinces, but the provinces will retain responsibility for intra urban activities, so far as can be foreseen at the moment. The Surface Transportation Administration, through its Railway and Highway Branch, is responsible for the administration of those operational aspects of highway planning that are currently a federal responsibility, in particular the Trans-Canada Highway. The Transportation Development Agency coordinates the ministry's research programs from the point of view of undertaking assessment and research studies that ultimately could lead to changes in operational procedures or changes in the technology used in urban transport. It is also responsible for research into subsidy issues, particularly of an intermodal nature. The Policy, Planning and Major Projects Group within the central ministry staff has a policy monitoring function and also has a responsibility with respect to strategic planning. Because it seems difficult to divorce the urban transport problem from those associated with regional transport in Canada, both the policy and strategic planning aspects are associated under the general topic of urban and regional transport.

I would now like to try to describe the role of the federal government in Canadian urban transportation. The activities of the federal government in the urban field are constrained by the Constitution because urban affairs are primarily a provincial responsibility. In fact, the federal government has only limited jurisdiction in Canadian cities. In addition, because most metropolitan transport problems are associated with roads and highways, which are also within provincial jurisdiction, there was for a long time a tacit assumption that urban transport was of little or no interest at the federal level.

But during the 1967 Federal-Provincial Conference on Housing and Urban Development, the then-Minister of Transport suggested that an attempt should be made to undertake coordinated research in urban transportation and to develop a focus for trying out promising new concepts and techniques. This proposal was accepted by the provinces who indicated that they felt that there was a need for coordination at the federal level, particularly in those areas where urban transport problems cut across jurisdictional responsibilities as, for example, happens with many railway and airport access problems.

On the basis of that agreement, the Minister of Transport has felt free to encourage the support of a number of research studies in the urban field, and emphasis has also been placed on coordination within the 3 levels of government and with industry in an attempt to assist in the policy and planning process. There are a number of different coordinating committees within Canada as well as international committees that allow us to maintain a close relationship with our colleagues in the United States and within the Organisation for Economic Co-operation and Development.

So far as the federal presence itself is concerned, airports, harbors, and railways as well as the Trans-Canada Highway are all a federal responsibility and all impinge on the urban scene. It is, therefore, necessary to coordinate a wide range of interests such as the Department of Regional Economic Expansion, the Department of Public Works, the Central Mortgage and Housing Corporation, and, of course, the portfolio of the Minister of Transport.

In addition, at the start of the current session of Parliament, the Speech from the Throne gave an indication of another thrust that the present government will wish to pursue. The Speech highlighted the increasing pressures of urban living, forecast that by the end of this century some 80 percent of the population of Canada may well be resident in a few large cities, and suggested that this introduces a large number of additional problems that, if solved, will require an ever-increasing share of the nation's financial resources and that, if not solved, will in the government's judgment result in an unacceptable drain on the nation's human resources.

The government, therefore, indicated that it proposes to focus the development of its urban policies under the direction of a new Minister of State for Urban Affairs and Housing, one of whose principal functions will be to foster coordination of the activities of all levels of government and, at the federal level, to act as a coordinating body for

all federal programs that in some way affect the city and the urban system. This new thrust is, of course, at the formulative stage, and transport will plainly be an important element; but some of the activities that we have been able to implement during the last 3 years should be of immediate relevance to the work of the Minister of State for Urban Affairs.

I have already mentioned the coordination work that is now well established in the Ministry of Transport, and I would like to conclude with a brief reference to our research work.

The Ministry recognizes that equal importance must be given to the movement of goods and to the movement of people, and a number of consultant contracts and seminar programs have had the former as their principal objective. One of the more important consultant contracts we have sponsored is the so-called urban transport efficiency study that attempts to assess some of the benefits that might accrue on a national level if there was an increased investment and perhaps even governmental involvement in city commodity flow activities. I will not say more about this work because it is the subject of another paper presented at the conference and published in this Special Report.

Similarly, a number of practical studies are being undertaken by the Canadian Trucking Association in association with Smith Transport in Montreal, Toronto, Calgary, and Vancouver. This work is also reviewed in another paper.

One element of our activity that perhaps will not emerge from the Canadian material presented at this conference is the importance we attach to encouraging university research groups to work in the field and to encouraging post-graduate students to take an interest in urban transport problems. We have established within the Ministry of Transport a small number of university centers of excellence that have as their major goals stimulation of both teaching and research in transport. With respect to urban problems, I must mention the University of British Columbia, the Universities of Toronto and York who have established a joint center, and the University of Waterloo.

So far as post-graduate research is concerned, of the 33 transport fellowships that are active in the current academic year, 10 have a direct relevance to urban problems. In addition to transport fellowships, I should also mention that 20 of the 125 fellowships granted by Central Mortgage and Housing Corporation are on transport subjects or have a significant transport involvement.

So far as the immediate future is concerned, at the federal level we intend to increase our support of work in the universities and, through our Transportation Development Agency, we have identified 4 areas—airport access, urban freight, demand-responsive bus systems, and transit control systems—as being topics for early consideration.

Finally, we have just announced that in collaboration with the province of Manitoba and metropolitan Winnipeg we will sponsor a railway nationalization study in the Winnipeg area that will attempt to delineate some of the problems involved in rationalizing the impact of Canadian Pacific and Canadian National Railways on Winnipeg. Because Winnipeg is a major interchange city (I once heard it described as the Canadian Chicago), the tentative solutions to these problems will undoubtedly involve proposals as to how alternative modes of transport can cope with freight and raw materials movement in the city.

These then are some of the areas of interest where we expect the level of activity to increase. We also firmly believe that to extract maximum value from an increased level of activity we urgently need access and collaboration with complementary work being sponsored in the United States.

PROBLEMS AND ISSUES IN URBAN GOODS MOVEMENT

J. Douglas Carroll, Jr.

Urban goods movement is a new subject area that is not yet heavily studied, measured, or commonly understood. For proof of little knowledge, witness the fact that we had hoped by the guidelines of other conferences to invite to this conference a number of people that would produce a desired attendance of about 55 or 60 people for a working conference. Instead, acceptance and interest were so high that about 100 people attended. We can see this is a subject of some interest.

There are two kinds of problems that we face, and they have to be kept reasonably separate. First, there are the problems concerned with what is or what may be. These are usually questions of fact, generally in the field of science, and generally concerned with description and with "if-then" kinds of statements. These questions are not value laden.

Second, there are questions of policy, and these are generally concerned with what ought to be done. They are very valuable and provocative questions. They are the ones that start your clock running and whip you every day, but they are separate from the questions of fact. Therefore, what ought to be done about urban goods movement is one set of questions; and how urban goods movement works, how it will change if something is done, and what the consequences of actions and rules may be constitute an entirely separate set of questions. The latter are essentially value free, whereas the former are value drenched.

All of us who have worked in this field for some time have used the terms "goods" and "people." We have given them equal billing. Although they are equal in rhetoric, they are sadly unequal in the amount of information gathered and work that has been done. We know a great deal about people movement but comparatively little about goods movement.

There are probably several reasons for this. Goods movement is not centrally organized. It is a multifirm activity, so there are few records of uniform, area-wide quality. Regulation, as it does apply, and records, as they are required, are generally limited to a few carriers for intercity movements, and these kinds of records are buried fairly deep in the total cost picture of American businesses. The facilities used are not unique or centrally managed.

There seem to be two organizing influences to this vast array of activities that constitute urban goods movement. One is the marketplace, i.e., the sheer matter of costs and economics that organize the industry. The other is the union. There are a number of small operators, owners and carriers with but a single union. As we examine both organizing elements, I hope this will provide a means of developing information that is more descriptive and more reliable.

Intercity records are reasonably well kept, but there is no governmental agency to want or require records for the movements occurring within the city such as from the terminal to the warehouse, to the retail outlet, and thence to the consumer. Whether a ton of goods, a package, a lading, or whatever—there is no single unit to which we can all agree. For a person movement, there is one human you can trace out. For a goods movement, there is a shipment, a part of a truck, and to trace this is a difficult problem.

In the urban transportation studies, we have shown a great deal of interest in the population of trucks and surveys of vehicle movements. The kinds of questions asked have been, Why does a vehicle move? Where does it move? What quantity does it carry? This has led a few investigators to ask, What goods does the truck carry? What is the purpose of the truck trip? Some attempts have been made to trace commodity movement by tracing truck movements, but this has proved to be a very awkward approach.

Moreover, as one begins to look at trucks, one recognizes that goods movements are one thing and truck movements are quite another. Service trucks, repair trucks, family trucks, farm trucks, and garbage trucks do not create a picture as tidy as one would have thought in the first place. Commodities are not trucks, nor is the reverse true.

It seems to me that one way to begin to look at this question of goods movement is to first organize one's point of view. May I suggest a way to do this. Consider that every urban place is a functioning unit made up of a cluster of humans living in cooperative fashion, each person dependent on his neighbor in some degree. This human beehive lives and prospers by interdependency and specialization of task. For this kind of unit to exist, it has to take in and also to export a vast amount of materials. In the process between receipt and export occurs a phenomenon that we might call urban metabolism wherein goods are consumed or transformed. As a single human has to take in food, operate on it, use it for his purposes, and get rid of it, so does an urban place. No urban place can live on the basis of what is on its own subsoil. It has to import its food and raw materials; and generally it exports manufactured products.

This concept is part of our training. If we think of goods movement within urban places as an internal metabolism, I think there are some interesting notions that do come to bear. For example, we can assert that any urban community of reasonable size has to import more by weight than it exports. Conversely, we can see that it has to export more by value than it imports, because labor is added in processing.

How does one begin to keep records at this scale? What is the basis of each community compared with the country and its region? How much raw material does it require? This import-export picture is important for it tells something about the lifelines that support large urban concentrations of people. But this says little about the activities required to move these goods through the processes of internal metabolism, for example, the city-to-city cost of transport in relation to the terminal or transfer costs at the urban end.

It is estimated that nearly half of the total freight bill in the greater New York region goes for internal goods movement. These estimates include no costs for the expenses incurred by consumers who haul groceries and other purchases home by private means, nor do they include costs for piers, freight yards, and other terminals that have to be established in the urban area in order to service goods that arrive by intercity travel.

Costs of goods movement and people movement are about equal as far as we can determine. It appears that 53 percent of all of the costs of transportation in the Gross National Product goes for moving people and about 47 percent for moving goods. I predict that in the future the costs of moving people will exceed the costs of moving goods for two reasons. The first reason is that, in a highly technological society, we do not increase the output of goods at the rate that we increase the output of services. Accordingly, we are placing more and more of our creative power into service industries, while manufacturing industries are at a level of employment that is fairly constant. Even though their output is rising and they are absorbing more raw material, manufacturing industries do not grow much in employment, and added real income is increasingly used to purchase services. The second reason is that productivity is moving ahead in the goods-movement field at a higher rate than in the person-movement field. Whether these are reasonable estimates or not, they do suggest what we might expect in the future if we think of the system as operating in a metabolic way.

One other point that I would like to make in terms of urban metabolism relates to the problem of waste products. Urban consumption is rising and this is increasing the

wastes generated. Solid wastes, gaseous wastes, and liquid wastes are all straining the absorption capacity of our environment.

Even water and air that pass through the urban area go out contaminated. Certainly, much of the goods that come in go out as waste products that have to be buried, burned, or disposed of in some way. These cycles are not currently closed, and the effects are becoming more and more of a load for a fixed environment to bear. This crucial point is going to change costs, so we have to give a great deal more attention to disposing of urban wastes. I think our calculations show that we are generating about 4.5 to 5 pounds of solid wastes per person per day.

I hope this overview will provoke some concern for the science of the matter, some concern for the facts, some concern for an outlook, and some speculation on ways in which we can deal with technology and with institutions. I hope also that we might consider the extent to which goods movement is a substitutable element, now that coaxial cable information channels are being vastly increased in size, capacity, and performance capability, and whether changes in the institution and in the techniques of living in urban areas will have a serious impact on the goods-movement problem.

STRUCTURE AND ECONOMICS OF INTRAURBAN GOODS MOVEMENT

Robert T. Wood

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

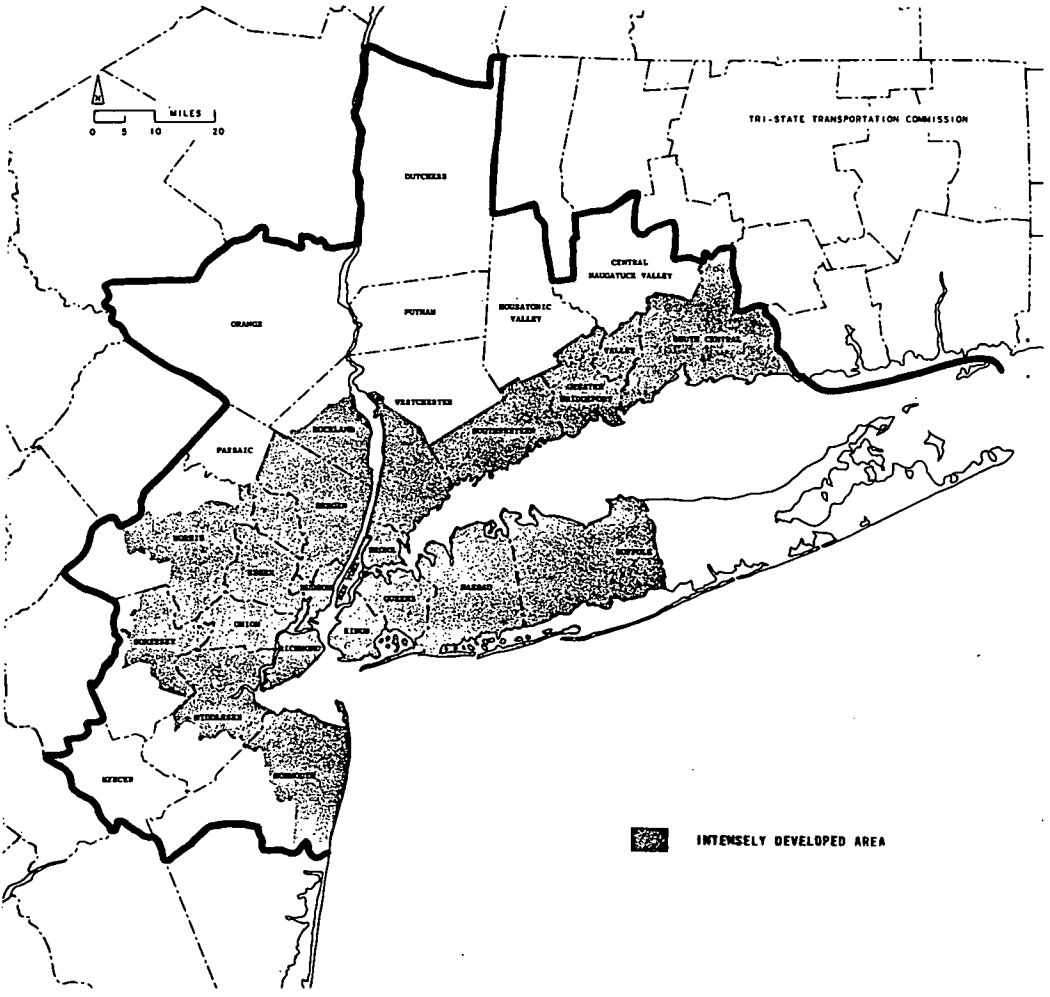


Figure 1. Tri-State region.

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.

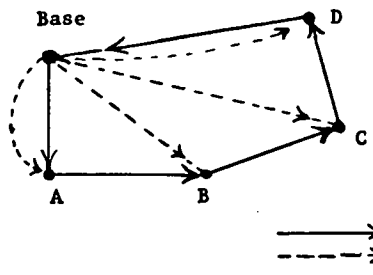
CONSUMER-FREIGHT VERSUS COMMERCIAL-FREIGHT GENERATION

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.

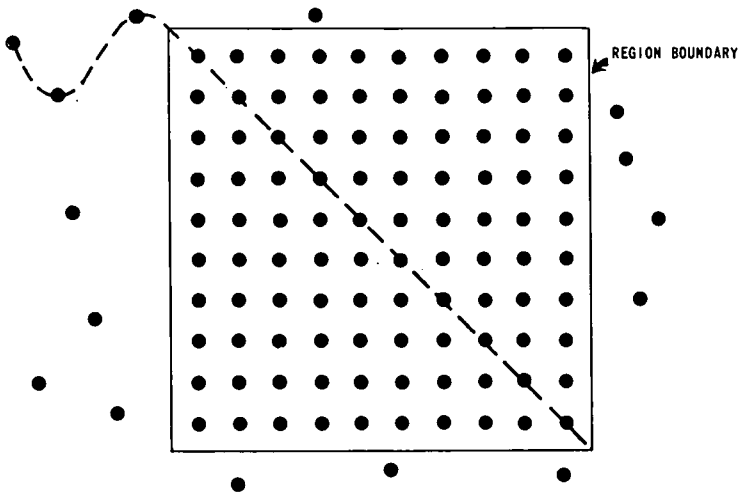


Figure 4. Schematic arrangement of goods movement origin and destination points.

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.

EFFECTS OF GOVERNMENTAL POLICY AND PROGRAMS ON THE INDUSTRY

Charles A. Taff

A person undertaking to discuss some of the effects of governmental policy and programs on the urban freight industry has such an array of possible topics that it becomes necessary to make an arbitrary selection that will indicate the problems involved and possible solutions. When we consider the unsystematic way in which we have gone about the formulation of transportation policy through the years, it is not surprising that we have uneven approaches to various aspects of policy and programs. We hope this will change in the future, but we still have a long way to go.

COMMERCIAL ZONES AND TERMINAL AREAS

In urban freight transportation, an important factor in existing regulatory policy deals with motor carriers in commercial zones and terminal areas. The Motor Carrier Act provides a number of exemptions such as the agricultural commodity exemption that reflects political efforts at the time the Act was framed to protect the mobility and pricing freedom of the then-existing agricultural transporters. A careful reading of the legislative hearings on the exemption of commercial zones and terminal areas indicates that the competition of unregulated carriers with railroads was not of the intensity in local transportation that it was in intercity transportation. Further, an exemption for local transportation would relieve a regulatory body of a very burdensome type of regulation that did not seem to the framers of the Act to be justified.

Thus, the exemption for commercial zones and terminal areas was created. Section 203(b)(8) provides a partial exemption of local transportation, even though the operation may be interstate in nature within the zone, when such transportation is performed wholly within a municipality or between contiguous municipalities, or within a zone adjacent to or commercially a part of any municipality or municipalities. (Local motor transportation is a partial exemption in that local carriers are subject to safety regulation but not to economic regulation.) This exemption does not apply if the transportation is under a common control, management, or arrangement for a continuous carriage or shipment to or from a point outside a municipality. A local cartage carrier operating in the District of Columbia, for example, may have operations that extend into Maryland or cross the Potomac River into Virginia. In either case, the operations are interstate in nature but if performed wholly within the commercial zone are exempt from economic regulation.

Because transportation in the commercial zones established by the Interstate Commerce Commission is exempt, it is understandable why the boundaries of the area embraced become rather important. Our first commercial zones were established for many of the larger cities by the Commission, and later it developed a general formula based on population and mileage for those commercial zones it had not previously specified. This formula was designed to apply to different sized municipalities. The prescribed commercial zone limits surrounding a point, according to the Commission, should have reasonable stability for a least a decade following the taking of the census on which the population-mileage formula was based.

To examine a problem that arises from this exemption, let us consider the following: An over-the-road carrier domiciled in North Carolina who has operating authority to serve Washington, D.C., including the commercial zone, may not be able to serve a community such as Rockville, Maryland, because it is not a part of the commercial zone under the population-mileage formula. This means that the North Carolina carrier cannot render a through service to Rockville, even though most of us would look on it as being part of the Washington homogeneous community. So he has to make arrangements with a local carrier regarding delivery of the shipment. The local carrier, because of his transporting under common control, management, or arrangement for continuous carriage, is also subjected to economic regulation. It is typical that the local operator like this one completes his haul on a basis that many over-the-road operators feel is too high for the short-haul service rendered. The failure of commercial zones to be truly embracive results in less service efficiency and higher costs.

It took about a decade of litigation to get Rockville included in the Washington, D.C., commercial zone. Laurel, Maryland, is not now within the commercial zone. With growing industrialization, Laurel is trying to be included in this Washington commercial zone. Will it take a decade for this to occur?

The ICC commercial zones and terminal areas policy, I believe, should be reexamined. More Commission flexibility through initiation of actions to embrace new and important traffic points should be instituted so that motor carriers and shippers would not have to bring actions that often become protracted proceedings.

The commercial zone offers an additional opportunity for regulatory innovation. Many private and governmental studies have argued the case for relaxing regulation in view of the substantially changed competitive conditions and for relying more on the marketplace for decisions involving matters such as pricing. This has met with a good deal of opposition, in some measure, generated by fear of the unknown and, in some cases, generated by reluctance to forego the protection that regulation affords. As important as the rise of competitive for-hire carriers among the different modes has been, the most incisive competition is that of private carriage. This is a competitive element that economic regulation does not control.

In the more urbanized areas of the United States, there has been a slow growth in the size of commercial zones in some instances; but, as one looks ahead and views the predictions of large metropolitan areas developing into strip cities, one may question whether this will result in commercial zones gradually being made co-extensive, say, from Washington, D.C., to New York with all motor transportation within that area being exempt under the commercial zone exemption. It is possible. Rather than wait for such a development and to test the efficiency of noneconomic regulation, the Interstate Commerce Commission could, with boldness, extend the commercial zones of 2 metropolitan areas, such as Washington, D.C., and Baltimore, Maryland, so that they were made contiguous. This could allow those motor carriers transporting between the 2 points to be free from economic regulation. The Commission and all interested parties could then observe the results of such operations to see if there are benefits to the public in such a situation. Such innovative action would be provocative, but the proposal would give us a test of economic efficiency within a limited area and experience that would be valuable later in this century when population growth results in strip cities wherein intrastrip or corridor operation is deregulated due to contiguous commercial zones.

INCIDENTAL-TO-AIR TRANSPORT EXEMPTION

Let us consider the effects of transport technology on governmental policy and program. Improvements in transport technology can effect changed competitive relationships that necessitate reexamination of certain facets of regulatory policy. One such area is that of jet transports with their greater productivity and cargo capacity that in some markets have become more competitive with long-haul trucking than small piston planes were with their limited cargo facilities. The so-called indirect air carriers—air freight forwarders—who utilize the airport-to-airport services of air carriers have, as a result of the improved technology of transport planes, also become a competitive factor in this market.

When the incidental-to-air exemption was made a part of the Interstate Commerce Act in 1938, the amount of transport affected by the exemption was negligible. Section 203(b)(7a) provides an absolute exemption for the transportation of persons or property by motor vehicle when incidental to transportation by aircraft. There were early determinations by the Commission on a case-by-case basis in which varying distances between cities and outlying airports were used in determining the exemption. Intercity motor common carriers had urged the Commission to prescribe the commercial zone of a city as being the limits of the exemption.

The Commission felt, however, that a reasonable terminal area for an air carrier at particular points might be different from that of a surface carrier; and, in the Kenny case in 1953, it ruled that motor transportation of property to fall within the incidental-to-air-transportation exemption must be confined to transportation in bona fide collection, delivery, or transfer service of shipments that have been received from or will be delivered to an air carrier as a part of a continuous movement under a through-air bill of lading covering, in addition to the line-haul movement by air, the collection, delivery, or transfer service performed by the air carrier. To fall within the exemption, the transportation by motor carrier must be confined to the terminal area of the air carrier as defined by the Civil Aeronautics Board. At the time of this report, the Civil Aeronautics Board generally used as a "rule of thumb" a radius of 25 miles from the cities or airports served by the air carrier as the terminal area, although air carriers could file tariffs to serve points beyond the 25-mile limits and, in some instances, have done so.

By 1964, it became necessary because of the increasing problems arising under this exemption for the Commission to adopt regulations applying to this exemption rather than to continue to deal with the problems on a case-by-case basis. The Commission's regulations provided that the territorial scope of operations conducted under that section is generally co-extensive with the limits of an air carrier's terminal area as described in its tariff filed with the CAB. The regulations also contained a proviso that either on the Commission's own motion or on petition of an interested party a proceeding could be instituted to define specifically the geographical extent of the exemption at a particular point. In a proceeding in 1968, the petitioners requested that the regulations be modified to be more restrictive than it appeared was then the case. In this case, decided in July 1970, the Commission denied the petition to reopen the rule-making proceeding (1). It found in responding to a petition involving Indianapolis and Atlanta that certain points beyond the 25-mile limits were being served, and this was not to be a allowed. On November 4, 1970, the effective date of this order was indefinitely postponed.

I do not find any economic grounds for a mileage limitation of any kind, whether it is 10, 20, or 50 miles. It almost appears that the Commission does not want to see any dilution of its authority; and yet we are on the threshold of significant air cargo development that in the urbanized areas can be impeded by unrealistic restrictions. When the exemption was enacted by Congress in 1938, there was no legislative history regarding its intent, so Congress could be asked to rectify the situation by providing a broad guideline, perhaps that the surface portion of a shipment moving primarily by air would be exempt from economic regulation in order to facilitate its movement. This would provide more flexibility for the ground portion of the haul and increase the area of customer service. Thus, we could inject additional competition on a store-door to store-door basis.

One might ask the question, If we had a single regulatory body, would this exemption be looked on somewhat differently?

INTERMODAL

We have tended to compartmentalize our modes of transport and have found it very difficult to develop effective intermodal domestic operations. Although there has been some development of these operations, our statutory or regulatory interpretations have limited true intermodal transportation. The Federal Aviation Act's provision, for example, that a carrier other than an air carrier cannot own an air carrier has denied

common ownership. In surface transportation, the restrictions that are imposed on railroad ownership of motor carriers has worked in a similar manner. A strong economic case can be made for permitting a carrier to engage in other types of transportation without the typical restrictions that usually result in a service inferior to that which might otherwise be possible. Freed of these restrictions, management should be able to devise a transportation system that would be geared to shipper needs as well as being competitive with private and other for-hire carriers.

These restrictions were enacted as protective devices, and the regulatory agencies have been extremely reluctant to make any change. Recently the grant by the Civil Aeronautics Board of air-freight-forwarder operating rights to 4 large trucking companies and 2 railroads indicates some change; but, in these cases, the grants have been made not for direct air carrier authority but for intermediary or indirect air carrier—the air freight forwarder.

The growth of air cargo capacity and increasing managerial efforts of business firms to reduce inventory and, at the same time, avoid stock outs of their products at key points are combining to produce optimistic forecasts as to future growth of air cargo. Whether these forecasts materialize will depend to some degree on the removal of some of the current impediments by statutory or regulatory action or both. One such impediment is the prohibition contained in the Federal Aviation Act against the establishment of joint rates and through routes between an indirect air carrier (air freight forwarders) and surface carriers that are subject to regulation by the Interstate Commerce Commission. On the other hand, direct air carriers can establish joint rates and through routes with surface carriers. Why does this situation exist? The air freight forwarders are placed in an inferior competitive position with the direct air carriers, and yet in moving the freight they so actively solicit they utilize the direct air carriers.

The establishment of a combination of air and truck service could result in fewer stops by air cargo carriers, and shipments could be consolidated at certain air terminals. This could have a twofold benefit of lessening air and surface congestion within the cities and utilizing greater capacity of the airplane.

Intermodal shipments in water-truck service have been referred to as being "... now so good that there is little room for improvement. Whenever water service requires the supplement of truck service, the connection is readily available. The truck lines and the water carriers work in friendly harmony in developing new traffic and improving the service" (2).

The coordination of rail and motor transportation through the establishment of joint rates and through routes is quite limited. If one excludes the more recent development of trailer-on-flatcar or containerization, coordination between railroads and motor carriers and railroads and water carriers is slight. The efforts to establish joint rates and through routes in these combination services have been so unsuccessful that there have been repeated attempts to make changes legislatively in this facet of transport policy that would require carriers to provide a joint rate service to shippers. Even if we were to have compulsory joint rates, I think we could expect some rate bureaus or individual carrier members to move rather slowly and with reluctance in the institution of such rates.

The provision of such services would mean more shipper options in their analysis of distribution patterns to be utilized and should result in greater efficiency in transportation service. One of the reasons for some enthusiasm for the containerization move has been that it has facilitated through services.

Because the intermodal transfer points are often in urban areas, there are several implications for this phase of urban goods movements if some of the current impediments were removed.

URBAN FREIGHT AND THE DEPARTMENT OF TRANSPORTATION

Critics of regulatory bodies often charge that there has been a fragmented approach in handling many aspects of regulation. I wonder what appellation one should attach to the modal approach assigned to the operating divisions of the department. And where does urban freight fit into this organizational mosaic?

One of the operating divisions of the Department of Transportation, the Urban Mass Transportation Administration, has viewed its role as being one involving passenger aspects, and so far it is hard to detect that it considers that interfaces between urban passenger and urban freight exist. There are many areas of common concern, however, and it would seem to me the outlook of UMTA might be a broader one. After all, the transportation problems of cities are not solely passenger problems. It may be that it is assumed that the Federal Highway Administration will handle all urban freight matters, though this is doubtful.

A basic question is whether the total urban system is being dealt with in a systematic way as to federal policies and programs by the Department of Transportation. Perhaps what is needed is an additional modal administrator for urban freight transportation. Because the primary function of each modal administrator is to promote vigorously his area of administration, we could then expect a focus on the many problems involving urban freight transportation. As it is now, urban freight at the operating level appears to be falling between the chairs. Perhaps we should institute an urban freight demonstration grant program in order to get things moving.

One of the policies of the Department of Transportation is economic efficiency in transportation. I think the question should be asked: Could there be a better organizational framework for handling urban freight within the department?

PLANNING

Under the 1962 Highway Act, urban transportation planning of a comprehensive and coordinated nature involving joint state-local planning for land use, transportation, and highways is required. All the urbanized areas have established planning processes, but there appears to be a wide variety of approaches to such planning. In one case with which I am familiar, the transportation planning has been largely highway oriented and, also not surprising but unfortunate, the emphasis is on passengers. Little conscious effort has been made to factor-in the freight aspects in the planning process.

One cannot help wondering if there has been a systems approach in the planning process. It would almost seem mandatory that such an approach be used because the very nature of urban areas encompasses freight terminal origin and destination points and significant intramodal and intermodal freight transfer points to say nothing of the impingements between passengers and freight. The planning process for urban freight should not be a "tag-along" or afterthought consideration but rather should be viewed as a primary factor in the satisfaction of many urban needs. Several questions might be asked: Is there clear evidence of significant changes since 1962 in the planning process as compared with the earlier period when it was handled basically by highway departments? How effective is the planning process in achieving a more balanced transportation system in urban areas? How are the interfaces of urban freight and urban passengers handled?

Thrust into the planning process now is the element of environmental factors that are rather difficult to quantify; yet, if the planning process is to serve us for the future, there has to be an input of environmental factors and not just tokenism. The specialists in the planning process need to educate elected officials or other citizens who serve on the committees regarding the importance of incorporating environmental elements into planning even though there is not the degree of precision about their impact that we would like to have.

SIZE AND WEIGHT AND ENVIRONMENT

Significant changes have been and are occurring in our urbanized areas, and they influence urban freight transport. In the period from 1950 to 1969 in our metropolitan areas with central cities of 50,000 or more in population, we experienced a growth from 89 to 129 million. Practically all of the increase of 40 million persons occurred in the suburbs beyond the limits of central cities. During that period, a number of the larger cities actually lost population; and where gains were recorded, they were very nominal in comparison to surrounding suburban growths. As an example, Philadelphia's gain was 20,000 from 1957 to 1964 while the suburbs' was 450,000. The preliminary results

from the 1970 census show a continuation of this trend; several central cities lost population during the 1960's, but considerable gains were experienced in the suburban areas.

Accompanying this population trend has been the decrease in density of population per square mile. Between 1950 and 1960, the average density of urbanized areas within the metropolitan regions declined from 5,438 to 3,752 persons per square mile; and in the central cities, the decline was from 7,788 to 5,349 persons per square mile.

The change in the marketing pattern of retailing from the city to suburban area has been particularly accentuated by the development of shopping centers, and this has virtually arrested the growth of retail sales in the central cities. Companies engaged in manufacturing continue to move from central cities into the suburbs, and an examination of the larger metropolitan areas shows a decline in manufacturing employment. Projections indicate that within 15 to 20 years half of the jobs will be in the suburbs.

Traffic and congestion problems will accompany the spread in population. Intrasuburban freight movements to service the retail or shopping centers as well as moves between manufacturing plants or industrial parks in the processing of materials will continue to increase and, when combined with our automobile-oriented suburban living, cannot help resulting in traffic flow problems.

The early central city thoroughfares were built to high standards, and size and weight aspects were of little concern for many years. As the volume of total traffic has grown, though, increasing concern is expressed about the size of trucks. Length has its impact in the traffic flow as well as in the turning radius problems so that some localities have instituted some degree of enforcement regarding length but little in regard to weight. Within the central city, there seems to be very little enforcement activity, in my opinion, and where it does occur it is concentrated on vehicles used in connection with building construction. As we become more suburbanized, however, we may have to begin to administer size and weight limitations more effectively because there are many highways that are not designed for the volume of freight traffic that may be imposed on them by future intrasuburban freight movements.

The suburban areas are deceptive in terms of availability of space as compared with downtown congestion, and there is a tendency in suburban areas at the present time to allow the development of poor habits, for example, in the use of vehicles and roadways. These include loading and unloading on the street when there is a loading zone where it should take place, operation of poorly maintained vehicles that add disproportionately to pollution, or operation of vehicles that violate size and weight limitations.

Liberalization of size and weight limits over the years has enabled technological advances to be made in trucks and equipment that have played a part in making motor carriers more competitive with other modes of transportation. It is time that these benefits be measured in terms of costs incurred. The increased concern regarding environmental factors is giving rise to greater recognition of the impact that noise, pollution, and congestion are having on the quality of our life. There has to be a balancing of the benefits that may accrue from further technological advancements with the costs that may accompany them. Larger trucks are noisier; unless this can be rectified, there may be prohibitions against their use in parts of metropolitan areas. Highway design can be utilized to a certain extent in noise abatement through reduced starts and stops and also through the level of roadway. For example, a depressed roadway has been found to reduce noise from heavy trucks more than an elevated road. However, for non-truck-traffic noise, the elevated road was found to be more effective than the depressed road in dissipating noise (3).

With a cabinet-level Environmental Quality Council established last year whose concern is for noise abatement, open space, and general environmental improvement, new impetus may be forthcoming within metropolitan areas that will result in antinoise ordinances and pollution controls at all levels of government. The effectiveness of new ordinances, however, will rest on enforcement that has not been very effective in the past.

PICKUP AND DELIVERY

Geographical dispersion and greater congestion have increased motor carrier pickup and delivery costs from both time and distance standpoints. The productive time of a driver is that directly involved in freight handling and not that spent traveling between stops. The latter has been going up and up, and we are all paying these costs in higher prices.

In some of our larger cities, congestion has resulted in the establishment of rules and regulations applicable to the use of the streets by certain types of vehicles. One effort in this direction has been to limit in certain areas of the city during certain hours of the day freight vehicles that exceed a specified limit. This is applicable to larger units that are considered to be less flexible and that when parked often constitute an impediment to the flow of truck traffic, albeit limited at that time, which has to be curtailed in the curb lane because this is the normal access lane to business and industry located on the affected streets. The parking prohibition during rush hours impedes service to buildings in the inner city area where no off-street access is available.

The inadequacy of loading and unloading facilities at new buildings stems in part from the reluctance of builders to dedicate an adequate amount of space to facilitate the movement of the freight necessary to service the building. Such cubic footage is not revenue producing, and builders curtail it as much as they can. If streets are to be restricted for traffic flow, then freight loading and unloading areas will have to be provided that are adequate to serve the buildings.

There have been some public as well as private efforts to reduce the number of freight vehicles on city streets by the establishment of a union or joint terminal, although none has made participation in the terminals compulsory. Efforts at common terminals, though, have been very limited. Probably, the most publicized is the New York Port Authority's truck terminal that opened in New York City in 1949 and the Newark Union Motor Truck Terminal built in the early 1950's. The New York terminal was expected to reduce by 25 percent the movement in the city of over-the-road carriers that handled less-than-truckload lots. The basic concept was that the over-the-road units would bring their loads to the Union Terminal where local pickup and delivery carriers would handle shipments to and from the terminal, thus substantially reducing street congestion by restricting the use of the already heavily congested city streets by over-the-road units.

Although the idea seems to be sound, those carriers who participated on a voluntary basis soon became dissatisfied, mainly because of a division of operating responsibility. The design and utility of the installation were considered to be satisfactory, but the lack of common management in the responsibility for line-haul, terminal, and pickup and delivery operations made it difficult to integrate these operations. The pickup and delivery by operators who were serving several over-the-road carriers was a consolidated service, which had the desirable effect of reducing the number of vehicles calling at the points of pickup and delivery; but the over-the-road operator lacked control over such operators, and very quickly felt the sting of complaints from shippers and receivers about the inadequacy of the service. They were especially sensitive to a shipper's desire to have his shipments picked up promptly. A promise would be made to do this in order to meet a scheduled departure time, but there were too many instances in which the pickup was missed by the local contractor or was substantially delayed.

Not all of the over-the-road carriers serving New York went into the Union Termial, and those using the terminal were at a competitive disadvantage. They either left the terminal to return to their earlier method of operating from an individual terminal or continued to operate from the terminal but under a different arrangement that allowed more individual control of freight. The Newark Union Motor Truck Terminal never opened as a joint terminal under common control.

A few privately financed common terminals have been opened in which truck tenants provided their own pickup and delivery services and then pay a lease or rental fee for the facilities they use at the terminal and, in addition, share terminal operating expenses.

With the growth of urban areas and the increasing congestion, particularly at certain hours, some type of restriction may be imposed that involves joint pickup and delivery service, thus considerably reducing the number of vehicles on the streets engaged in

such service, even though carrier reaction is not favorable. Carriers are particularly adamant about controlling pickup of freight, for it is in this part of their service where their salesman can be the most responsive to shipper needs. Their primary objections are as follows: (a) They do not feel that a joint pickup service can be instituted in which the service can be comparable to their own service because there are so many shipments at a variety of locations; (b) they do not feel that joint pickup operators are as careful in handling so the shipper has an immediate concern about excessive loss and damage to the shipment; and (c) they feel they are in a better position to obtain the long-haul portion of the transportation on jointly routed shipments with other line-haul carriers by picking up the shipment. The joint delivery aspects do not seem to be as bothersome.

There seem to me to be sufficient advantages to the joint pickup and delivery aspects in the relief of congestion in urban areas that there should be concerted effort to solve the problems, such as those experienced in the New York Union Truck Terminal. Innovations of all kinds should be explored, and, to be successful, a joint project would almost have to require participation by all carriers serving a metropolitan area.

CONCLUSION

The topics that I have covered are simply representative and symptomatic of the effects of governmental programs and policies on the industry. As I pointed out, in some areas there should be a lessening of regulatory constraints that are actually accomplishing very little and for which there is no real need. In the area of traffic congestion, however, it seems almost inescapable that some additional constraints will have to be imposed that will have an impact on relieving traffic congestion. We need to work toward a closer coordination of urban passenger and urban freight matters in order to effectuate a more efficient movement of people and goods in urban areas. If we do not implement desirable changes, urban transportation costs will continue to rise disproportionately and service will deteriorate.

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INFORMAL DISCUSSION

James C. Nelson

This paper makes a real contribution and pinpoints the nature of these problems. In the discussion of the sizes and weights problem, you appropriately brought in the environmental factors. I do not think, however, that you mentioned the extra costs of building this strength into the suburban roads that would be necessary for heavy axles and larger trucks. I would like to have a comment on that. And, second, in the discussion of the congestion problem, you mentioned the matter of regulation of street space by the use of lanes and by parking. What about congestion? What about putting on prices and trying to shift some of the traffic on the most crowded or overcrowded arteries to the off-peak periods?

Taff

I mentioned that we have had the technological advances, thanks to modifications of size and weight limitations. I thought that I indicated what the costs of this should be.

I think they should be the total costs we would incur, and they should be measured with the benefits that are involved.

With regard to congestion, I think there is a great tendency on our part to look for exotic solutions and to ignore more commonplace ones such as peak pricing or congestion pricing. These are grubbier solutions, and they are more difficult to do. Yet, I am inclined to go that way before we go the exotic way.

I think we have had some evidence that we can get greater utilization of the streets. The Federal Highway Administration has a program, TOPICS, in which it has tried to improve the use of streets. I think this is a good idea, and I also think that we should have some experimental programs in peak pricing.

How can you shift some of the traffic out of the peak periods during which passengers are moving? Some cities have initiated key-stop systems for handling fuel, gas, fuel oil, and so on. In these systems, the driver can make the deliveries at nighttime or during off-peak periods. In some metropolitan areas, they have worked very successfully, and I would like to see a broader coverage than just bulk commodities.

We are in a situation where we actually have more tools than we think to do things with if we wanted to do them. The exotic things are great, but we need some solutions now.

James R. Blaze

The Chicago Area Transportation Study has been looking the past 2 years into what really is germane for a regional transportation agency to apply in freight analysis. Mr. Wood of Tri-State has been helpful in getting us going on commodity flow analysis. In the meantime, we have had a short-range program in which we have looked at what the freight system is like. One of the serendipity things we discovered was that at present approximately 95 percent of all the for-hire truck bulk terminals are located well within the ICC-defined Chicago commercial zone and that, from 1970 to 1975, 88 percent of all the projected bulk terminals to be constructed will also be built within this ICC zone. The 12 percent exceptions involved cases where an over-the-road carrier has a certificate to serve the area outside the zone. We also looked at where all the prime industrial acreage within the region is located and found that 85 percent of the most likely to be developed industrial acreage is outside the commercial zone.

We, therefore, have a mismatch. The focus of truck service is inside the commercial zone, and the focus of future development, which will provide future business for these truck companies, is outside the zone. Can you speculate as to what is going to happen? Are manufacturers going to be reluctant to settle outside the zone where the area is available because they realize they will not get the same degree of service they might get if they were inside the zone? Are they aware that they will not get the same degree of service? For example, Elk Grove Village is outside the zone, and the manufacturing activity has grown up there in the past 5 years at an amazing rate. There is now a huge concentration of industry, industrial buildings, and complexes, and they have been screaming to the ICC for the last 3 years to expand the ICC commercial zone privileges to include Elk Grove Village.

We are not sure what effect this commercial zone has. We have asked the ICC in Chicago for an explanation of how it derives the location of this zone. Is there any economic basis for locating the zone at 10 miles to the periphery of the central city, in this case Chicago? The ICC's answer was "No."

Taff

You have heard my proposal: The ICC should reexamine its policy dealing with the commercial zone.

As to the question whether the manufacturers will locate outside the zone, I believe that, if there are compelling, nontransportation reasons that override the transportation reasons, they will do so. I would maintain, however, that, if those manufacturers have a good distribution manager or a good traffic manager, they will put him to work to get the area included within the commercial zone.

This is probably what they will do. Even so, the zone location is an impediment that by today's standard is not necessary at all, and it can have an effect on service and on price. I would think the Commission has a golden opportunity to reexamine this particular policy, and I would like to see it take this initiative and do so.

Kenneth R. Ketcham

I find an inconsistency in the argument. The solution to extend these commercial zones would put a multiplicity of carriers in a region. Yet, you say that, because we have a multiplicity of carriers, we need to impose on them some measure for getting joint pickup and deliveries. I think that the large shipper, which would have profitable hauls, would attract the larger, responsible interstate carriers to take his inbound-outbound freight and that all of the smaller shippers and receivers then would be thrown into this so-called marketplace with a multiplicity of carriers competing for that traffic. This is the same problem that now exists in the smaller commercial zone.

Taff

I do not think there is an inconsistency. In the first place, giving the shipper flexibility by removing the current impediment means that he does not have to go to somebody else to perform services but that he can, if he wants to, perform the services himself. It does not then take the local cartage carrier and subject him to regulation. That could be done either by extending the area or by eliminating it. I have tried to show that in one area we may need to lessen constraints; but, in an other area, we may have to impose constraints on some kind of a limited basis where congestion demands require it. The congestion demands are most likely to occur in the downtown area essentially, but they may spread to the suburban areas.

We may end up with fewer carriers doing the job if the commercial zones are eliminated. But even if that is not done and if the number of private carriers that come into the area continues to increase, nobody has seriously proposed that we economically control private carriage in some way. It is entirely possible that the private carriers will simply proliferate to the point where the opportunities for for-hire carriage are extremely negligible.

J. Douglas Carroll

Will you comment on another aspect of the question of commercial zones, and that is how the limits would vary by mode? For example, in the Chicago region, there is very little coincidence at any point between the boundaries of the Chicago commercial zone and the Chicago switching district. Air freight also has a different boundary. Do you think that it is possible to get a set of boundaries that would have some relationship to each other?

Taff

It is possible, yes, but not probable. The incidental-to-air exemption that exists now is an arbitrary restriction of roughly 25 miles. If the shipment is primarily by air, why not let the surface portion of it be completely unrestricted and completely open. Then, you will not have to worry about this at all.

URBAN GOODS MOVEMENTS IN CANADA: INFORMATION SOURCES AND REQUIREMENTS

Norman D. Lea

This paper deals both with the current sources of information concerning urban goods movements in Canada and also with the requirements for improved information. The emphasis is rather more on the needs than on the sources because this is considered to be important in order to achieve a proper perspective and because the current sources are very skimpy in Canada.

This paper draws substantially on the results of the Urban Transport Efficiency Study, which is currently being carried out by N. D. Lea and Associates for the Canadian Ministry of Transport. This study is a broad-brush, national evaluation of the efficiency of urban transport in Canada, of the means that may be employed to improve this efficiency, and of their possible effectiveness. This study has provided a perspective for the evaluation of information requirements, directed to the goal of improved efficiency of urban goods movements.

We have taken the point of view of the community as a whole and sought to assess information sources and requirements that will benefit the total community. From this point of view, we must, initially, assume that benefits are equally desirable, whether they accrue to a particular sector of the community, such as the trucking industry or certain shippers, or whether they are widely distributed throughout the community. Nevertheless, we have sought to point out where a particular consideration is of special interest to a particular segment of the community and where the interests of a particular segment may differ from the interests of the community as a whole. The findings of the study are given in summary in Table 1.

CHARACTER AND COST OF URBAN GOODS MOVEMENTS

Whereas there are many modes for intercity goods transport, including air, rail, marine, pipeline, and road, there is essentially only one mode, trucking, for urban goods transport. If we exclude pipelines, then practically all urban goods move by truck.

The exclusion of pipelines may be argued, of course, because sewer and waterlines are major urban goods transporters, which, from a long-term historical perspective, are substitutes for the earlier use of night soil carts and water carts. Similarly, natural gas pipelines and electrical power transmission lines are currently substituting for the transport by truck of fossil fuels. There are also a few cases of pipelines being used to move chemicals from one plant to another in an urban area. Although for certain purposes it would be useful and even necessary to include these urban pipe transport activities, nevertheless, for purposes of this study they have been excluded, and our attention is focused on urban trucking.

Our scope, therefore, is all commodity movements involving truck transport within an urban area. We include not only the portion of the transport that is by truck but also the loading, unloading, transfer, and terminal operations. We include all goods movements that have both origin and destination within a particular urban region, and also those movements that have one end of the trip outside the particular urban region.

TABLE 1
SUMMARY OF STUDY FINDINGS

Possible Means of Improving Efficiency of Urban Goods Movement	Possible Impact in 2001 ($ per person per year)	Current Information Sources					Suggestions for Improved Information Sources					
		Veh. Registration	Traffic Studies	Spec. Studies	Industry	Veh. Mfr.	Vehicle Registration Information System	Standardized Trucking Cost Series	Modified Regional Traffic Studies	Special Origin and Destination Studies	Studies of Customer Service Requirements	Spec. Studies
Make street and traffic improvements	90	L	L	L			S	S	S			
Consolidate terminals, shipments, and pickup and delivery	25			L	R			S		S	S	
Improve terminal design and location					R							S
Improve shipping and receiving facilities	10				R							S
Improve vehicle design					R	R	S					S
Apply new technology	30 to 70[a]					S		S	S	S	S	S

Note: L = limited information available; R = some information available but restricted; and S = substantial information available.
[a]Not additive.

There are a great many different possible classifications of services of urban trucking. Table 2 gives some categories that may be used for convenience in discussion and analysis. Pickup and delivery is the function of department store delivery vehicles and others that handle parcel pickup and delivery operations. Bulk haulage usually involves the use of dump trucks, operated either privately or under contract. An increasing amount of urban goods movement is by special vehicles, designed for a particular product, such as cement trucks, concrete trucks, and oil trucks. Service vehicles are a special category because it is essential that at least one person with a

TABLE 2
TYPE OF SERVICE AND TYPE OF CARRIER OF URBAN TRUCKING

Type of Service	Private Carrier	For-Hire Common Carrier	For-Hire Contract Carrier
Pickup and delivery of packaged goods	X	X	
Bulk haulage, such as earth, sand and gravel, and snow	X		X
Single-product special haulage, such as fuel, cement, chemicals, and concrete	X		X
Emergency and service such as fire and repair	X		
General cartage of manufactured goods both semifinished and wholesale including food and construction	X	X	X
General cartage of farm produce	X		
General cartage of machinery and furniture	X	X	
Containers		X	
Carriage of people by trucks	X		
Carriage of goods by automobiles	X		

Note: X indicates that the type of carrier performed a substantial part of the indicated service.

special skill be transported in the same vehicle with some commodities. A plumber's repair truck, for example, must carry both the plumber and his tools and materials. General cartage is used to refer to nonbulk goods, which are transported usually in an unpackaged state. Containers are considered as a separate item, although their volume is still comparatively small in urban trucking. Automobiles are frequently used for pickup and delivery; this is the function of many shopping trips. Trucks are sometimes used as people movers. This includes a pickup truck carrying people in the cab and also a truck with benches, army style. This category, of course, is not goods moving, but it is included so it will not be forgotten. The segregation of trucking information into such categories would have considerable value for some uses, but such segregation is largely unavailable at present.

Although such breakdowns are not readily available, it is possible, from a number of existing sources, to get estimates of the total magnitude of urban trucking. For example, for 1966, for all Canadian cities with over 100,000 population we have estimated (1) that the total urban transport costs are as follows:

Costs	Per Person Per Year
Goods trucking	$280
Person transport, with no value on unpaid time	250
Total	$530

These numbers have been prepared by computer simulation on generalized cities and checked against various statistical sources in order to provide order of magnitude estimates of the national total. They are purported not to have a high level of accuracy but to indicate the order of magnitude of costs for purposes of a preliminary assessment of the relative importance of various possible measures for efficiency improvement.

One characteristic of urban trucking that needs to be kept clearly in mind is its resistance to improvement in productivity. This is a major contributing factor to the importance of trucking cost in the total cost of urban living. The trip length is tending to increase and speed to decrease. The load per vehicle cannot be substantially increased. The crew per vehicle is already practically at one and cannot be decreased without full automation. Therefore, it is exceedingly difficult to achieve any substantial further improvements in productivity. The hourly variation of urban trucking is shown in Figure 1. The peaking tends to be slightly out of phase with automobile peaking. This, of course, is one reason for the overall efficiency of urban motor vehicle transportation; it is used by many different types of vehicles throughout the day.

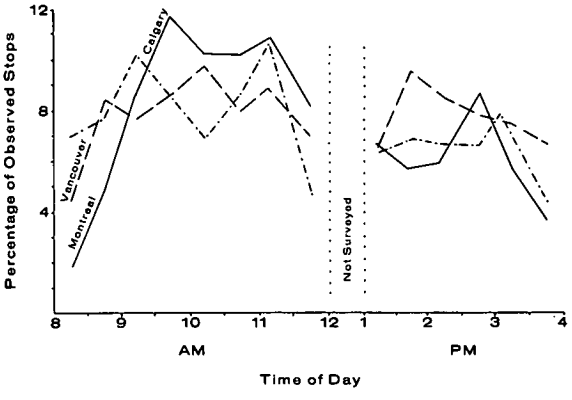

Figure 1. Timing of truck activity in test cities (3).

POSSIBILITIES FOR EFFICIENCY IMPROVEMENTS

Make Street and Traffic Improvements

Any measures that might be instituted to relieve congestion of roads and streets and to improve the efficiency of urban transport generally will have a direct effect on urban trucking. Indeed, if savings in unpaid travel time are considered to be a social rather than an economic benefit, then the possible economic benefits that may be achieved through

changes in urban transport have been estimated (1) to be about $125 per person per year and to accrue approximately 75 percent to trucking and 25 percent to people movements. The potential social benefits, of course, in terms of unpaid travel time, accessibility improvement, and environmental improvement, must be sought largely through people transport, although even in this regard truck transport has a significant contribution to make. Economic benefits to trucking, therefore, through such measures as optimizing arterial and freeway pattern and spacing, improved access road patterns, and traffic operational improvements will certainly be very great, greater in fact than economic benefits to motor vehicles through such measures and also much greater than the economic benefits that can be achieved through measures aimed directly at trucking.

Consolidate Terminals, Shipments, and Pickup and Delivery

Consolidation could, theoretically, achieve very great benefits. There are great difficulties in realizing these benefits, however, because they require cooperation among entrepreneurs, who would otherwise be independent, and because some type of government-imposed monopolistic arrangement might be necessary. Nevertheless, because of the very substantial benefits that have been indicated by various studies, this is a topic that merits considerable investigation. Our study (1) has indicated that benefits in the order of $25 per person per year are obtainable by 2001 from consolidation and improved terminal design and location. Improved information systems and improved rate structures are measures that would probably be associated with such achievements.

Improve Terminal Design and Location

Improvements in the design of terminals that affect the efficiency of overall goods transport are continually taking place. Similarly, improvements in terminal location are an efficiency increase, and this too is continually occurring as a result of location studies by terminal operators.

Improve Shipping and Receiving Facilities

Various studies (2) have indicated that a substantial amount of the inefficiency in urban pickup and delivery trucking, and probably also in general cartage, is due to inadequate shipping and receiving facilities and services. Delays of this type include waiting to get into a loading dock, waiting for shipper or receiver, waiting for paper work, waiting for handling equipment, and searching for freight on truck. Such delays are due partly to obsolete shipping and receiving facilities and partly to the paper work. Improvements involve cooperation among municipalities, regulatory bodies, vehicle designers, and shippers. Rate variations could be a helpful tool in bringing about improvements. We estimate (1) that the value of attainable improvements might be in the order of $10 per person per year by 2001. Some improvements in vehicle design will help in bringing this about.

Improve Vehicle Design

Vehicle design improvements are continually being made and will achieve benefits as they are carried out with specific and clear objectives in view. Changes to improve vehicle operating efficiency, for example, are also continually being carried out by motor vehicle manufacturers. Motors, tires, and other components continue to be improved. This is gradually resulting in improvements in truck performance and relative reduction in truck operating costs.

The improvement of vehicle design to achieve commodity handling efficiency is not quite so easily achieved, however, because it requires close cooperation between vehicle manufacturers and users. Improvements in this category include improvements in truck bodies aimed at making the pickup and delivery operation more efficient. This

type of efficiency improvement is closely related to improvements in shipping and receiving facilities.

Improvements in the road and vehicle system require cooperation between vehicle designers and road designers on such items as vehicle size, gross vehicle weight, and axle loads in relationship to pavement design and load restrictions. Motor vehicle design improvement, with regard to safety, has become a big topic in itself and can properly be considered as a separate topic. Vehicle design changes may be made to improve the environmental impact of vehicles, both with respect to noise and odor. As with motor vehicle safety, the environmental impact of trucks may be considered as quite a separate topic.

Apply New Technology

Various forms of new technology are being considered that would provide intracity urban goods movement by conveyor, programmed modules, or some other automatic means. These are potentially very attractive, particularly if they are combined with personalized transit systems and thereby achieve extra efficiency by a sharing of capital cost between people and goods movements. The potential benefits from such new technology have been estimated (1) to be in the order of $30 to $70 per person per year by 2001. It must be borne in mind, however, that there are substantial staging problems in implementing such new technology and that the benefits are not necessarily additive to those already referred to. There is also considerable uncertainty as to the amount of the benefits because of incomplete information.

Substitute Intercity for Urban Trucking

One factor tending to lower the apparent cost of urban trucking in smaller cities is the substitution, to some degree, of intercity trucking for urban trucking in supplying goods and services to the residents of the smaller cities. Although this substitution, in certain types of accounting, may appear as an efficiency improvement for urban transportation, it is not necessarily a national efficiency improvement because it involves a transfer of cost from urban transport to intercity transport. It is, therefore, not considered further in this paper.

NEED FOR INFORMATION

Street and Traffic Improvements

Street and traffic design have traditionally been based on automobile traffic flows developed from automobile origin and destination data. Usually trucks are allowed for by increasing the truck flows by a factor of 3 or 4 and thereby converting to "automobile-equivalent" vehicles. This may be quite adequate for the design of particular facilities and for planning and evaluation based on social criteria. If economic criteria are to be considered, however, it is important to have enough information to evaluate the impact of various schemes on truck operating costs. This necessitates information on truck origins and destinations, vehicle operating costs on various types of facilities, congestion costs, and costs of diverting from preferred truck hourly variation patterns.

Consolidation

In order to evaluate potential benefits from terminal consolidation, shipment consolidation and pickup and delivery consolidation, one requires information on the present costs, load factors, volumes of flow, and origins and destinations of goods involved in these operations.

Improved Terminal Design and Location

The basic information required here is the cost of various terminal operations and the volume of goods handled.

Improved Shipping and Receiving Facilities

In order to evaluate such benefits, one requires information on cost of operation of present shipping and receiving facilities and the hourly flow variation. Costs must include and identify trucking delay costs.

Improved Vehicle Designs

The information required for improved vehicle design is testing and evaluation of particular vehicles in particular service. For improvement with respect to noise emission, for example, one would measure the level of noise created by particular conditions, establish goals, and then test vehicle variations to determine the practicability and cost of achieving different noise levels.

New Technology

In order to evaluate the benefits from new technology, one requires the same information as for improvements to streets and traffic plus information on commodity origin and destination and the assignment criterion.

CURRENT SOURCES OF INFORMATION

The Dominion Bureau of Statistics (DBS) is the major publisher of national statistics in Canada. Individual trucking firms do gather considerable movement and cost information on their own activities, but such data are jealously guarded because of the extremely competitive nature of the trucking industry. Some vehicle registration information is published by DBS and by a private agency. Some urban transport studies gather a little trucking data. These all result in meager useful urban trucking information.

Dominion Bureau of Statistics

Between 1957 and 1963 the DBS carried out monthly, one-week trucking surveys in each province. These surveys comprised approximately a 1 percent sample each month of all trucks registered in each province. Excluded from the surveys were all vehicles not normally engaged in goods movement. Information was gathered on the type of trucking operation, gross vehicle weight by weight class, and functional categories, such as for-hire, private intercity, private urban, and farm.

Based on the survey, information on truck registration by type of operation and vehicle weight class, tons and ton-miles by type of operation with some indication of origin and destination, costs by type of operation, and unit costs of transport were published (3).

The 1964 survey was substantially changed because changes in the industry in the preceding 10 years made it increasingly difficult and costly. Growth in quarterly registrations and in reciprocal agreements among provinces made sample selection more difficult, and growth in interlining made the origin and destination survey more difficult. The procedure of selecting an individual truck and tracing its activities in detail for a week resulted in increasing difficulties and costs by the truckers. In 1964, therefore, there was an attempt to simplify the survey and to eliminate primarily urban carriers. The results were not fully successful, however, and the DBS staff was not satisfied with the quality of the results. The series has been terminated with the publication in 1967 of the 1964 data. It is understood that DBS is seeking a suitable substitute that will satisfy the apparently changing needs for information.

The demands on DBS are largely for intercity commodity movement information. There is little demand for urban commodity movement information. One reason may be that DBS is known not to deal with costing data. It would appear that the public demand will need to be much greater before DBS feels that spending much money for gathering urban commodity flow data is merited. A pilot project last summer using a small sample of waybills from for-hire intercity trucking firms is understood to have been quite successful and modest in cost. This could result in a new series replacing 53-207 but omitting urban trucking and private trucking.

Less relevant but available DBS information may be found in the following DBS publications: 53-222/3, Motor Carriers-Freight (Common and Contract), Parts I and II; 53-217, The Motor Vehicle, Part I: Rates and Regulations; 53-219, The Motor Vehicle, Part III: Registrations (4); and 53-220, The Motor Vehicle, Part IV: Revenue.

The registration information is incomplete partly because it is published in more complete form by R. L. Polk and Company. This company buys provincial registration forms, codes them, and produces monthly reports on numbers of new vehicles by vehicle class and by area of registration. This record is updated annually to provide an annual statistical summary of the current motor vehicle fleet. This is usually published every second year. Information is made available to subscribers who are understood to be primarily the motor vehicle manufacturers and users of mailing lists.

Truckers and Terminal Operators

Because they directly handle the urban goods shipments, truckers and terminal operators are potentially the best sources of information on urban trucking. There are valid reasons, however, why they are not currently producing much information beyond internal management information. These include the following: Conducting studies appears to be a non-profit-generating activity; the majority of the trucking firms do not have the staff to carry out such studies; cost information on a firm's operation is of a valuable proprietary nature and as such is jealously guarded; and the trucking industry is not a well-structured industry that has matured to a position where it can sustain ongoing industry-wide studies.

A few of the larger firms do gather considerable cost and flow data on all their goods-movement activities. This is normally restricted to their own use. As currently structured, terminal operations are a part of each trucking firm's system. Information on each firm's activities is similarly restricted.

Within the provinces, truckers' associations are established to promote the interests of the trucking industry on a provincial level. Similarly, the Canadian Trucking Association promotes the industry on a nationwide basis. These associations support transport studies on a modest scale. The recent research work by Bates (2) is a good example of such a special research study. Nevertheless, the associations have not addressed themselves to providing statistical series giving meaningful measures of urban goods transport.

Vehicle Registration Statistics

Motor vehicle registration information is obtained by the provincial governments but not processed or published by them in statistical series. DBS does publish such a series, referred to earlier. The most complete information on motor vehicle registration, however, is stored by R. L. Polk and Company and is in a form compatible with that used in the United States by the parent company.

Urban Transport Studies

The information obtained in regular urban transport studies concerning goods movement is spotty and inconsistent. Most studies obtain no trucking information except manual traffic counts at selected locations. At these locations total vehicles may be classified, for example, into automobiles, light trucks, heavy trucks, buses, and motorcycles. On some other projects, roadside origin and destination interviews have been carried out, and these obtain more information concerning the trucks including classification into more than 2 categories, information on the number of people carried, and possibly gross vehicle weight and number of axles. Usually, no information is gained concerning the goods carried. The origin-destination information may be quite incomplete or misleading because the questions are designed primarily for automobiles.

INFORMATION DEFICIENCIES AND SUGGESTIONS FOR IMPROVEMENTS

Street and Traffic

The traffic techniques that have been used in the past for facility design are reasonably adequate, possibly more than adequate. Improvements that are required to give consideration to trucking are improvements in planning techniques, in selection of transport systems, in selection of arterial and freeway locations, in scheduling, and in selection of truck routes.

In our opinion what is required, in the first instance, is some research to develop new transport planning techniques that will be reasonably fast and low cost and yet that will give due consideration to the economics of trucking. Without this research, it is difficult to define exactly what the new information requirements are. It is quite possible that a transport planning methodology, considering the economics of trucking, could be worked out that would require a minimum of expensive data gathering. It might be based, for example, on DBS processed vehicle registration records plus standardized truck operator cost information and small-sample, in-depth surveys to determine vehicle type, load factor, origin and destination, and generation and assignment coefficients. The supplementary traffic studies of each particular city could probably be cut to a small amount. Vehicle registration information could be made a very significant information source by adding some information to the registration form and by coordinating with any other licensing requirements.

Reliable vehicle operating cost information by vehicle type and road condition is very important and requires some continuing in-depth studies to keep current. Truckers need some governmental inducement to produce a reliable series of such data. The cost could be very modest.

Consolidation

This, of course, needs to be evaluated a single project at a time. In each case the origin-destination information can be obtained usually by a modest modification to the information system of truckers, terminal operators, and shippers. The crucial aspect of compatibility of shipments, from a customer-service point of view, and of compatibility of information and accounting systems is one that requires careful study. Standard trucking cost information is an important need.

Terminal Design and Location

The information required could be obtained from records of terminal operators and truckers, although some standardization would be desirable. If this is to be achieved, some agency of industry or government would need to take the initiative.

Shipping-Receiving Facilities

The information required here can be obtained from the standard trucking cost series of information as described earlier and from special trucking delay studies.

Vehicle Design

Vehicle manufacturers and users may be expected to carry out the research and development necessary to bring about improvements in vehicle operating efficiency. Government agencies need to continue their involvement in this work with respect to the interaction between the vehicle and the road system. As far as axle loads are concerned, this is usually considered to be more of a rural problem. There may be some justification in urban areas, however, for having 2 sets of both road design and vehicle design requirements, one for arterials and freeways and the other for local streets. For local streets, one would expect there to be lower axle loads, smaller vehicle dimensions, and more stringent noise and odor restrictions.

For each such public interest topic relating principally to vehicle specifications, there usually are no data requirements, other than the data generated in specific goal-

oriented research and development projects. Such projects would need to be publicly sponsored, as far as they pertain to environment, safety, and road-vehicle interaction. For assessing the benefits that may be achieved from such changes, one needs a fair amount of information about the vehicle fleet, but this could likely be obtained with modest modifications to vehicle registration information.

New Technology

The information required for considering new technology is the same as that for streets and traffic improvements, except that in planning street and traffic improvements one can be satisfied with origin and destination information by truck movements, whereas in dealing with new technology one must have information on the actual goods movements and enough information concerning the goods so that one may determine which shipments would be assigned to the new technology system. Such information would require more of the specially designed surveys because the registration information would be less useful. The special information requirements for new technology will only become clear as the character of the new technology becomes more clearly defined.

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INFORMAL DISCUSSION

J. Douglas Carroll

There are regulations in Canada comparable to those of the ICC in the United States. Although this is an issue with us all, does it appear to be more nearly a U. S. issue?

Lea

Regulation is the one field where there are significant differences between Canada and the United States. Otherwise, things in both countries are very much the same—common ignorance.

Michael A. Powills

A number of people have referred to institutional improvements that could be made. Does that fit into your 4 areas where gains can be made, or is this really a separate kind of area of concern?

Lea

I think it is a means to these ends.

Barry Brune

I am not prepared to evaluate the actual numbers that you placed on the potential efficiency improvement in these areas, but I think I would have to take some degree of exception to the relative magnitude in certain areas. I am concerned primarily about the shipping and receiving facilities and the $10 improvement that you put on that relative to some of the other improvements that you have evaluated through your studies. It would appear to me that in the shipping and receiving area we have potentials that far exceed in relative terms those amounts that you have shown.

I say that for this reason: In some of our studies we find that the time the driver spends standing still at a shipping or receiving area is a very large portion of his total day. Unless we provide incentives for receivers of goods to provide facilities that are adequate for the needs of the carrier and private haulers, we will not achieve any degree of improvement in this area. I am thinking primarily about a large office building or large facility in the central business district. The comment was made earlier that no builders today, or few builders today, are providing adequate receiving facilities. The reason is that they do not have economic incentives to do so. If the tax structure could have an element relating to the provision or the lack of provision for a central receiving point in a large facility of this nature, then there would be some kind of economic incentive for an architect to build these facilities into a structure of this type.

I think that we ought to keep that in mind in terms of structure and in terms of the relative dollar amounts. I think there might be some reexamination of the relative values that you have placed on potential improvements. You may find that they may be greater in the actual delivery and pickup operation itself than you have shown.

Lea

These figures are based on the best information we could find. There is one significant point in our work that is in support of what you say. There is an assumption, in the case of consolidation, that improved shipping and receiving facilities have been provided. In other words, one cannot achieve the gains through consolidation unless the shipping and receiving facilities are also provided. The reverse is not true. One can get the shipping and receiving gains without the consolidation gains. From this point of view, irrespective of the numbers, one can say that shipping and receiving facility improvement is more important than consolidation.

Brune

It seems to me, though, that there may be a vehicle for use in achieving some of these improvements in the shipping and receiving area merely through a mechanization of taxation. The advantage would be that, on specialized or consolidated pickup and delivery operation, the tenants of any one large structure would have a great deal of control over the efficiency with which their goods are distributed from one central point. The individual trucker would have a receipt showing the times at which his goods arrived, and he could refute any claims of bad service; there would be immediate control over the problem. Whereas, when we are talking about one great big consolidated pickup and delivery operation, the fear of lack of control, particularly lack of sensitivity to shipper and receiver complaints, I think is a valid one in many cases. I think we ought to examine this.

Lea

I think this one is easier to achieve.

Brune

Yes, I think there is a direct mechanism whereby we can get at it.

C. B. Lewis

It seems to me that you are not dealing with independent variables. Perhaps some of the confusion regarding benefits arises from that. Shipping and receiving facilities are part and parcel of the consolidation and concerned with street and traffic improvements. The apportionment of benefits to those 3 items is very arbitrary. As I say, they are not independent variables.

My second comment is related to the taxing question. I come from Canada, and I cannot see how a tax rebate is going to help anybody. It seems extraordinary that you would ask the taxpayer to pay for better facilities for the tenant of a downtown building. The general taxpayer is going to have to make up the difference.

Brune

I meant an add-on for the building that does not provide adequate facilities. I do not see having any kind of rebate. I am sorry if I did not make myself clear.

Lewis

All you are doing is shifting the rebate.

Brune

And placing a higher tax on those buildings that add to congestion. Therefore, the occupants of those buildings should pay for higher congestion.

Lea

As to your first point about the independence of the variables, I would agree that they are not completely independent. I think there is a practical measure of independence in that consolidation deals with one end of the trip, shipping and receiving facilities with the other end, and the street and traffic with the trip itself.

Dale L. Anderson

Is there not another segment here dealing with information such as common commodity codes? The Canadians are working on this, trying to come up with a common code for individual packages, computerized coding, and information that parallels this and would have a significant input to reducing costs.

Lea

That is a very important point.

Kirk Foley

We might find it benefitting to the public in the amount of $90 per person, but the creation of that benefit comes from putting more investment in shipping and receiving facilities. What we see on the surface as street and traffic might not be as important as consolidation. We do not trace the benefits back to consolidation but to improvements in streets and other facilities. And the same thing would occur with new technology.

Lea

What we have done, in working in annual costs, is to include an annual capital charge equal to 10 percent of the capital cost incurred to achieve the benefits. Thus, we have

sought to take account of that point. In the case of streets and traffic, the capital charge caused a reduction in the net benefit. Thus, the benefits shown are the net benefits after deduction of an allowance for the capital investment required. The same is true in the case of new technology.

A. L. Peel

Regarding the street and traffic item, how much of this is dependent also on solving the people-moving problem? There is common use of a facility here. Is the realization of this benefit as you see it based also on solving the people-movement as well as the goods-movement problem?

Lea

I put it the other way. If the streets and traffic are improved, it benefits both the goods and people movement. The improvements we are talking about here—improving the spacing of arterials and freeways, improving the traffic operations, improving signalization, and so on—benefit both the movement of people and the movement of goods. But we found the economic benefits were more in the category of moving goods than in the category of moving people because of our assumption that saving unpaid time was a social rather than an economic benefit.

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.
>
> 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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PROBLEMS ASSOCIATED WITH URBAN GOODS MOVEMENT AT THE LOCAL LEVEL

A NATIONWIDE TRUCKING COMPANY

Charles W. L. Foreman

United Parcel Service is a company engaged in pickup and delivery services throughout most of the United States. The company presently services 43 states; applications are pending in those states in which UPS already partially operates and in several others. If these applications are approved, then UPS will be active in 47 states. We have not yet applied in the remaining 3 states because of several unique characteristics; but, these notwithstanding, we serve in more states than any other transportation company. United Parcel Service offers to pick up and deliver from any point that can be designated accurately enough to locate; it serves both the individual and the corporation. Our service includes both the pickup end and the delivery end, whether this be in the mountains, in the desert, or in the city.

At the same time we do recognize that our primary competitor, the U.S. Post Office, has a natural edge by having throughout the United States about 45,000 post offices that can reach the remotest citizen. Because we do not have so many terminals, for $2 a week we offer to pick up parcels at the door. We have about 850 terminals in the areas in which we presently operate. We receive packages every day up to 50 lb and 108 in. in length and girth, which is 2 cu ft, from about 175,000 regular daily shippers, and we make well over 2 million deliveries each day, 5 days a week.

We are a partnership organization, and this is most important. About 4,800 of our managers and supervisors own the business. No one owns more than 8 percent of the stock, but it is a significantly internally owned and operated organization. (I am later going to emphasize some of the intangible and institutional factors that are also important.) I do not believe that we could stay in business if it were not for the fact that all of the managers and supervisors are owners of the business and consequently carry that ownership interest into their daily dealings with the shippers, the consignees, and the employees.

Some time ago, because we were not able to offer our hourly employees ownership of the business as stockholders, we developed a plan for profit-sharing modeled after the Sears-Roebuck plan, which has been working very well. Every employee in the business can put away some of his income each week and receive what in the past 10 years has averaged about 14 to 15 percent on his average monthly account balance. We think that ownership on the part of the managers and supervisors and profit-sharing involvement on the part of the hourly people have a great deal to do with the interest we take in details and in the service to the customers.

I said I would concentrate on the institutional aspects, and that means people. We tend to believe in career involvement. In my experience, 30 years with my company and great activity in the American Management Association, it seems to me that the typical motivation of a manager is his monthly paycheck and cash bonuses, which cause him to compete with other managers in the same company for a special advantage over the others. We concentrate our entire incentive system around long-range capital gains

from stock ownership. This means that 2 supervisors or 2 managers can only enhance their financial estate by doing things not because they will help increase their monthly paycheck but because they will enhance the well-being of the organization.

Accordingly, it is not very difficult to conclude that those things that will enhance the organization over the long run are customer satisfaction, achieved by superior service and low costs. And we concentrate on this single goal.

In the selection of employees, of which we have about 45,000, our experience has been to interview between 25 and 100 persons for a single hire. In mature areas the minimum is 25 interviews for one hire. In newer areas it is closer to 100 interviews. We believe that if you are going to hire a man you cannot hire him for the first year of his life; you are hiring your troubles for 30 years, so you may as well make a big investment in hiring a 30-year man who will give you some benefits from his employment instead of a 30-year man who will give you trouble. We cannot spend too much money trying to find men who want to perform well.

We have insisted that our labor contracts include a probationary period. If we have made a mistake during selection, we can correct it before the new employee gets seniority. Our personnel departments work the hardest for the first 30 days of a man's employment, asking every supervisor and associate how the new employee is working out and whether he has the right point of view toward the customers. We also ask the customers how they like him. An employee does not last for 30 days unless we are ready to keep him for 30 years.

Another of the institutional factors that we highly regard is supervision—supervision at the lower levels and management at higher levels. In the field of transportation of goods (or property as we call it), too little attention has been given to the science of management, of supervision, and of motivation. It is an industry almost devoid of expertise in this area. This is not to say that we are experts either, but we do devote a great deal of attention to management problems. For example, every manager who gets beyond the first level of supervision spends 6 months to a year in our industrial engineering department in order to become capable of using standard data and setting standards for every job that he may supervise. The supervisor learns by riding with the driver on the truck, standing beside a man who is sorting the packages or doing anything else he has to do, and then being able to tell immediately when something is being done in the wrong way and will produce overexertion and fatigue that eventually leads to overtime and results in overcosts.

Every manager has to be capable of measuring the job in such a way that he can set the standards for it. We believe that only when a man can set time standards and method standards for a job is he capable of supervising a job. We are all subordinates of somebody, and I think we all have the feeling that, unless our boss knows when we are doing a good job and when we are not, he is not a boss that we can respect. If he knows what a good job is and tells us when we are not doing it, we have more respect for him. If he can tell when we are doing a good job and gives us credit for what we are doing, we have additional respect and some affection for him. In addition to his technical knowledge of the job, he should also have some appreciation of personnel aspects; and we see to it that our managers and supervisors get experience, for about the same length of time, in the personnel departments. They take courses in personnel and motivation in order that within a short time (i.e., a year or two) one thing will occur: They and their subordinates will have a feeling of mutual trust that will enable them to talk frankly with one another, even to shout at one another, within the framework of respect and understanding.

We have found that employees respond to what you and I respond to: mutuality of trust and a recognition that they do not have to do anything for anybody if something is not going to be done for them. Just as we have profit-sharing plans and shares in stock, we have shares in a man's desire for himself and his career, his own well-being, his own interest in life. And this may sound, because it is so brief, like silly YMCA generalizations, but we live by it. We have at every level in the organization a large corporation of line managers who for a period of about a year are taken off their line job and taught how to interview. And they become auditors in every part of the business

including how well subordinates regard their supervisors and what suggestions they have for improving their own environment in the company.

Exercising authority over younger people coming along into stock ownership and partnership in the business in a true sense is not unlike exercising authority in a family situation with regard to your wife or your husband or your daughter or your son. You know how little authority you have over them. If you can accept this in a business situation and manage a business on a partnership basis instead of on the basis of authority or greater knowledge or greater skills or something of that nature, you will understand the way we try to operate our business.

We have a department that works very closely with shippers, particularly in terms of the speed with which we make pickups and deliveries. We make promises for pickups each afternoon. If for some reason we do not make it, the next day a customer serviceman will call on that customer and try to find out why we did not make it. Sometimes a previous shipper may have caused the delay; sometimes the shipper did not have the goods ready for us. Similarly, if a signature is required at delivery, we try to make sure that the one who is authorized to sign is there and that he moves to the front of the establishment when he sees our driver coming in the door and signs for the packages the minute they are delivered.

We make a big thing out of locating hubs, which are the major central operating centers that we use around the country, the operating centers that are secondary to the major hubs, and the satellite centers that are secondary to them. We have about 850 of these scattered around the United States. The major hubs are equilateral triangles, approximately 150 miles apart, that make it possible for us in a series of 5-hour jumps to move and re-sort packages (if they have to be re-sorted) anywhere we serve from one end of the country to the other. However, we endeavor to develop a direct load and to transport it all the way to the center in which it is going to be delivered if we can get it that far.

We have an enormous industrial engineering department. As I mentioned, every supervisor has to be a half-baked qualified industrial engineer. Backing up every district manager in every state and fraction of a state, however, we have a full-fledged corporation of industrial engineers who work out matters, such as whether to make direct loads, how to split them if we have to split them, how to by-pass any point that can be by-passed, or how to consolidate if consolidation is required.

Consolidation can become a fetish, but consolidation itself costs money and it can cost more money than is offset by a saving. We can consolidate small packages quite well. But we also handle furniture for some of the major department stores we serve, and we have a very difficult time consolidating the bulk of the furniture we deliver. It is only for the marginal account and out "in the sticks" where we can do a good consolidation job. I could go into a lot of detail that would discourage you from thinking that consolidation is an automatic solution to every delivery or pickup problem in metropolitan or other areas.

When we have engineered the job and have worked out the territory to be served by an operating center and even by a driver in his own route for the day, the driver and the sorters who put his packages in order during the night work get together with their supervisor to review the routing. The knowledge that the driver has about the territory can influence the sequence already developed. As you can easily imagine, there are many addresses that are reached most easily from a street other than the address on the letterhead. The driver knows this. Every time he finds an address that is better than the one he has, he passes it on to the sorters, who then place that package in that order instead of the order on the label. In this way we accomplish our primary objective, that is, to achieve the least number of miles. Miles produce time; time produces overtime. So for every route we make periodic traces with a little map tracer that follows the driver's record from one stop to another. In this way we see whether it would have been possible to have saved a mile or a half of a mile or even a tenth of a mile on that particular delivery. If we find that savings were possible, we teach this to the sorter and we teach it to the driver. Sometimes the driver teaches us that it is not always what you read on the map that counts; for example, there may be a canyon or a one-way street that we did not know was there. So it is a cooperative effort among the

supervisor, the delivery man, and the sorter working to produce the least number of miles and the most effective delivery for the next day.

Another important engineering problem we have in metropolitan areas is the combination of delivery and pickup. This is a major engineering job. The problem is to allow within an 8-hour day 3 hours for pickup and the remainder for deliveries within a certain area in the least number of miles. We have solved this problem quite well now that we have the machines and the computers.

Management, it seems to me, is our greatest skill both in its presence and in its absence. I have a list of 5 questions that I think are fundamental to success for carriers in the urban areas to reduce the congestion, to reduce pollution, and to reduce the problems of satisfaction with customers and themselves.

First, is it possible through engineering attention to dispatch (which is our word for it), or to assign or plan, an efficient day's work? If we fail in overdispatching or underdispatching, this is measurable and controllable. We can check against the theory and we can check against the fact. There is no excuse for overdispatching or underdispatching. We attempt to find out the cause for it and then eliminate it.

Second, what is the cause of nonproductive time, if we know what our dispatch is? If the man fails to return in the time planned, we check first to see if he was delayed waiting at a dock, waiting for a traffic light, or waiting for a customer.

Third, what is the cause of substandard work? Substandard work may merely be the man's pace. Many men work at a slower pace than the job calls for. If this is the case, we take him out and the supervisor takes over. We have had strikes to preserve the right of our supervisors to do today's work when performing on-the-job training. We feel it is vital not to lose this right, because if we lose this right, then we have lost our control. Often a supervisor will take out a delivery load for a whole day with the driver sitting alongside of him. The supervisor will deliver the load an hour or two faster than the driver does without ever running or without ever lifting his heels off the ground to demonstrate that it can and must be done. And we have made discharges stick when we have been able to make the demonstration that this solution is required.

Fourth, what is the cause for excess to-and-from time, that is, the time from the terminal to the first stop and the time from the last stop to the terminal? Many drivers have a tendency to gather in bunches at coffee stops and spend a long time chatting with each other or stopping for lunch or dinner when they come back in. We pay strict attention to the to-and-from route time and distance (and, of course, to the cause of disinterest).

Fifth, how are standards maintained? We work with our thrift plans and require managers and supervisors to spend time after hours. Any man who is not up to standard can expect to spend evenings out of uniform with his boss. There is something about a uniform that dehumanizes a person. We make it a point for a supervisor to spend much time with a man when he is dressed the way you and I are today. He is a human being and has points of view that are valid and ideas that are valid.

A REGULATED INTERSTATE CARRIER

Paul H. Banner

What can we do as an interstate carrier about the flow of goods in the urban area? We operate within the city in a limited manner; we carry traffic through towns; and we are called on to perform certain functions within the city for which we generally lose money. Our tracks sometimes are on city streets. Our trucks enter the city for we deliver to people who do not have sidings. We serve individual plants, and we do something called intracity switching. We may deliver from a water terminal to a plant.

Our major contribution is where we succeed in eliminating transportation within the city. (I exclude TOFC service where essentially we perform as a trucker so that we are no different from the motor carrier.) What we can do as an intercity carrier to eliminate transportation and solve some of the problems in the city is to influence the market, the nature of the product, and the production process. For example, the weight of the commodity can be reduced; product substitution can be made such as frozen products instead of fresh ones; and the quantity, size of the shipment, periodicity, packaging, or form of delivery can be changed. Any one of these that eliminates the number of moves will help. Rail can and has contributed to change in these areas.

The furniture industry is an example of this kind of change. Furniture is a bulky commodity, and storage is very expensive. Interest rates have gone up, and rental rates have gone up. What can we do to eliminate the industry's transportation problems? Eliminating multiple movements within the city and using direct delivery from plant to receiver will contribute to eliminating some pressure on transportation. We have succeeded in doing this and have actually experienced a growing participation in this industry. We consolidated movements in the area of production by putting consolidators into business, and we moved large quantities to distributors near the point of consumption who then delivered directly to the consumer. Wherever we can improve storage outside the city and eliminate city movement, we have made a contribution.

A change in the density of the product itself can reduce the demand for transportation within a congested area. A good example of this is the movement of wool. It is very light and fluffy; moved sheared, it requires a lot of transportation facilities. However, building a rate structure that provides an incentive to moving a more densely packaged commodity actually eliminates the demand for transportation. Delivering 60,000 lb of a commodity in 1 delivery rather than 20,000 lb in 3 deliveries seems more efficient. Delivering a bulk commodity in large quantity reduces handling and congestion.

These are not direct attacks on congestion within the city but rather on problems of commodity interface between the intercity and intracity movement. We could assist in the movement of material from the city. A large percentage of urban hauls are scattered within the city and do not occur along particular corridors. They are haphazard movements, but there is a commonality in the movement of many products. Any diminution in the average haul for these items moving into or out of the home should contribute to lessening congestion and contribute to a more efficient use of the streets. What has a railroad that can be used to contribute to the movement of material out of the city? We have one thing: a track, running through the city. How can this facility be used to help solve urban commodity flow problems? The household has mail coming into it. It has electricity coming into it. It has water. It has other utilities. And it has trash going out. Perhaps rail cannot collect the trash, but certainly it can play a role in where it goes.

What have we done in this area of trash collection and disposal? While society has advanced phenomenally in the last 50 years, trash collection has remained about the same or deteriorated. Dump trucks now have compacting units, but the system of collection and disposal is about the same, even in the newest, fully planned cities. As far as I can see, the only infusion of capital into this industry has been the capital of the individual. He buys more trash cans. For 3 people in my family, I now have 6 trash cans. Every Monday morning I listen for the trash men to come by and hope that my trash will be removed. The system consists of a man standing at the bottom of the truck and one standing at the top. The man at the bottom throws the trash can up with a whoop. The top man empties the can by hitting it and throws it with all his might to the man below who, if he catches it, emits a cry of success and moves to the next container. If he misses, I repair or replace the can. At the end of 4 blocks, the truck is filled and is moved to some destination where the trash is burned. Obviously, this is an inefficient scheme and we could do it a lot more efficiently.

Where does this trash go and what can we do about it? In the city of Washington, we are building a new subway, and it happens that the subway track will use our railroad yard. As long as the subway goes through the city where the people are and by our railroad yard, is there any reason why trash collection points could not be located along

the subway for nighttime movement and consequently for shorter hauls by truck on the city streets?

The reaction of the subway planners to this has been close to outrage. If the subway were to have multiple use, then planning of items such as curvature of track, weight on rail, and equipment would require consideration. Furthermore, other uses could immediately be considered such as mail and small-parcel movement.

I do not think that it would be unreasonable to request that post offices be built along corridors to improve utilization of public investment. Furthermore, there is no reason why water, electric power, and telephone facilities could not be built along the same corridors so that public investment could be shared. If you have seen how streets are dug up for telephone lines and then for gas lines and so forth, you can appreciate the advantage of commonality of investment.

This is not now being considered, and the reasons are unknown. Without even the use of the subway, rail movement of trash has not had very sympathetic reaction. We have been willing to perform a service at a total cost that we believe is less than the out-of-pocket costs for the city, which is normally a reasonably good economic argument; and we have not been asked to bid on the service. This raises a question when we talk about the requirements for transportation. Are we dealing with economics, or do we have a whole host of political and social arguments that must be dealt with?

A NATIONWIDE RETAIL ORGANIZATION

Stanton P. Sender

I would like to describe the operations of Sears, Roebuck and Company as shipper of goods in the urban areas. The first part of my remarks will provide some statistics about the firm, and the second part will describe the changes that the firm is making in movement of goods in the urban and other areas.

Sears has approximately 850 retail stores, 1,900 catalog sales units, 11 catalog order plants (the twelfth is being built in Columbus, Ohio), and 600 warehouses. We also have a number of catalog sale merchants. Sears buys over 150,000 different items from approximately 20,000 suppliers. The 1969 published net sales of $8.8 billion represents a volume of freight that would cover a 4-lane highway between New York and Chicago, covered to a depth of 10 ft.

More than half of all items listed in the Sears catalog did not exist 20 years ago. More than a third of all items did not exist 10 years ago. Most of these products could not have been made then because the necessary materials or manufacturing processes were not available. For example, let me refer to the trash situation. Our newest product is called a trash compactor. Six cans of household garbage can be placed in this small device that can be installed next to the dishwasher. We feel that the ecological problems of trash can be solved better by compacting it into small packages that then can be handled by the garbage men in neat packages and sent out to the local landfill to be disposed of or burned.

Sears' transportation expenditures are more than a quarter of a billion dollars a year. More than half of this is accounted for by inbound transportation on purchases. This is the merchandise shipped to Sears by suppliers, and it consists of goods, supplies, and equipment. About a quarter of Sears' transportation dollar goes for home delivery of merchandise purchased by customers. Approximately 10 percent is expended for postal service charges to deliver catalogs to customers. The remainder is cartage expense for moving goods between stores and warehouses. Approximately 50 percent of Sears' transportation dollar goes to common carriage, approximately a fourth for private and a fourth for contract carriage. The contract carriage operations

are the fastest growing part. They are now slightly over a fourth and may reach 40 percent by 1975.

That is the general picture of the firm and its transportation operations. The important thing to note is that urban goods movement involves a line-haul transportation from the manufacturing source to the warehouse, a cartage operation from the warehouse to the store, and a delivery operation to the customer's home. There has been some talk about new devices for substituting communications for transportation. Sears for several generations has had a catalog sales operation that involves only 2 steps: the source to the catalog plant, which is essentially a large warehouse, and from there to the customer. The customer need not leave his home; he can order from the catalog by mail or by telephone, eliminating the intermediate step of going to the store to pick up the goods.

Sears is also using containers in distribution channels to a large extent. The use of containers in Sears is practically a way of life. Containers permit merchandise to be consolidated for shipment sold in units, minimize handling or loading expense, and eliminate lost or mismatched orders. The same container is used to ship returns from the selling units back to the catalog plants.

Sears also uses night deliveries. We find that, where they are used, they produce more efficient runs because the transportation time is less in the evening and service is improved.

There was a day when every Sears store had its own warehouse and its own delivery truck. This is no longer practical for the following reasons: high cost of building and maintaining many small warehouses; increasing inventory holding costs; increasing transportation rates on small shipments; and difficulty of maintaining an assortment of merchandise demanded by customers.

Just a few years ago there was one color for shirts and refrigerators; now they come in many colors. This involves a great merchandising problem. Whereas before we stocked white shirts and white refrigerators, now we have to stock many, many more because of the variety demanded by the customer.

To provide that variety, as well as for other reasons, we have gone to the distribution concept involving consolidation of the number of warehouses and enlarging of the service areas. In the Cleveland area, for example, a new distribution center is being built to serve stores in a 75-mile area. I want to emphasize that this is part of the urban movement of goods. Instead of moving from the Sears store, goods are moving from a distribution complex 75 miles away.

It is almost commonplace that most new retail facilities are not being located in what is known as the inner city; they are being located in shopping centers or in the suburbs. It has also been noted in many retail circles that there is a synergistic effect in having shipping centers that contain more than one store. The feeling is that the shopper prefers to go to an area where, if an item cannot be found at one store, it can probably be found at another. The result of this is that there are larger shopping centers and fewer individual-store shopping centers that were popular a few years back.

I have discussed with a number of retailing people the possibility of being able to shop by cable TV—of the customer viewing merchandise through a television set and ordering and being billed through the television set. Catalog sales, which are now really sales to suburbia, are a fast-growing part of the Sears business. Still, it seems that the housewife prefers to leave her home and go to a store simply to get out of the house. Generally, it is the felling in retailing that shopping by communications is longer ahead than the next 10 years.

There is a growing trend to encourage the customer to take his purchase with him instead of having it delivered. I think this will be an increasing trend because of the higher cost of making deliveries.

Sears and others are looking into the home built-in appliances. This new type of major appliance is a compact multi-appliance, drop-in unit that is sold and built right into the house or into the apartment, thus eliminating delivery.

A number of stores are also considering whether to combine the movement of repair parts and the movement of service and whether the delivery men should also be the

servicemen. Should you send out one man in a truck with a washer-dryer and a second man in a second panel truck to plug it in?

In a retailing magazine called Stores Magazine, a columnist, who is a vice president, predicted that free retail parking facilities in parking lots of suburban shopping centers will totally disappear by 1980 and that not only will retail parking facilities downtown be posting charges in 5 to 10 years but also parking facilities for all types of traffic are likely to disappear. He says that the retailing industry should plan for the customer who will shop primarily by public transportation. Assuming that he is correct, it would indicate to me that beyond that time there will be a greater growth of shopping by phone or by cable television and that this will essentially cause considerable delivery problems for the U.S. Post Office or United Parcel Service.

THE U.S. POSTAL SERVICE

Ronald B. Lee

Probably because of the post office's traditional place in the President's cabinet it has been overlooked when basic industrial problems, such as moving goods in the urban environment, were discussed. For this reason, I welcome the opportunity to discuss some of these problems. My remarks deal with the practical problems involved in moving 85 billion pieces of mail a year, the institutional constraints under which we operate, and some of the things we are doing to solve the problems and remove the constraints.

PROBLEMS

The first practical problem is the immensity of the U.S. Postal Service. There are 44,000 facilities, many of which are located in the center of urban areas. Almost a quarter million vehicles move the mail. Some are contract-owned and some are our own. The latter collect mail, shuttle it between branches and the main office, and to a limited degree move it between cities. The U.S. Postal Service employs 730,000 people who work in 32,000 post offices. However, the 75 largest of these employ half of those 730,000, so that our urban presence is extensive indeed!

In addition to these problems of sheer size, the Postal Service has significant network problems. These are problems not only in intracity movements but also in the intercity links that end up being metropolitan problems when they get to the other end. Incidentally, we spend three quarters of a billion dollars annually buying intercity transportation from railroads, air carriers, and private trucking concerns with whom the Postal Service contracts directly.

Mail by and large does not move by rail anymore. In 1940, there were approximately 10,000 trains in this country on which mail moved. You have seen pictures of the arm that used to swoop the mail bag from the car, the mail already having been sorted to that particular crossroad. Today, there are less than 300 mail-moving trains in the United States. In 1940, mail volume was 27 billion pieces; today it is 85 billion pieces. This represents a 97 percent decrease in rail transportation and a 210 percent increase in mail volume. With the prolonged but basic alteration in the transportation network, new problems appeared. It now became necessary to do more distribution in post offices that had been ideally located for a rail-oriented transportation system but were not well suited to an air and highway operation.

Congestion is a major factor in impeding intracity movement. It particularly hampers our outgoing mail operation. In the first place, we are out on the street every evening during the peak of the rush collecting mail from boxes and building chutes and

from our branches and stations all over the city. During the same time, we are shuttling mail to the airport, and too often we miss flights and sometimes delay mail because our trucks are caught in the familiar airport-access traffic jam. We are not able to estimate precisely the cost of time lost because of congestion or to isolate its effect on service, but most big-city postmasters would agree that it is a serious problem.

Fortunately, our incoming mail operation is not similarly hampered. Vehicles bring the mail in from airports and railroad ramping yards over relatively empty streets. A concerted effort is made to keep this a late-evening and very early-morning operation. Several hours later, but well before the morning rush, the mail is moved out to the branches and stations for carrier delivery. Granted, our motorized carriers do confront heavy city traffic, but where congestion is acute our carriers travel on foot because nothing substantial can be gained by providing vehicles.

So, not only is the Postal Service big, but it travels a lot—the equivalent of 1 trip to the moon each day delivering city mail alone, and 8 trips to the moon each day delivering rural mail.

CONSTRAINTS

Many of the constraints that the Postal Service has faced center around its prior dependence on the Congress. The Postal Service is one of the greatest supporters of the American economy. It has been estimated that through the Postal Service each year travel transactions that total some $5 trillion. In other words, the entire GNP turns over many times through the mail. The clearinghouse function in New York City alone is a $3 trillion a year operation, and most of it goes through the mail. When postal operations are hampered as a result of congressional delay, the entire American economy suffers.

It is unfortunate that, too often in the past, our progress has been impeded because of traditional political mechanisms. There have been too many occasions when the Postmaster General has gone to Congress to request an adjustment to our product line or rate structure. Far too frequently no changes have been made or delays have made them almost ineffective. The appropriation process itself has been a constraint. Obtaining funds for investment capital, and indeed, for everything has entailed competition with the war in Vietnam, the war on proverty, and every other federal program.

As an operational organization that has a measurable product and whose total operational capability is tested daily in a real-world context, the Postal Service is unlike any of the other governmental departments and should not have to compete with them. Most other agencies receive their funds based on changing national policy and priorities. The Postal Service has a constant mandate to serve the public every day of the year, with no delays and few mistakes tolerated.

In a period of tight budgets, our doors cannot be shut with a declaration that the offices are closed for the duration or a statement to the public, "We are sorry but we did not get our appropriation; come back next year." You cannot do that when you represent a vital communication link as the Postal Service does. However, with the increased managerial flexibility we have gained under the postal reform law, it should be easier for us to develop new products, improve service, and increase revenue with little delay or burden to the public.

SOLUTIONS

Admittedly, a quarter of a million vehicles and 44,000 facilities can create a lot of pollution. Efforts are being made, however, to control it. All of our vehicles have been changed to include the new antipollution devices, and no vehicles are purchased unless they have these devices. In addition, low-lead and no-lead fuels are used in all of our vehicles.

The Postmaster General announced on November 5, 1970, that the Postal Service will test a natural gas engine. Under the program, $65,000 has been allocated to modify 54 postal vehicles so that they operate on compressed natural gas. The project will be tested in 4 cities and evaluated over the next year. This pilot program is the result of a year-long study conducted by the Postal Service and 2 utility companies.

Finally, a directive was issued on cutting down the idling time of vehicles; employees are not allowed to let the vehicles idle while going for a coffee break or walking a long distance to the front of a house. Although this is not necessarily effective in cutting down the idling time of our employees, it is reasonably successful in cutting down the idling time of some of our vehicles!

To reduce street and terminal congestion, we are beginning a program of accelerated facility construction and improved site location. No longer are the huge colonnaded edifices being built that have served as landmarks since the beginning of the Union. Light-industry types of factories are being built near the confluence of highways where there is access to airports, the Interstate Highway System, and other major transportation arteries.

In addition, plans have been formulated to construct and operate a bulk-mail network that will consist of 21 highly mechanized bulk-mail centers and 12 auxiliary service facilities. The system will process parcel post and second-class and third-class mail. One desired effect of this network will be the disappearance of many postal vehicles from the overcrowded streets of the central business district. Now under study is the concept of whether the same principle is valid for preferential mail.

The Postal Service is also moving toward versions of the supermarket concept. You all can remember going down to the corner store and giving Mr. Jones the grocery order and watching him assemble the groceries. Now, of course, we stand in line for a carriage, push the carriage around the aisles, stand in line again to pay for items purchased, and thank the cashier for the "privilege." If the Postal Service can get its customers to do the equivalent, most if not all of our outgoing operation could be bypassed and thereby eliminate some of the urban congestion we cause.

In addition to internal changes the Postal Service has made (i.e., off-hour transport) are the external efforts that have been made. Through positive incentives and some negative ones, our customers are being induced to mail early, to use ZIP codes, and to presort by ZIP codes. Some positive trends in these areas are becoming noticeable.

Perhaps the best solution lies in reflecting on the fact that the current law creating the U.S. Postal Service in place of the U.S. Post Office Department carries on the post-road tradition. To refresh your memory, a post road is any road, highway, street, waterway, or railway over which mail must travel to be delivered. The law states that the U.S. Postal Service cannot be denied access to any post road. Therefore, it is reassuring to see that this conference was convened to figure out ways to get all those other vehicles off the post roads so that the U.S. Postal Service can deliver the mail!

A NONGOVERNMENTAL TRANSPORTATION PLANNING AGENCY

D. Reid Ross

I work for an industrial development organization that is nongovernmental in nature and character and that has an interest in transportation planning, principally because transportation facilities obviously can facilitate or impede economic growth and, therefore, urban growth.

A city like St. Louis or any other gateway city really functioned from its beginning as a freight city. It handled, collected, distributed, transshipped, broke bulk, consolidated, and interlined freight. In 1764 fur and lead were collected in St. Lous, and that is the only reason the city ever got started. Two hundred years later 70 million tons of freight valued at some $10 billion were handled in the city, a little bit less per person than is handled in New York.

What do we do then to adapt to the new transportation technology, as we have adapted over the centuries to the impacts of old transportation technology such as the steamboat, truck, and airplane? New transportation technology that will be here in 1985, it seems to me, involves jumbo jets and containerization as the most important single impact, but also probably unit trains of all types, large barges, double-bottom trucks, and new kinds of pipeline movements, even semisolids.

What does this mean then in terms of urban design and transportation terminal facilities, urban design in general, and transportation and land use patterns?

We propose in St. Louis, for example, to build a new airport. It could in 1985 (it will take until 1982 to build it if we are lucky) serve as a nucleus for a freight city, if rail, barge, truck, and possibly even pipeline terminal facilities locate in proximity to that airport. If it is built, this airport will be in the Illinois portion of the St. Louis metropolitan area—at least all indications suggest that. The airport authority itself has, to my knowledge, unique legislative authority. It can assemble the land necessary on which to build the airport, some 16,000 acres, and it can in addition use its power of eminent domain to acquire land in a belt one mile wide around the entire perimeter of the airport. So it is conceivable that this airport authority can own nearly 25,000 acres of land. On that belt of ground one mile wide surrounding and embracing the airport, it can develop for any airport-related purpose any kind of land use. The authority can develop the land, lease land to other developers, or do whatever it chooses to do in accordance with the master plan that it must prepare for this purpose.

One of the reasons, of course, for this legislation is that the incremental value that will accrue to the land adjacent to the airport can accrue to the public good and in effect pay for the airport or a portion of the airport construction cost itself. Another reason for the legislation is to permit the planned development and emergence ultimately of related freight terminal facilities—rail, truck, pipeline, and barge.

Studies being conducted or about to be launched can contribute to the design of this intermodal terminal complex. These are the airport location study, which is in its final stages, 3 highway corridor studies being conducted by the Illinois Division of Highways, a rapid transit study, and a rail yard relocation study for which funds are committed by various agencies in the U.S. Department of Transportation. If these studies are conducted simultaneously and are guided and coordinated so that they can all contribute to the relocation or location of terminal facilities in proximity to each other, presumably around an airport that serves as their nucleus, then we have a chance for probably the first time to design an intermodal terminal facility between the sea coasts.

Hundreds of millions of dollars have already been invested in intermodal terminal facilities on both coasts of this country. It does seem to me that an inland, mid-continent location for an intermodal terminal facility will emerge some place between the Appalachian and Rocky Mountains within the next 15 years. We are in St. Louis, it seems to me, well along with respect to studies that can lead to the design of such a mid-continent location for this type of a facility.

There are obviously institutional constraints, not the least of which are the Interstate Commerce Commission, the CAB regulations with respect to switching limits, commercial truck zone boundaries, and air shipment and terminal shipment boundaries.

The need, however, for analysis of institutional constraints is only illustrated by this particular set of problems. The emergence of a U.S. Department of Transportation suggests that at least at the national level we have started. It may be slow to begin with, but momentum is being gained to deal with some of these institutional constraints.

The need for coordination of federal and state governments is enormous in an effort such as we are undertaking. We have identified, for example, some 15 separate studies to be undertaken by 6 different federal agencies before a complete design and location analysis of this particular type of facility can be actually completed. Because so many federal agencies are involved—Department of Interior, Corps of Engineers, Health, Education and Welfare, Department of Housing and Urban Development, Department of Transportation, and even the Economic Development Administration and the Small Business Administration—there is a need at the federal level for coordination. In that regard, we have approached the White House and achieved some degree of interest and

commitment from the Office of Management and Budget with respect to federal coordination.

The state government has at least 5 different agencies involved. There are some 200 truck lines, 14 railroads, 36 barge lines, 6 pipeline companies, and 12 air carriers that are going to make inputs one way or the other into the development of this intermodal facility. It seem to me that this type of intermodal cooperation among industry and government agencies is absolutely essential if new transportation technology is to be developed and effectively used.

THE U.S. DEPARTMENT OF TRANSPORTATION

Michael Cafferty (presented by Gene Tyndall)

Goods-movement problems within urban communities are illustrative of the operational difficulties that the urban transportation planning process has experienced. I would, therefore, like to motivate thinking first within an overall metropolitan focus and to make clear the interest of the U.S. Department of Transportation in the urban transportation planning process so that urban goods movement may then be analyzed from the broader systems point of view. The practical problems and the institutional constraints that planners and decision-makers face at the local level can then be better defined and understood.

There are 3 important new considerations or new concepts that affect the programs of the Department of Transportation; they are all institutional by nature.

1. The new focus is on the environment and on the national desire to preserve and enhance the quality of the environment with whatever tools we may adapt to serve that goal. This effort is supported by the Environmental Policy Act of 1969, signed by the President on January 1, 1970. It is also supported by Secretary Volpe's own concern about environmental quality and by steps that he has taken to establish within the Department of Transportation new mechanisms for coping with the need to assign a high priority to environmental factors in transportation planning, policy, and programs.
2. The Bureau of the Budget came to the department last year with a request that we evaluate the urban transportation planning process to see where and how it might be improved. Here again, many of the improvements will probably be institutional, and technological solutions alone cannot serve the need completely.
3. Another problem area is the need for urban systems, and solutions here are institutional rather than solely technological. The Department of Transportation itself was created in an effort to bring together and to rationalize into a system a collection of transportation modes, techniques, and methods of funding. Nowhere was the need greater than in the nation's urban areas that were reacting to the impact of a variety of factors including urban freeways and urban freeway revolts, interstate highways funded 90 percent by the trust fund, faltering and failing municipal and private transit systems, increasing reliance on airports and increasing concern about aircraft noise, and an automobile-population explosion that matched the people-population explosion.

These new considerations, these institutional innovations, have already been reflected in transportation philosophy at the federal level. Secretary Volpe created the new Office of Assistant Secretary for Environment and Urban Systems. The head of this office was the highest subcabinet presidential appointee in government whose responsibilities, by title, include environmental concerns.

Too often in the past transportation planners have given more thought to transportation efficiency in the narrow sense than they have given to transportation as an environmental consideration that might profoundly affect the quality of life. Undoubtedly this

kind of focus has progressed partly because of inefficient institutional mechanisms. To investigate this deficiency, my office has been directing an evaluation of the comprehensive urban transportation planning process. There seems to be almost common agreement about the need for something better than that which exists today.

The department's evaluation is based on the process as outlined in Section 134 of the 1962 Federal-Aid Highway Act that called for "a continuous coordinated comprehensive transportation planning process" for those metropolitan areas with more than 50,000 population. This evaluation is aimed at rationalizing all departmental planning assistance programs in urban areas. It is the first such effort to rationalize federal planning assistance programs for transportation. Once such urban transportation planning is rationalized, the Department of Transportation will have made a significant step toward allowing local government to establish intermodal urban systems.

We have already reached preliminary conclusions in this evaluation. The major strengths in the urban transportation planning process that have resulted from Section 134 include its serving as the first major federal stimulation of functional planning for highway, transportation, and land use planning in most urban areas. It has enabled planners to gather economic data to use in highway forecasting. Further, it has provided a formal structure by which state highway departments and local governments can relate to each other and cooperate on highway planning projects. In general, in spite of its shortcomings, it has provided the best highway transportation planning process that has been developed up until this time.

Preliminary findings as to weaknesses in the process have indicated that in most urban areas intermodal transportation planning as a part of area-wide planning is largely a fiction because planning is dominated by the availability of funds for highway programs. Citizens groups and committees seem to have had little impact on coordinating and guiding transportation planning in most urban areas especially in those early stages when many of the major decisions are reached.

Existing planning procedures give too little consideration to new technology and to experimentation with new transportation techniques. Further, most urban transportation study groups do no comprehensive transportation planning and give too little attention to problems relating to public transportation, airport development, water transportation and parking and pedestrian problems. Most have given too little or no attention to the problems of urban goods movement. I know of only a few isolated instances, most of them very recent, where urban goods movement has been studied well and planned within the planning process.

Moreover, at this time environmental factors play little part in the transportation planning process. Most urban transportation planning groups lack the capability to evaluate their own programs because they have neither standards nor goals for their planning activities. Many urban transportation study groups are confused about the roles of the Department of Transportation and the Department of Housing and Urban Development in financing planning and planning for transportation.

It seems to us that a new concept of urban transportation planning, emphasizing the transportation system as an urban development and environmental tool, is badly needed. Urban transportation planning should be a process promoting new systems by which urban areas use transportation to meet other goals for land use, growth, and life style.

The various elements of the department are now examining alternatives and aiming at a single departmental policy statement and guidelines for all federal-aid urban transportation planning. It is also possible that the central target of urban transportation planning assistance should be the development of metropolitan institutions capable of dealing effectively with increasing federal-aid for airports, airport access, highways, and public transportation. Criteria for receipt of federal-aid urban transportation planning funds may well include the following:

1. Capability within one metropolitan area to tie transportation planning to general land use planning, social planning, and metropolitan and environmental goals and objectives (if there is inadequate articulation of metropolitan and environmental goals and objectives, perhaps consideration should be given to withholding approval of federal transportation aid);

2. Capability within one metropolitan institution to reflect accurately the political majorities of each participating local jurisdiction in a uniform and reasonable way and to maintain a viable metropolitan forum for bargaining and decision-making to occur; and
3. Capability of staff to deal with intermodal urban transportation planning and systems planning and to reflect balanced staff capability to deal with performance and external characteristics of various modes and systems.

Those knowledgeable in urban transportation planning will quickly point out that few such metropolitan institutional mechanisms exist at this time. However, alternative strategies to identify and promote viable metropolitan institutions that may have the capability to meet such needs are now being developed. Federal planning aid can help to bring about this institutional response.

Current transportation planning funds appropriated to the Transportation Secretary for use by the various modal administrations represent the source of the department's new urban transportation planning program. Based on the premise that balanced, intermodal planning should occur as a regular process at the urban level, and that federal aid should not contribute to modal distortion in local decisions on transportation, it may develop that any planning fund should avoid modal identification or association.

A new impetus for urban growth through transportation and land use planning and control could be provided by this new program. Because urban form is shaped by transportation systems, each mode having its peculiar effect on land use, then metropolitan areas should have the opportunity to plan and achieve more diversity and opportunity for their people. A larger more flexible transportation planning fund, accompanied by carefully conceived federal criteria and data on the potential growth and environmental effects of various modes in each unique situation, would give new life to the urban planning process.

As I mentioned earlier, I hope to create an overall frame of reference within which there can be discussion of problems of urban goods movement at the local level and of solutions based on an institutional response. Now, let us turn to some indicators of urban goods movement within this perspective.

First, what is the magnitude of goods movement within a typical urban area? A recent report stated that an urban area required an average of 54 tons of inbound and outbound freight per citizen in 1962 (1). The demands of urban areas for basic domestic needs and desires as well as support for commercial and industrial activity seems to increase exponentially as economic growth occurs.

It helps us little to argue that only 10 to 20 percent of daily vehicular count is associated with goods movement. Superficially, this is not surprising; but what does it means as we observe and participate in the terrific congestion that takes place in urban areas? When we experience more and more 6-hour rush hours, is it not indicative of the problems with the overall system? Is it not the interaction of people and goods movement contributing to the difficulty?

These problems seem to proliferate at terminals, freight transfers, and transshipment points. Studies point out that the average urban delivery is 110 lb. It seems particularly inefficient for so many large vehicles to travel significant distances to deliver small loads, then take an average of 23 minutes for unloading and consignment (2). These are real physical problems that promise only to become more prevalent in the future as the demand for goods and services increases. Yet ours is a dilemma: Can physical investments really solve these problems?

I submit to you that fragmented physical and technological approaches to these problems will only serve to prolong the difficulties and continue to choke cities. Although goods movement may be more susceptible to economic analysis than people movement, is not society's entire logistics system actually based on people? Thus, should we not foster the consideration of changing social values in urban planning?

The department's recently completed Center City Transportation Project uncovered many real issues with respect to the interrelationships of people, transportation, and the city. One of the major findings is that institutional and administrative changes are needed to improve transportation within urban areas and to permit the development of

improved distribution and circulation systems. Elements of the city must be made accessible to all other elements; and this requires increased mobility for people and for goods.

Planning for urban goods movement should be incorporated into broader systems planning activity for each metropolitan area. Each community should decide for itself what kinds of problems it has, set priorities for their solutions, and allocate resources for planning and implementation. The federal government should provide the institutional response to minimize the institutional constraints that inhibit this kind of metropolitan development planning process.

Serious consideration has to be given now to the impact on society and on the quality of life that technological innovations may have. We must do a much better job of technology assessment than we have done before. The quality of our urban environment demands it.

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LABOR PRACTICES AND PROBLEMS IN URBAN GOODS MOVEMENT

Abraham Weiss

It is encouraging that the U. S. Department of Transportation and the Canadian Ministry of Transport have sponsored a conference on urban goods movement. As a representative of a labor union whose members are primarily engaged in goods movement and storage, I think our interest in this subject is self-evident. We hope that out of this conference will come a measure of perspective, a more balanced view of urban transportation problems, and a greater awareness that these problems involve not only the movement of people but of goods as well.

It is well known that rapid urbanization has created many transportation problems for metropolitan areas. Most of the attention has been directed to public transit—the movement of people—rather than to the overall urban transportation issue. The lack of free and easy circulation frustrates the whole social and economic edifice of urban centers and leads to decay of metropolitan areas. Moving goods to and from the central city is as important to urban communities as moving people.

Other papers in this report discuss the statistics of urban goods movement; changing patterns in urban growth; shifts in population, employment, retailing, and industry among the cities and the suburbs and the consequences for truck travel; data sources for urban motor truck trips; central business district traffic versus other traffic; and intracity versus intercity movement. My assignment is to discuss labor practices and problems in urban goods movement.

The Teamsters Union has negotiated well over 30,000 collective bargaining contracts, covering both trucking and nontrucking operations in all types of private and public industries. The Teamsters Union is the largest union in the world, with more than 2 million members at the seasonal peak.

The vast number of Teamster agreements in effect and their wide variety and diversity preclude an overall analysis, appraisal, and evaluation of Teamster practices and policies in urban goods movement. The problem is further complicated by the fact that the term "goods movement" has many facets, each of which may have its unique characteristics, mode of operation, bargaining representative, labor contract, and size of bargaining unit. In addition, goods may be transported either (a) by a for-hire carrier, a contract carrier, or a private carrier or (b) by a private firm as distinguished from a governmental agency.

Labor policies and practices in the movement of freight (general commodities) may well differ from those, for example, in route-sales delivery of baked goods, milk and ice cream, soft drinks, and beer to retail stores or to the housewife. Driver-salesman delivery in turn differs from service traffic, such as garbage collection and public utility and road maintenance activities. These activities, in turn, differ from other types of motor truck delivery of merchandise from retail or furniture stores and bulk products such as petroleum products, coal, concrete, and building materials. Still another category of goods movement is service calls by the plumber, TV repairman, or the telephone company. This listing, of course, is not all-inclusive.

The number of labor unions involved in these different types of delivery operations, of course, is substantial. Hence, there exists a broad and diverse spectrum of labor practices and policies, some codified, others informal, that may impinge on urban goods

movement or that, conversely, may be affected by changes in the pattern of urban goods delivery.

A global, comprehensive overview of labor practices and problems in urban goods movement is, therefore, nearly impossible. How, then, do we tackle the issue of labor practices and problems in urban goods movement? The discussion that follows is based on an analysis of the National Master Freight Agreement and various supplemental agreements, negotiated between the Teamsters Union and the trucking industry. This agreement is the broadest based and most significant Teamster contract in urban goods movement. In addition, I shall cover the policy of the Teamsters Union toward technological change.

THE FREIGHT AGREEMENT

The National Master Freight Agreement, together with a series of broad regional supplements, covers more than 400,000 employees engaged in local cartage and over-the-road freight operations. The agreement covers more than 400 Teamster-affiliated locals. Every Teamster local union that has members employed in freight operations, either local cartage or over-the-road, is a party to the agreement, with rare exceptions. More than 12,000 firms—private, common, and contract carriers—are covered by this agreement. First negotiated in 1964, the agreement has since been renegotiated at 3-year intervals in 1967 and again in 1970.

Appended to the National Master Freight Agreement are a number of area or regional supplements for either road operations or local cartage. Some of the area supplements cover an entire region such as the Central States (14 midwestern states) and the Western Conference (13 states in the far west and on the Pacific Coast). Others embrace only a single state (Virginia or West Virginia) or a metropolitan area (San Francisco Bay area or Philadelphia and vicinity).

As of 1967, there were 18 local cartage supplements to the National Master Freight Agreement. These 18 local cartage supplements were reviewed and analyzed to ascertain those contractual provisions that might have a bearing or impact on urban goods movement. These supplements cover freight (general commodities) carriage and not the specialty delivery trades.

In analyzing the local cartage freight supplements, I sought to focus on 2 interrelated items: congestion and its impact on efficiency and on the cost of transporting goods within the metropolitan area, and, conversely, changes in urban goods movement so as to ease congestion and effect economies in goods distribution. In essence, I posed the following questions:

1. What if urban deliveries and shipments of goods were made during nighttime hours or on weekends rather than during congested daylight, Monday-to-Friday hours? If this were done, what labor practices, if any, included in the local cartage agreements would inhibit or prevent or make more costly truck deliveries at hours other than peak hours? In other words, what are the local cartage labor contract provisions that would restrict 7-day, round-the-clock delivery of freight by motor carrier?
2. What labor practices, if any, restrict the use of larger vehicles or tend to reduce the number of vehicles on the streets at any given time and so relieve congestion?

The following findings are based on a review of the 18 local cartage and pickup and delivery supplements to the National Master Freight Agreement with respect to starting times, scheduled work days, premium pay for weekend work, night-shift premiums, and pay differentials for operating large equipment.

Starting Times

Only 3 of the 18 broad regional local cartage supplements prescribed a fixed starting time or times: San Francisco Bay area, Chicago, and New Jersey-New York metropolitan area. In one other supplement (upstate New York) only 1 of the 13 local unions covered has a fixed starting time—between 7:00 and 8:30 a. m.; but the hourly rate for members of this local union is 4 cents an hour less than that for the other locals.

The remaining local cartage supplements either do not mention starting times or refer to starting times in general terms, such as the following from the Western Conference supplement: "Present practice with respect to starting times shall prevail with a maximum of six starting times per day, unless mutually agreed to otherwise. This shall apply separately to drivers and dock in each terminal."

Another illustration, found in the Southwest Areas and the Virginia supplements is as follows: "When the starting time is changed the position will be bulletined as a new position and the employees will be permitted to exercise their seniority." Still another illustration is taken from the Southeast Areas supplement: "At any terminal where 10 or less employees are employed, starting time shall not be subject to bid. Employees are to be notified at the end of the day's work the starting time available for the next day."

Obviously, in these last 2 illustrations, starting times are fixed by management, unilaterally. Moreover, the Western Conference provision for as many as 6 starting times would appear to provide trucking management with sufficient flexibility to adjust its work force to the flow of freight.

Work Week

A fixed Monday-through-Friday work week is prescribed in 9 of the 18 local cartage supplements. Two of these 9 state that the employer will guarantee a 40-hour work week to 80 percent of his employees if they agree to a flexible work week—in one case, Monday through Friday or Tuesday through Saturday, and, in the other case, Monday through Friday or Tuesday through Saturday or Wednesday through Sunday.

The remaining contracts call for any 5 consecutive days; 5 consecutive days Monday through Friday or Tuesday through Saturday; or, in one case, 5 days consecutive if possible within a 7-day period.

Premium Pay for Weekend Work

With respect to premium pay for weekend work for local drivers under the 18 local cartage supplements, 9 provide for premium pay for work on Saturday as such and 12 require premium pay for work on Sunday as such.

Night-Shift Premiums

Only 4 of the 18 local cartage supplements include provision for a night-shift premium amounting to 7½ cents per hour, 10 cents per hour, $1.00 per shift (12½ cents per hour), and 10 percent respectively. The size of the premium is not a deterrent to nighttime delivery or pickup or to sorting freight for delivery next day. The premium is more than offset by the time and fuel savings of deliveries at other than congestion hours.

Pay Differentials for Operating Large Equipment

The fifth subject of investigation dealt with vehicle size and whether Teamster contracts affected the use of larger vehicles. I raise this question because one ought to consider whether urban goods-movement costs and efficiences are affected by the size of motor trucks permitted, for example, in the central business district, the area with which congestion and resultant higher transportation costs are most frequently associated. The assumption is that one should be able to achieve operating economies for a given movement by use of larger equipment, all other things being equal. The assumption is that fewer, though larger, trucks might help to ease congestion on the city streets.

I shall not attempt to determine whether larger equipment per se adds to or relieves congestion. But if larger equipment would yield operating economies in urban goods movement, are there any labor practices that would inhibit the use of such larger equipment?

In local cartage operations, under the various supplements to the National Master Freight Agreement, differential wage rates geared to size of vehicle are found in only

6 of the 18 supplements: Western Conference; Western Pennsylvania (where the sole wage rate distinction is between trucks of whatever size and double bottoms); New Jersey-New York metropolitan area (10 cents an hour differential between straight truck and tractor trailer); Northern New England (in Maine, but not in Vermont, 4 cents an hour differential between straight truck and tractor trailer); Chicago Local Union No. 710 (10 cents per hour differential between straight truck and trailer); and San Francisco Bay area (13 cents an hour differential between vehicles weighing less than and those weighing more than 10,500 lb).

These wage rate differentials for vehicles of larger size or weight are negligible in absolute terms. They can certainly be justified in terms of productivity, and difficulty of handling the larger equipment.

Higher mileage rates in road operations, of course, are paid for the newer types of equipment. The critical issue is, have such differential rates (based on size and cargo) acted to restrain the use of new, larger equipment? The answer is clearly "no." The differentials have been low (⅛ or ¼ cent per mile), and they have remained constant for years. As mileage rates have risen, the relative importance of the differentials for larger sized units has, of course, declined.

With the average trailer today, 40 ft as against only 25 ft 20 to 25 years ago, the differential for the largest tandem units is only 4 percent above the mileage rate for the smallest trucks.

Conclusions

The picture, then, as reflected in these 18 basic local cartage contracts covering the United States is one of considerable flexibility to trucking management in scheduling its work force in terms of scheduled work days, starting times, and night-work operations to meet shipper and customer needs. The Teamsters Union does not limit round-the-clock operations. The docks of all transcontinental carriers run 24 hours a day. Five or 6 shifts a day are scheduled in local delivery and transfer of freight in break-bulk terminals. Freight-handling operations take place during the night in motor carrier terminals.

If a conclusion can be made, it is that in some metropolitan areas Teamster labor practices have some impact on urban goods movement, but the impact tends to be minimal. Certainly, the high degree of flexibility in starting times, coupled with the prevalence of a flexible work week, and the relative absence and small size of night-shift premiums support such a conclusion.

In terms of both the prevalence and the size of wage rates geared to size of equipment, the basic Teamster local cartage agreements pose little problem to the use of larger equipment. This conclusion is equally valid in long-haul, over-the-road freight operations. The rapid expansion of improved highway freight-carrying equipment, such as larger semitrailers, double bottoms, "trains," and triples, indicates that the Teamsters have not resisted their introduction and use.

TEAMSTER POLICY ON TECHNOLOGICAL CHANGE

The Teamsters Union has been quite cooperative in the trucking industry's introduction of technological improvements, new techniques, or other changes in methods of operation to provide faster, more flexible, and more efficient service. This demonstrated by the following 2 brief examples:

1. The National Master Freight Agreement (Article 6, Sec. 4) provides that "Where new types of equipment and/or operations for which rates of pay are not established by this Agreement are put into use, rates governing such operations shall be subject to negotiations between the parties. In the event agreement cannot be reached within 60 days after date such equipment is put into use, the matter may be submitted to the National Grievance Committee for final disposition." Note that the employer is free to install or put new equipment into use, without prior consent or approval. The only issue is the rate of pay applicable to such new equipment or operation.

2. Local cartage agreements used to spell out several work classifications, and employees could not work outside their classifications. This has been modified so that an employee can now work at various jobs, provided he is paid at the highest rate for the work performed. This is particularly helpful to the small firm that does not have the volume to hire a full complement of employees by strict classification.

It is fair and accurate to state that the Teamsters Union has not hindered technological innovation in trucking. The evidence is clearly visible: Trucking units have increased in size, cube, and power. Docks and terminals feature the newest materials-handling equipment. Piggyback is accepted in the industry. We have cooperated with our employers in changes of operations.

Trucking industry spokesmen have publicly acknowledged that the Teamsters take "a realistic and commendable perspective of the values of transportation automation"; that the "leaders of the Teamsters recognize that... restrictive conditions and featherbeds are harmful to the industry..."; that the Union "is exercising the judgment of responsible unionism."

These statements are supported by the findings of impartial scholars. Professor Harold Levinson of the University of Michigan, in his study of collective bargaining in the trucking industry, concluded: "The union has strongly supported the newer technology, sometimes in the face of strong resistance and resentment from local officials and rank and file members." Professor Levinson cites some illustrations. Discussing the introduction of labor-saving devices in terminals, he found that "very little in the way of restrictive practices were found among the companies surveyed. Rather, the local unions were generally receptive to such devices as conveyors and materials-handling equipment which reduced the arduousness of the freight handling tasks." He adds, "The Union has almost always taken the position that terminal consolidations are both necessary and desirable to protect the competitive position of the trucking industry, despite the resulting displacement of some terminal employees."

Professor William Gomberg of the University of Pennsylvania's Wharton School was commissioned by the Secretary of Commerce to study labor-management relations in the transportation industries. He commented as follows on the Teamsters' attitude: "By and large, the Teamsters Union has pursued an attractive economic policy that appeals to a manager's sense of rational economics." He added, "The trucking industry is unique in that it makes up the only group of employers [in the various transportation industries] who express little concern over work rules."

Several years ago, a management research firm, Industrial Relations Counselors, Inc., issued a report that stated as one of its major findings, "With some exceptions, the union's impact on operating matters has not been serious." The report further stated, "In one company after another the behavior of the Teamsters showed it to be a pragmatic union.... many companies give local union leaders credit for their ability to understand distribution economics and to be flexible in job demands, and for living up to their word.... Union representatives understand trucking economics and they are not inclined to force employers into poor decisions.... In the total picture of Teamster activity, work restrictions have not yet become a critical problem for management."

I hope that I do not create the impression of being an apologist for the Teamsters Union or the trucking industry. I have tried to present a factual picture, as reflected in our collective bargaining contracts, because they record the rules and regulations governing our drivers and dockmen in relation to urban goods movement.

The fact is that local trucks and trucking terminals often do operate round the clock. The fact is, too, that trucks add to urban traffic during daytime or peak hours. We all know the reason why. Carriers do not control shippers' or receivers' working hours, their dock facilities, city traffic congestion, or the increased urban sprawl. Commercial and industrial establishments have customary hours of doing business, during which they both receive and ship goods. They dictate when their goods are to be handled. Motor carriers must coordinate deliveries with the practices of those businesses they serve. Therefore, schedules of pickups and deliveries must be adjusted to coincide with the hours that the businesses served are open.

In many cities, freight drivers report that it is difficult to make deliveries after 3:00 p. m. because the customer is at that time preparing to make shipments from the same dock or facilities. Because this is the case, congestion and its accompanying goods transportation costs would be present even if there were no labor contracts, or if labor contracts granted management complete freedom to schedule drivers at any time of the day or night. Trucks would still have to compete, during that same normal working day, with all other vehicles (and persons) using the same streets and roads for commuting, shopping, sightseeing, and all other activities that bring vehicles into urban communities.

The receiver, by his decisions on requested times of delivery, may be the primary determinant of truck-congested streets. It may be worth exploring whether he is cognizant of the costs he is causing.

We believe it important that those responsible for urban transportation planning recognize that shifts and changes in present transport systems have labor and labor relations implications and consequences. We would, therefore, urge such planners to explore the labor issues involved. Every change affects someone's vested interest. A worker has a vested interest in his job. It is this interest that is at the root of the so-called "featherbedding" problem. By the same token, the International Brotherhood of Teamsters is aware that cities must be efficient places to live and to work and that this requires adequate facilities for the expeditious and economical movement of goods as well as the movement of people. We offer our support and cooperation.

INFORMAL DISCUSSION

James Nelson

These very interesting facts and information throw a lot of light on this problem, at least to this economist. It seems to indicate that labor practices in contracts do not seem to be a material factor in this congestion problem.

Weiss

Insofar as this union is concerned.

Nelson

You seem to place responsibility more on the shipper demand situation, the 5-day work week and the 8-hour day, and such other practices of society. This sort of indicates that we ought to work toward changing these things to get less congestion, lower pickup and delivery costs, and lower terminal operation costs and to make cities more livable. Can you particularize a bit? You must have thought of this rather deeply, I am sure. Can you specify the few things along that line that might get at this problem of excessive congestion and high costs?

Weiss

First, several caveats. Although I work for what is essentially a transportation union, I am not a transportation economist. I am a labor economist. My specialty is collective bargaining and labor relations, and I have not, unfortunately, thought deeply about this issue. I would be the last one, because I work for a union that often makes demands on management, to prescribe what other people should do. It is bad enough having to do it in my work relations.

Let us be candid with each other. You and I love a 5-day work week, 8:00 a. m. to 5:00 p. m., and the people I represent love it, too. They know when they go to work for a trucking firm that it is essentially a 7-day, round-the-clock, 24-hour operation. To the fullest extent possible, they hope that, in the course of time as they acquire whiskers or seniority, they can bid on specific runs that have what they would call decent hours, so they can be with their families in the nighttime hours or on weekends.

Now the fellow who runs a little business or a little shop who has to have pickups and deliveries made wants the same amenities of life in terms of when he is going to work and what hours he is going to work. I would be the last one to say, "Hey, look brother, because of the social costs and the economic costs of urban congestion, be a nice guy and have your shop or your store or your plant or your warehouse or what have you open until 11:00 p. m. so that we can either deliver to you or make pickups at these late, out-of-congestion hours." I would be the last one to say to a high-fashion operation, "Sorry, we are not going to deliver to you until 12:00 midnight or 3:00 a. m. even though it means you lose a day of being able to display merchandise to appeal to fashion-conscious women."

I do not know what the answer is. Perhaps central terminals could be an answer, and we would cooperate in serving central terminals. All I am saying is that the finger tends to be pointed at the vehicle and that we should look at what dictates the time and the place that the vehicle is at the particular dock or on the street double-parking and creating congestion.

Let us also look at it from the reverse point of view. Of course, an attempt ought to be made to do something in the way of scheduling to keep as few trucks as possible on the streets during peak hours. But that is going to be of no avail if customer demands (whether receiver or shipper) require the trucker to be there at the time you do not want him to be there. It is as simple as that, and that is all I had in mind.

Charles E. Pixton

You have given us a pretty good rundown on how things stand in 1970. Can you compare what the shifts have been, say from the contracts negotiated in 1967, so we might see how these changes are occurring?

Weiss

The provisions that I summarized for you were taken from agreements current for 1967 to 1970. I could not do that for the 1970 through 1973 agreements because they are not all printed up yet.

Pixton

How about from 1964 to 1967?

Weiss

I would suggest that the quantities and the figures that I gave to you show little, if any, change. In other words, our cartage agreements tend generally to provide for a flexible work week and have tended in the past to have flexible starting times. There has been one shift over time that I ought to mention. A decade or so ago it was much more common to have the wage rate vary with the size of the vehicle. That has diminished. As I recall, there are 6 out of the 18 that have a differential wage rate. In years past there were more agreements that had higher wage rates depending on whether a larger vehicle was driven. This has since diminished. You will recall that in most of the illustrations the only distinction was a straight truck of whatever size and capacity and a tractor-trailer, or between a straight truck and a double-bottom tandem unit. The size of the differential is peanuts, really, in absolute terms or relative terms.

Teamsters have long had the reputation of being reasonable in terms of business dealings with their employers. I think these contracts definitely reflect it, and I am not trying to gild the lily. We are too much in the public eye.

Irving Hoch

You pointed out that New York, Chicago, and San Francisco were the 3 areas with fixed starting times. Does this mean that this is the first-shift starting time, or do you have a second or third shift, or does this mean that everybody starts at that time?

Weiss

It is essentially a first-shift starting time on the West Coast. In the New York-New Jersey area, and I am going by memory now, I think this is a single-shift operation so that if you schedule somebody outside these shift areas you run into premium payments.

Hoch

These seem to be the areas of most congestion in the United States. Although there are only 3 out of the 16 who have the starting time, those three happen to be the crucial ones.

Weiss

All I can do is shrug my shoulders and say this is it. I do not know, because this probably goes back to the myths of antiquity, why there are fixed starting times in these 3 particular communities.

John Clayton

It is possible that there are fixed starting times in these areas because there is a better chance of getting them there than in some other less congested area?

Weiss

There is an assumption explicit in your question: Some cities have congestion problems and others do not, depending on the area of the country in which they are located. I am not sure of that. Certainly in the Midwest there are many cities other than Chicago where there are congestion problems and where there is no limit at all on starting time.

Clayton

My point is that maybe your union is stronger in these areas than any other.

James R. Blaze

I am from Chicago, and the press media has given the impression that the recent Teamster negotiations completed in July were separate in Chicago from the National agreement. Are there other major, substantial differences in the national freight contracts with respect to Chicago Teamsters we should be aware of when analyzing local problems?

Weiss

No. If you were to compare the Chicago local cartage agreement with any other local cartage agreement that is part of the National Master Freight Agreement, the differences would be minor, except for the fact that in Chicago, as I mentioned, there is a fixed starting time. In Chicago also wage rates vary by size or capacity of vehicle.

Edward Margolin

You referred to other unions and other union relations. Is it proper for you to comment on other union activities dealing with the movement of urban freight?

Weiss

The principle of the trade union movement is unity. I am not trying to be facetious. I can only speak with knowledge of one union. Urban goods movement obviously involves other modes, and there are other unions involved. I have neither the time nor the capacity to study their labor practices. It would take a whole classroom of PhD students several years to run through and analyze their practices and procedures to

come out with some summary that could be presented within a reasonable period of time. It seems to me that because you are with the ICC you have read sufficiently of the state of labor relations that exists, for example, between the railroad unions and railroad management. It would be presumptuous and not in a true union spirit for me to comment on it. The maritime union obviously plays a part in urban goods movement. That is a wholly different area of expertise about which I may have some impressions but would not presume to discuss with knowledge and certainty.

Margolin

You remember, I said it might be an improper question.

Weiss

As a matter of fact, as you know, depending on whether one is looking at the East Coast or the West Coast, one can get two divergent and opposing points of view in terms of labor relations practices and their impact on commodity movements. The practices and policies of the International Longshoremen's Association on the East Coast regarding containerization, for example, may differ significantly from those of the International Longshoremen's and Warehousemen's Union on the West Coast. I am sure you are aware of the automation agreement negotiated in the early 1960's between the Pacific Maritime Association and the ILWU. That is why I said a comprehensive overview is just impossible unless several years of study is devoted to it.

J. Douglas Carroll

Are the Canadian practices different?

Weiss

I have not had too much experience in working with our Canadian cohorts. I would be inclined to think not. I have had only one experience in the Canadian freight industry and that was just a few years ago in helping our locals negotiate an Ontario-wide freight agreement that included a cost-of-living clause and parity with U. S. rates. I have not looked at their agreements in any specific detail, but I think the general policy would tend to prevail. We know that this is a round-the-clock, 7-day operation.

Marvin L. Manheim

It seems to me that one kind of principle that is emerging in bits and pieces is the principle you enunciated that any technological innovation in transportation should have its return split in some way between management and labor. Can you see emerging a pattern, perhaps, whereby there might be a general productivity or profit-increase clause in the agreement that is more general than specific agreement on piggyback or any other issue on which there is a basic ground-rule laid down. For example, if an innovation is implemented and there is an increase in profit (there may be some other measure), then X percent of that should go to the union and the other percentage should go to management? Is it possible to formulate such a clause?

Weiss

I do not know of any and I do not anticipate it for this reason: Innovation does not necessarily come in dramatic, one-shot, instantaneous forms such as piggyback. It may be the accumulation of a whole series of moves that have adverse employment consequences for people in particular plants or establishments. Moreover, unless one is a super cost accountant, how does one ascertain or put a price tag on the savings flowing from a given type of innovation? I will not even use technological innovation, but generalize to any innovation. Moreover, a firm's profit can be determined by so many factors that have nothing to do with innovation or that may have nothing to do with managerial expertise and competition.

For example, suppose you are a garment manufacturer and you read in Women's Wear Daily that every woman in the United States is going to wear the midi. So you buy your goods and materials and you instruct your cutters to cut only midis and you have your seamstresses sew them up. You have an inventory of thousands or millions of dollars in midis, but American women say "Nuts, we are going to continue to wear minis and we are going to wear pants suits." Now, you could be forced to the wall because you have obligated resources to a product that is not going to sell. How under these circumstances are you going to get a union to agree to a fixed allocation "savings" flowing from a particular innovation or modification, whether it be tangible or intangible and whether it be a one shot or the result of many, many steps?

There is, however, developing in American industrial relations the concept that workers have a vested right in their jobs and that an employer, in order to gain flexibility in his operations of whatever type (and I am not now limiting this to transportation), in a sense has to either buy out any union restrictions or limitations or inhibitions in order to give himself maximum flexibility or dispense with part of his work force or do both. This is receiving more and more credence, it is being discussed more and more at industrial relations conferences, and it is reflected more and more in labor contracts. The ILWU Pacific Maritime Agreement, to which I referred earlier, recognized that principle explicitly in numerous aspects. It is a forward-looking step.

In a nutshell, to answer your question, there is developing, and we see concrete evidence of it, a doctrine of buying out workers' vested rights, whether it be in performing a specific job in a particular way or easing him out through severance pay or early retirement. The UAW contracts give a worker a pension of X dollars a month but, if under certain circumstances he loses his job because of conditions over which he has no control (for example, the closing down of a plant), the UAW pension plan provides an early retirement pension that is greater in amount than his normal retirement pension. This is explicit recognition of the vested interest and the buy-out principle.

IMPROVEMENTS AND INNOVATIONS IN URBAN GOODS MOVEMENT

C. Kenneth Orski and Wolfgang Jakobsberg

Our purpose is to share with you some of the thoughts that emerged from a recent meeting on urban goods movement sponsored by the Organisation for International Cooperation and Development.

The OECD is an intergovernmental body having as members 22 of the leading industrial nations of the world. Its primary objectives are to promote a high rate of economic growth, financial stability, and expansion of world trade among its member countries and to assess the implications of growth for economic, social, environmental, and technological policies. The OECD's interest in transportation stems from the realization that transportation activities, accounting as they do for some 20 percent of the Gross National Product, are bound to have a major influence on economic development and investment decisions of industrialized nations. Because most of the growth is taking place in high-denstiy population areas, it follows that OECD has focused its attention particularly on the problems of urban transportation. The activities of OECD in transportation are conducted under the aegis of the Consultative Group on Transportation Research, a group of high-level officials who meet periodically for consultations, policy discussions, and exchange of experience on problems of common interest.

Among the Consultative Group's activities are the so-called "policy assessments"—discussions in which a subject of major interest from the investment policy or planning viewpoint is explored in as much depth as can be achieved by careful preparation and intensive discussions lasting up to 2 working days. Emphasis is placed on innovative ideas, techniques, and policies that have been already put to test and that can thus be evaluated on the basis of practical experience. These assessments are designed to provide senior officials a convenient means of keeping abreast of new developments around the world, and of assessing the effectiveness of their own policies and programs in comparison with those of other governments. In this way, the Consultative Group has examined and reported on urban bus policy, new approaches to transport in major activity centers, policies concerned with the improvement of airport access, and policies for urban transport of goods.

The assessment on urban goods movement covered the following 3 major topics: the problem of urban goods movement, near-term transportation improvements, and long-range transportation improvements. The discussion on the urban goods-movement problem, to which approximately half of the OECD meeting was devoted, will not be reported here in detail because we consider this redundant to the other presentations at this meeting. We will limit ourselves only to a set of general observations—just enough to place our discussion on technical innovations into perspective.

SALIENT FEATURES OF THE GOODS-MOVEMENT PHENOMENA

The discussion on the urban goods movement produced the following insights into the current situation and future trends:

1. Urban movement of goods can be divided into 2 types of flows: (a) the flow of commodities into and out of a circumscribed urban region, sometimes referred to as a "cordon area," and (b) the circulation or redistribution of the goods within the

circumscribed urban region. The flow of goods into and out of a cordon area is characterized by bulk shipments of a single commodity utilizing large capacity transportation systems. These transportation systems comprise every mode from truck to pipeline, although the former predominates. In contrast, the recirculation of goods within the region is characterized by relatively small shipments, utilizing trucks almost exclusively.

2. The requirement each of these 2 categories of urban goods movement imposes on the urban environment is quite different. Flows into and out of the urban area, because of the large capacity of the vehicle used, require special loading and unloading facilities to receive and disaggregate the shipments. When such facilities are absent, the processing time for goods becomes excessive, imposing penalties in productivity. Although the shipment of goods within the urban region can advantageously utilize such special loading and unloading facilities, their absence is less debilitating to the efficient processing of goods. On the other hand, the wide dispersal of retail outlets and goods users requires a far greater number of delivery vehicles for handling the smaller shipments than for bringing the commodities to the cordon area. This brings with it such social costs as traffic congestion, pollution, and noise.

3. The consumption of commodities within the urban area seems to lend itself to large-scale statistical analysis and forecasting. Some of the OECD presentations have shown that the relative ranking of goods consumption is similar over a wide range of communities in different countries. For a cordon area, the amount of each type of commodity that flows into it can be estimated with considerable precision. In contrast, the time and space in which these goods are consumed within the urban areas are subject to many variables and defy accurate prediction. What this means is that large capacity goods movements into and out of an urban area can be anticipated with considerably higher confidence than the movements associated with the redistribution of those goods within the area. The inability to anticipate microdemands, coupled with the inability of the current distribution techniques to respond quickly to the individual user demands, means that adequate inventories and space to contain them must be maintained.

4. The movement of goods into an urban area and out of the urban area is accomplished by many modes. Each mode specializes in the movement of specific commodities over distances peculiar to that mode. Ships and railroads tend to move bulk cargo in very large quantities over very long distances because they are specifically designed to handle these movements economically. Trucks move smaller bulk commodity shipments from widely dispersed areas into the urban region. Aircraft shipments are economical over relatively long distances and for small volume commodities whose delivery time is critical. Pipelines move bulk liquids over medium distances where the use is fairly continuous.

5. Distribution of commodities within the urban area is predominantly by truck because only they can provide the needed flexibility to serve widely dispersed outlets for those commodities. Small 4-tired delivery vehicles predominate but move only a small percentage of the total tonnage (1, 2). The proliferation of small trucks is a response to the wide dispersal of consignees within the urban area. The underutilization of the capacity of these trucks causes congestion and unnecessary transportation expense.

The remainder of this paper will be devoted to a presentation of various suggestions for improving the distribution of commodities within the urban area. No further reference will be made to the inflow of goods into the cordon area. Improvements in the transport of commodities within urban areas may take 2 forms: (a) near-term improvements utilizing current facilities and conventional technologies for moving goods, and (b) long-term improvements requiring replacement, adaptation, or conversion of existing facilities, or applying technology that is not currently used for goods transport.

NEAR-TERM IMPROVEMENTS: MANAGEMENT SCHEMES

Two courses of action have been advanced for achieving short-term improvements in the flow of commodities within the urban area. The first involves better management of the goods transportation resources within the urban area. The second involves

facility improvements for loading and unloading the goods at warehouses and at retail distribution outlets.

The management schemes attempt to sort out the goods-distribution activity from other urban activities with which they interfere. The schemes can be divided into those that attempt to reduce the interference by spatial separation and those that do so by temporal separation.

Evening Deliveries

Examples of temporal separation between goods distribution and other urban activities were mentioned by many representatives at the OECD technology assessment. All of the schemes mentioned involved rescheduling the delivery of goods to evening hours, taking advantage of reduced urban traffic density. Goods are delivered to shops within the urban area in the late evening hours. The consignees of the goods either have to remain open to receive the goods when they arrive, or they have to make special arrangements to have the goods stored in specially secured containers.

A large-scale experiment of this type was tried during the period of January to June 1968 in London (3). Known as "Operation Moondrop," the experiment involved evening delivery of goods to 95 individual stores and 6 warehouses. London was divided into 4 delivery zones corresponding to 4 geographic quadrants. Each delivery zone was supplied on one day of the week, starting with Monday and running through Thursday. On the day when the store could expect a delivery it was required to remain open an additional 4 hours from 6:00 p.m. to 10:00 p.m. A clearinghouse accepted orders for deliveries and routed these requests to the individual distributors who then took care of them on the next scheduled delivery day.

The experiment was beset by a number of difficulties that kept it from being adopted as a permanent scheme. One difficulty was the low quantity of goods that were handled at any one shipment. Even accounting for the fact that some deliveries continued to be received during the day and that 1 of the 4 major suppliers was unable to participate in the experiment, the volume of goods moved was too small and the distances between stops were too long. As a consequence, the nighttime delivery costs to the supplier were more than one-third higher than the costs of daytime deliveries. The only way to overcome the high delivery costs would have been a wider participation by more shops, but this did not occur. On the contrary, by the sixth week of operation, 14 percent of the smaller shops in the more outlying regions of the supply area had withdrawn from the experiment, further aggravating the economics of the scheme. By the end of 2 months, it became evident that, if the scheme were to be expanded and therefore made more economical, it would have to show some economic success, which of course was prevented by the eroding patronage.

There were other operational problems that beset the experiment and that contributed to its ineffectiveness. The absence of scheduled deliveries to individual shops caused queuing at many delivery stops and delays in loading and unloading. Because the distances between shops were long, drivers preferred to wait and accept the delay rather than to reschedule themselves to another store. Although individual delivery delays averaged only between 5 and 10 minutes per call, their cumulative effect was apparently high. A major contribution to the increased delivery costs was the cost of paying staff overtime for the extra 4 hours during which the shop remained open to accept deliveries. Besides the overtime cost, the inconvenience of having to be there was too great a burden for many store managers.

Management schemes that are based on rescheduling delivery of goods or reducing the interference between the environment and goods delivery currently fail because of the high costs that they present both to the owner of the transportation system and to the consignee. The cost burdens stem from the size of the shipment and the current dispersal of the origins of those shipments. One of the studies presented at the OECD meeting (1) confirmed that in the Tri-State region single shipments are pitifully small and that there is a long procession of trucks that drop little loads off at individual stores. Similar conclusions were drawn by representatives from Germany and France. Simple rescheduling of this mass of trucks will not improve congestion or the economics of goods delivery.

Consolidated Deliveries and Transshipment Centers

Several of the speakers at the OECD meeting proposed that small shipments be aggregated into larger shipments. A grocery store receiving dairy products, canned goods, and bread in separate shipments would receive instead one delivery that contained all those items. This system was reported to be under investigation by the Tri-State Transportation Commission, which has developed a computer model for analyzing the shipment consolidation scheme (1). The model has developed a drastically altered pickup and delivery route pattern in which a single truck would service all the small shipment needs of a particular delivery zone. Supporting the new loading pattern would be a system of sorting terminals, each of which would serve one cluster of delivery consignments. The model estimated an overall cost savings of some 12 percent and an improvement in social costs from reduced air pollution and congestion. The total waiting time at the curb was reduced by approximately 50 percent and the running time was reduced by 90 percent.

Although the model showed that most of the cost savings were needed to operate the much more complex terminal functions, the importance of the conclusions was to point out radically new ways for rearranging activities in the urban environment. By sorting out freight in specialized structures and off the street, the operation can be done at all hours under conditions that are specially suited to such activity. These improvements could all be attained without affecting the current working hours of either the shipper or the individual receiving the consignments. In addition, it offers an opportunity for introducing into the urban freight system such innovations as automated billing and collecting, real-time shipment control, and other efficiency-raising improvements. Except for the addition of the transshipment facility, all of this can be achieved within the current technology.

In a limited form, such transshipment stations have recently gone into operation at both Orly and Le Bourget airports. The 2 transshipment stations are serviced by rail and air transport systems, but the proportion of the commodity traffic serving Paris is below what has been expected for these transshipment centers. There is some evidence that the 2 transshipment centers are not optimally located. The routes leading from them into Paris are increasingly used by private automobiles traveling between Paris and the airports.

Transshipment centers have also been studied for several large cities in Belgium such as Brussels and Antwerp. In Brussels, which has superhighways traversing right through the center of the city, the location of transshipment terminals with the center city has been envisaged.

The use of transshipment centers is consonant with the growing trend toward consolidation of retail outlets in urban areas. It is capable of improving distribution costs and reducing congestion by eliminating the need for many delivery vehicles. It will never eliminate all of the congestion and, unless it is coupled with off-hours delivery and its attendant diseconomies, it cannot bridge the loading and unloading difficulties. The latter are intimately associated with the amount of space that is available for docking in urban areas.

An improvement that, when combined with the transshipment center concept, could further reduce congestion and loading and unloading times is the construction of special loading and unloading docks as integral parts of buildings. The Canadian Trucking Association (2) reported to the OECD meeting that one of the more serious impediments to the efficient distribution within the CBD is the absence of proper facilities for accepting goods. Research sponsored by them into the characteristics of truck stops around the city center of Toronto revealed that the number of deliveries was highest for office buildings and consisted largely of office supplies and related requirements of office workers. In the city of Toronto there was a high correlation between floor space and the number of stops a truck made at a building. In most instances these buildings were found to have insufficient space dedicated to loading and unloading merchandise. Facilities that are needed consist of space exclusively dedicated to goods loading and unloading and designed to fit the loading geometrics of the delivery trucks servicing those buildings.

Conclusion

No matter how it is done, there is a certain volume of goods that must be distributed among a given number of retail outlets within a given urban area. As long as road transportation is used, the space required to move this volume of goods will always interfere with the space needed for other vehicles. Therefore, the management schemes discussed at the OECD meeting, although offering some dramatic and comparatively immediate improvements in the efficient flow of goods within an urban area, ultimately offer only limited respite from current problems of high distribution costs and congestion. Many of the participants at the meeting expressed the fear that these short-term gains will be erased by the increasing volume of goods that will have to be moved to satisfy the higher consumption patterns and the expansion of urban population and densities in the years to come.

LONG-RANGE IMPROVEMENTS

Two kinds of long-range improvements in urban goods movement were discussed at the OECD meeting. The first kind involves adapting existing transportation facilities in urban areas to the transport of commodities as well as of passengers. The second kind of innovation involves supplementing (or, in the long run, replacing) existing goods-movement facilities with new systems that do not interfere with current surface modes of transportation.

Use of Public Transit

Use of public transit systems for goods delivery within urban areas has been proposed on many occasions. By and large, urban planners reject this as a solution to the goods-movement problem. Their objections are many and varied and not always consistent. Some are skeptical about the volume of commodities that would be made available for transportation by public transit; others think that freight demands would impose an intolerable burden on the already overloaded passenger facilities. Others still fear that the dispersion of origins and destinations would make such a distribution system operationally impractical. Another caveat often raised is that the additional physical facilities needed for adapting transit system technology to goods movement would be prohibitively expensive, especially in areas where such public transportation systems already exist. Finally, the critics express uncertainty over practicality of using public transit systems for such diverse purposes and express the fear that the already low level of service enjoyed by today's patrons of transit systems will be further eroded.

All of these objections are valid and cannot be rejected. But, neither should the potentiality of certain benefits be dismissed right out of hand. Currently, transit systems operate far below capacity for between 50 and 75 percent of the time. It seems only reasonable that alternative ways of using this excess off-peak capacity to raise revenue should help improve transit system productivity in a major way. The movement of freight does offer such additional revenue. Whether the costs of the additional facilities needed would offset the amount of revenue that would be derived from freight movement is a question that has to our knowledge never been answered in a thoroughly analytical fashion. However, it is conceivable that operating revenues from commodity shipment could even rise to a level where better amenities and higher level of service for public transit patrons could be extended.

Most importantly, the distribution of goods via public transportation systems could have a significant effect on alleviating traffic congestion and its externalities in urban areas. The number of trucks could be reduced not only by diverting commodities to the underground but also, in cities that do not have a subway network, by utilizing excess capacity of surface public transport.

Clearly, the pros and cons will never be sorted out until a thorough systematic series of studies is undertaken from which operational and economic answers are progressively derived.

Pipelines

Another system proposed at the OECD meeting entails a network of concrete pipelines that would run underground and connect goods distribution depots with large consignees within the urban area (4). In essence, such a system would not be too dissimilar from the concrete sewer pipes that traverse cities today, except that these pipes would be used for goods distribution. The concrete pipelines would be about 6½ ft in diameter.

Two concepts have been considered in Canada for using concrete pipelines for the movement of freight. One concept envisions freight being shipped in standard containers moved through the pipeline on powered, wheeled conveyors. A second concept envisions handling noncontainerized freight in "banded" consignments running on powered rollers or a bolt conveyor.

Preliminary studies of the concepts indicate that with the containerized freight distribution concept a Canadian city of 500,000 population consuming approximately 25,000 tons of commodities per day could be served by a system that is capable of moving 600 containers per peak hour. The containerized system proposed appears capable of achieving this throughput and doing so with acceptable headways, practical acceleration and deceleration profiles, and velocities of 3 to 5 mph. The "banded" system has a similar throughput capacity. Either concept is well within the state of today's technology.

The elimination of goods-distribution equipment and facilities from surface streets removes the interference that goods distribution currently causes with other traffic. The reduction in social costs is also inherent in the 2 concepts. It remains to be shown whether the economics of the system will justify its consideration and whether its reliability can compete with the current goods-distribution system.

Etarea: An Unconventional Goods-Distribution System

A proposal for an entirely new goods-distribution system was studied and proposed for a new town, Etarea in Czechoslovakia (5). The new town of Etarea was a theoretical design exercise conducted by a planning team at the Prague Institute of Architectural Design who was assisted by specialists, architects, and engineers from other Czechoslovakian research and design institutes.

The new town of Etarea was designed for a site south of Prague and was intended to serve as a study to test new systems to raise the quality of urban life. Etarea was designed as an urban unit for approximately 135,000 inhabitants located 10 miles south of Prague to which it is connected by a fast and frequent rapid transit system. The general plan of Etarea is based on 13 housing districts, each having its own town center and each having a residential district of approximately 10,000 population of which 5,000 were planned to live in the town center. The town center and 10 of the district centers are linked by branches of a rail rapid transit system connecting Etarea to the center of Prague.

A pneumatic-tube, household goods-distribution system is intended to be 1 of 4 shopping methods available to the inhabitants of Etarea. The pneumatic system consists of 19 delivery pipelines and the same number of return pipelines. Each of these pipelines supplies 100 flats. The deliveries within a pipeline can follow at 20-second intervals so that for 100 flats 180 deliveries per hour can be made in containers capable of delivering a weight of 4 kg.

The shipments transported through the pneumatic tube originate from 1 of 2 district distribution centers. The items in this center are referenced in a catalog, a copy of which is available in every flat serviced by that distribution center. A householder would be able to use this system to avail himself of some 600 different types of basic everyday commodities and by means of the pipeline, obtain delivery within 3 to 12 minutes after placing the order. Included among these commodities would be groceries, prepared and semiprepared foodstuffs, nonprescription medicines, cosmetic items, newspapers, magazines, and postal deliveries.

Supporting the pneumatic tube system are trucks and other forms of surface transportation that connect the district centers. In addition, the 13 district centers and the center are linked by an underground system of automatically controlled, electric

battery-operated trolleys running in underground tubes 2 meters in diameter. This delivery system supplies 2 distribution centers in each district center, one for foodstuffs and medicines, another for manufactured items, newspapers, tobacco, and the like. The automatic delivery of mail is carried out from this second center.

Although the goods-distribution system for the town of Etarea seems illusory, the technology on which it was designed exists. It was brought out at the OECD meeting that an automated warehouse for delivering groceries has been constructed in San Diego, California. This warehouse features automatic recording and processing of orders from subscribing customers who order groceries from a catalog via telephone. A computer controls the filling of the order and the routing and scheduling of delivery vehicles. The warehouse is equipped with conveyors and other automated materials-handling systems, which assists the handlers in compiling the order. Actual delivery is made by conventional delivery trucks.

Automatic System for Solid Waste Disposal

Another radical system described at the OECD meeting has progressed beyond the conceptual stage and is, in fact, in commercial operation. A. P. Contralsug in Sweden has developed an automatic system for collecting solid waste and transporting it to points where it can be disposed (6). By the manufacturer's own description, the system can be compared to a giant vacuum cleaner. Each flat has an individual refuse chute. Each chute is connected by a vertical tube to a large, curved section of tube that contains a hydraulically operated valve and connects the chute to the waste delivery pipe. Three or four times per day, or as programmed, the valve opens automatically, the refuse in the tube falls by gravity into the horizontal delivery tube and is sucked up at a speed of 20 meters per second into a silo. At the end of 20 seconds the valve closes and the next one is opened. For a system that services 4,000 flats, the whole program of emptying the chutes is completed in approximately 1 hour.

The system, as described here, is in production and the first one was installed in a section of the town of Sunbyberg. It has been working for 3 years and serves 1,200 flats. In 1970, 2,000 more flats will be connected to it and, by 1974, another 2,000 flats will be added to the system. The system is very flexible and can cope with expansions in the amount of waste as well as in number of subscribers. For individual, one-family houses, a collecting unit may be used that serves several houses.

The installation of the system in Sweden has shown that it costs approximately 1 percent of the total cost of the flat to install this system, that is, approximately $400 or the equivalent to $4 per square meter. On developer, who was interested in applying the automated waste disposal system to 1,100 garden apartments, found that the system would pay for itself after the third year of operation. These calculations were based on a 6 percent annual escalation in the costs of conventional waste handling.

The system will be introduced in the Swedish new town of Jarva and in the new Disneyland now under development near Orlando, Florida. It is also going to be installed in England in the county of Westminster in London. Plans are under way in Germany to install the system in Munich in time for the 1972 Olympic Games, and similar interest is being expressed for an installation in Grenoble, France.

CONCLUSION

In November 1967, a panel of distinguished transportation experts met in OECD to assess future needs and directions for research in urban transportation. Let me quote an excerpt from the Panel's report (7):

> Although the Panel tried to take a comprehensive view of research requirements in urban transportation, it left out one very important aspect from detailed consideration: that of urban freight transportation. The absence of specific recommendations on this point should not be construed as implying that the Panel believed this subject to be adequately dealt with already. Quite the contrary, the problem of urban distribution of goods remains largely unexplored, and the Panel's inability to treat this matter in detail can be taken as tacit evidence of the lack of an informed body of knowledge on the subject. Yet, the movement of goods in cities is so closely related to the move-

ment of people, that a study of urban transportation requirements which neglects to take freight into account can be quite misleading. This is why a systematic inquiry into the problems of urban freight transportation is, in the Panel's opinion, a very urgent necessity.

The Panel went on to suggest that more research is needed particularly on trip generation characteristics of various land uses, on modal allocation of freight demand, on more efficient operating procedures and use of existing facilities (e.g., improved scheduling of deliveries, consolidation of loads, and use of the underground during night hours), and on substitute freight transport technologies, notably pipeline movement in containers.

This conference marked an auspicious beginning of such an inquiry. The question that remains is whether we possess the ingenuity and the will to apply the improved understanding that will inevitably arise from these efforts to the solution of the real-life problem of goods movement in our cities. The challenge is only partly technological. As the OECD assessment clearly brought out, virtually all of the foreseeable improvements in goods transport are within the existing state of the art. The key problem resides rather in the large uncertainties surrounding the introduction of major changes in the existing goods-movement system: uncertainties concerning the feasibility of inserting an unconventional system into the city fabric, of integrating it with the existing city-wide transportation network, and of operating it as an economically viable service. In this respect, however, the challenge of improving goods movement is no different from the challenge of improving people movement. Both require institutional means and government incentives for testing and evaluating innovative schemes and for creating a market for new systems and technology. Perhaps what is needed most, therefore, is greater flexibility in the administration of the existing federal demonstration grants and financial assistance to urban public transportation systems to permit their use to demonstrate improvements in goods as well as passenger transportation systems and technology, and for the planning and implementation of integrated passenger-freight urban transportation facilities and equipment.

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James Nelson

Why does one have to consider, if one does, the London experiment a failure because it raised the cost? The problem of most of our urgent transport problems is to internalize externalities, and this is going to raise the cost. Why can we not face this?

Orski

I am quite sympathetic with that argument. I called it a failure on practical grounds; namely, the shopkeepers were unwilling to continue the scheme on a personal basis. There was no attempt made to legislate or enforce this scheme. One might conceive of institutionalizing this kind of system, either by creating the necessary economic incentives or disincentives. However, the way the experiment was set up in London, it was an entirely voluntary, nonincentive scheme. Because it did not work out, it did not elicit the shopkeepers' support. There was no other conclusion to be drawn, but that it was a failure in that sense of the word.

Bruce Goeller

With respect to the problems of innovation, it is important to distinguish the different instruments one has available for encouraging innovation and their different impacts. For example, if one uses legislative standards one may get compatible, similar kinds of modernization. If one uses accelerated tax write-offs, one may promote very highly individual kinds of responses to the same problem. So it is important to look at the differential effects of the different instruments available and pick the best one.

With respect to freight-passenger vehicle combination, it is important to make the distinction between the integrated vehicle, the vehicle that may simultaneously carry passenger and freight traffic, and the convertible vehicle. An example would be the European articulated bus, which is basically a tractor on which one can put either a freight trailer or a passenger trailer. The convertible systems and the integrated systems have entirely different problems with respect to how costs are shared among the different users. It is easier for convertible systems.

There is also the question of labor problems. If one is dealing with both freight and passenger traffic on the same vehicle, would there be justificational disputes among the unions or what?

Orski

I recognize all these arguments, and my plea was really for a systematic, dispassionate analysis of the problem and not necessarily for the adoption of such a scheme as a solution to urban goods-movement problems. I might say that even a small incremental improvement like designing buses to enable shoppers to carry packages in a more convenient way would be a contribution to solving the problem.

J. Douglas Carroll

Will you distinguish between your recommendation for analysis and for experiment? I am not sure which you stress.

Orski

To me, analysis and experiment are really intimately tied together. It seems to me that we must get away from theoretical analysis into the field of experimentation. Unless some city or public body is innovative and imaginative enough to be willing to try out such a scheme, I think no amount of theoretical analysis will convince the politicians and the decision-makers that this is indeed feasible. I guess my ultimate plea is for an urban goods transportation demonstration program.

Donald M. Hill

An analysis was made by Rouse and Company in connection with a new town, Columbia, which is being built midway between Baltimore and Washington. The analysis was done with an Urban Mass Transportation Administration technical grant. The conclusions are that it is feasible to develop a system that will move both people and goods on a completely reserved right-of-way within the complex of the town. The kinds of vehicle systems they are thinking of are comparable to a dial-a-bus concept where one dials for the service. A replaceable cab could be used either for people or for goods, depending on the delivery requirement. The experiment is proposed, and at this point requires action. As far as I know, the developer and his partner, Connecticut General, do want to proceed with it.

Dale L. Anderson

I do not want to leave this London experiment on a sour note of failure. I would like to point out that the American food chains for over 20 years have successfully used a night-drop trailer system in which one trailerload of goods is dropped and another one loaded with by-products is picked up. They have also successfully used the key room, which is a trailer room locked essentially from 2 sides. A perishable product is dropped into it in the middle of the night and locked in place. In the morning the store opens the other door and brings the goods out. Many chains have done this for many years and do not consider it an experiment anymore.

John Clayton

For many years flowers have been delivered just by dropping them on the sidewalk in front of the florist establishment. I am not certain but I think to some extent they are still delivered in the same fashion.

CHANGING URBAN STRUCTURE AND ITS IMPLICATIONS FOR TERMINALS AND PICKUP AND DELIVERY PROBLEMS IN METROPOLITAN AREAS

Harold M. Mayer

Within the past 2 decades, tremendous advances have been made both in our understanding of the relationships between transportation and urban structure and in the methods for study of such relationships. The traffic flow studies of the period prior to World War II evolved into the origin-destination studies of urban areas during the immediate post-war period from about 1945 until the mid-1950's. These, in turn, were expanded into the comprehensive transportation-land use studies, such as those in the Detroit, Chicago, Pittsburgh, and Philadelphia areas, during the decade between about 1955 and 1965. Since 1965, such studies have become integral parts of the comprehensive planning process, and, indeed, have become indispensable prerequisites for securing, by local governmental agencies, of federal assistance for a wide variety of programs and projects in metropolitan areas, without which the development of such areas could not, in most instances, effectively proceed.

As a result of such studies, we know a great deal about the structure of cities and metropolitan areas and about the roles of various patterns of land uses and economic activities in the generation of traffic flows. We can project, with reasonable accuracy, the traffic that may be expected to be generated by various combinations of land uses at various densities and at various distances apart; we can test alternative patterns in terms of the optimal systems of traffic facilities as the basis for metropolitan planning. Indeed, such testing has become virtually standardized and is an accepted part of the planning process. The methods of conducting such planning studies are constantly being improved, and the assumptions and hypotheses relative to the relationships among land use, locations of activities, and internal and external flows that they generate are being constantly refined.

The movement of persons is generally much better understood than the movement of goods. While the origin-destination surveys and the comprehensive metropolitan transportation-land use studies have produced vast quantities of information about the demographic and occupational characteristics of persons making trips as well as the purposes of the trips, information about the characteristics of goods movements is, by comparison, seriously deficient. We have, in most of the metropolitan areas that have been subjected to comprehensive studies, data on truck movements and information as to whether the trucks were loaded or empty, but data on commodities are generally either unavailable or fragmentary.

SYSTEMS OF METROPOLITAN COMMODITY FLOW

The difficulties of gathering and analyzing data on the flows of goods into, within, and out of cities and metropolitan areas are, in several significant respects, considerably greater than the difficulties of gathering, processing, and interpreting data on person movements. A person is a discrete entity, and the passenger-mile is a single unit. On the other hand, goods are of infinite variety, and the significance of a ton-mile will vary widely, depending on the nature of the good: whether it is package freight, dry bulk, or liquid; whether it is of high value in proportion to bulk, or of low value; whether it

moves in less-than-truckload or less-than-carload or in truckload or carload lots; whether it is changed in form en route or at intermediate stages in the production chain; or whether it proceeds without break-of-bulk. Some progress has been made in uniform classification and in coding of the infinite variety of goods for statistical studies, and a beginning is being made in the gathering of data for urban planning purposes in this field, but for the most part, the difficulties remain.

The alteration in the form of goods, as the result both of break-of-bulk and of processing, poses formidable obstacles in the study of the significance of goods movement in city and metropolitan planning. For example, it is well known that urban areas generally receive far greater tonnages of freight than they ship out and that the unbalance creates major problems for the carriers in the form of low outbound load factors and, hence, underutilization of equipment. This is particularly true for those carriers primarily concerned with the transportation of bulk commodities, including grains, ores, and fossil fuels. In the processing and utilization of these commodities there is, of course, a reduction in bulk, and the outbound movements of the processed goods and the products constitute far less tonnage than the inbound movements.

This unbalance, however, varies by type of carrier. Trucks, whose flexibility permits relatively economic utilization for movement of manufactured products in contrast to that permitted by the relative inflexibility but scale economies of ships, barges, trains, and pipelines, show less unbalance directionally than do those modes that are more adapted to bulk transportation. Nevertheless, all urban areas consume more tonnage than they produce, insofar as the total of all carriers is concerned. The difference, however, is not usually considered in terms of transportation requirements, for it is predominantly in the form of wastes: liquid wastes, which are disposed of in the oceans, lakes, and streams; gaseous and small-particulate solid wastes, which are disposed of in the air; and solid wastes, which are disposed of in bodies of water as solutions, suspensions, or solid fill, or on land as fill, "sanitary" or otherwise.

We know very little about the movement of materials in the urban systems. How much of the waste material is, or can be, recycled? What are the transportation requirements of a city or metropolitan area for various levels of recycling? How would more effective conservation measures, brought about in part as a result of the increasing concern for environmental quality, affect the total demand for transportation services for waste and recycled products in metropolitan areas? Where should the waste products be utilized in subsequent processes, and how would the location of such processing facilities affect the quantity, character, amount, and location of the transportation facilities required? It is evident that comprehensive studies of the complete cycles of movement of materials of all kinds are required. For these studies, there is urgent need for the development of techniques for gathering and analyzing flow data.

In several respects, our present knowledge of environmental quality in relation to urban land uses and densities is not unlike our knowledge of traffic generation as a function of the same variables. These are interdependent; because there are reciprocal relationships, none can be regarded as an independent variable. Just as accessibility takes 2 forms—mutual proximity, as expressed in land values and densities on the one hand, and flows, as expressed in transportation and communication costs on the other—so air pollution, for example, has a limiting or inhibiting effect on development, which ultimately may be reflected in ceilings on density of both land use and traffic, and which, in turn, may limit the desirability, and hence the land values, of central-city locations. Costs of pollution control to an individual establishment may not be completely unrelated to density, which, in turn, is related to accessibility.

The dichotomy of centripetal and centrifugal forces in the shaping of cities and metropolitan areas applies to both forms of access; it is as applicable to patterns of density of air and water movements as it is to movements of automobiles, trucks, or railroad commuters.

If we are to understand the role of commodity flows and goods movements in urban and metropolitan growth and development, we cannot confine our concern to conventional modes on fixed routes, whether common, contract, or private carrier. The total urban environment must be considered. The potentialities of such an approach are demonstrated in a small way, for example, by the recent concern of some

railroads for the development of traffic in solid wastes (garbage) from urban areas to disposal areas, such as in abandoned strip mines, at some distance from the originating areas.

TRENDS IN INTERNAL LOCALIZATION OF METROPOLITAN GOODS MOVEMENT

In spite of the deficiencies in both data and concept relative to total movements of matter of all kinds in urban areas, and at the risk of dwelling on the obvious, it may be advantageous to summarize some of the dominant trends in recent years relative to the changing patterns of urban development as they affect the patterns of internal and external movement of goods, as conventionally understood to include commodities, fuels, and manufactured products.

The conventional models of urban structure and growth are of some help. Most urban complexes embody, in their internal organization, varying combinations of the 3 classical geographic models: the concentric circle, the wedge or sector, and the multiple-nucleus models. All of these models involve gradations in density and, to a greater or lesser degree, segregation of land uses. The concentric circle model involves a dominant nucleus around which densities grade off in every direction, with growth taking place on the fringes and with densities increasing in the inner zones. The wedge or sector model also involves outward gradations of density, but the density gradient is less steep along the major transportation routes that are assumed to be radial, focusing on the core of the city. The multiple-nucleus model, which is not inconsistent with the other two, has several nucleii, around each of which the density gradient may take either concentric or radial form or both, even though one or more of the nucleii may be dominant. All of these models are mutually compatible, and all include dominant nucleii where densities peak. The urban land economist explains these models in terms of competitive bidding for the most accessible sites, which are at and near the nodes on the transportation network, with a consequent sorting out or stratification of land uses and establishments in relation to their ability to benefit from, and hence to pay for, the most accessible sites where the land costs are highest.

Since the advent of the automobile, motor truck, and modern highways, 2 mutually reinforcing trends have dominated the picture of urban growth. One has been the spread of urbanization into the surrounding countryside, marked by the outward spread of the built-up area—the "metropolitan explosion"—and giving rise to what is commonly known as the "urban sprawl." The peripheral movement has, of course, not been confined to residential developments. Equally significant has been the growth of commercial and industrial nodes in the formerly outlying portions of the metropolitan areas and along the major transportation corridors connecting metropolitan centers up to several hundred miles apart and thereby producing an intermetropolitan coalescence, such as that along the Northeast Corridor and other corridors throughout North America. The second trend has been a general reduction in urban densities within the built-up areas. This is a reflection, very largely, of the increased flexibility of highway transportation in contrast to that of public transportation that had been used for both persons and goods movement and that depended for its effectiveness on minimum threshold densities to justify the provision of expensive fixed-route facilities. The dispersion of urbanization and of flows have been concomitant. Because the newer developed urban areas are based on dispersed desire lines rather than on relatively few high-density routes, such areas did not need to be developed at densities comparable with those of the older urban areas that constitute, in most instances, the metropolitan cores. On the other hand, the lower densities eliminated the necessity for many high-investment fixed routes and, at the other end of the scale, low-density infrequent branch-line and local services of the common carriers.

These 2 trends, mutually reinforcing, have produced a pattern of low-density urban development, transcending the old limits of most cities and extending beyond the old metropolitan boundaries. Land is urbanized at an accelerating rate. In spite of a recent slowing up of the rate of population growth, as revealed by the 1970 census, there is still a substantial growth of metropolitan populations, reinforced by the out-migration of large numbers of people from the older inner portions of these areas. Not only has

there been a significant numerical increase in the metropolitan populations, there has also been a further increase in the suburban, exurban, and interurban population resulting from out-migration. Superimposed on these trends has been a general trend toward increased affluence, with an augmented demand for more land per person. The ranch house and split-level have replaced, generally, the multifamily apartment house. The planned shopping center, which is essentially an island surrounded by a sea of parking, has replaced on the one hand the old central retail district and on the other hand the streetcar-oriented traditional shopping nucleations and the interminable ribbons of commercial frontage in the older areas of cities. The industrial park with its single-story factories and warehouses has largely replaced the older multistory industrial buildings. In addition, there has recently been a surge of interest in the preservation of open space conveniently accessible to the metropolitan populations. The result of all these trends has been a substantial decrease in the density of population in urbanized areas. This has occurred both in the peripheral areas of recent urbanization and in the older central-city areas that have been partially evacuated and in some instances partially subjected to urban renewal and extensive demolition for highways and other nonresidential uses. The geometric increases in per capita demand for urban land has been superimposed on the increased metropolitan population and the decreasing densities of the older urban core areas to produce a doubling of the amount of urban land in each generation. There is every prospect that these trends will continue.

Among the multiplicity of new urban nodes that has develped in recent years are the "interfaces" or transfer points where goods and people are transferred between interregional and intercity carriers on the one hand and between intracity and intrametropolitan carriers on the other. These include marine terminals, airports, railroad COFC and TOFC terminals, and concentrations of motor truck terminals. Such facilities contribute directly to the economic base of their respective cities and metropolitan areas through the employment and purchases on site as well as through the commercial and industrial establishments that locate within easy access of the available carriers using such terminals. They also have a substantial multiplier effect on employment and purchases of the many suppliers of goods and services that are essential to their construction and operation. The rapidly changing technology of international, interregional, and intercity transportation has played a major role in the rapid evolution of the internal structure of urban and metropolitan activities and land uses.

Except for bulk movement of commodities and fuels that terminates directly at the consuming plants from water carriers, railroads, and pipelines, virtually all goods originate or terminate by motor truck on city streets and intercity highways, regardless of whether the truck is the line-haul carrier. Urban commodity flow studies, therefore, are predominantly studies of motor truck movements. These movements are of 3 types: (a) line-haul truck movements originating, terminating, and passing through the respective urban areas; (b) pickups and deliveries to and from line-haul highway carriers; and (c) collection and delivery of goods to and from other carriers, involving change of mode in which nonhighway carriers perform the line-haul.

In a consideration of the major spatial patterns of truck movements within urban areas as in a consideration of person movements, the local streets may generally be disregarded, except in terms of local access, because the arterials and the expressways perform the overwhelmingly dominant ton-mile transportation. The pattern of major highways, therefore, is the dominant consideration in the planning of industrial and commercial location at the regional scale and is also of importance in residential development.

Except in some of the peripheral areas, the major arterial or preferential street and highway pattern is, literally, inherited from the horse-and-buggy age. It is generally ill-adapted to modern traffic, and, of necessity, has been largely replaced by newer highways, generally limited-access expressways. In this transformation of the urban and metropolitan pattern of movement and of the functional differentiation of areas, the federal Interstate Highway System has played a dominant role. One-third of the investment in that system is in metropolitan areas. In most such areas the system is used by the dominant volume of motor freight traffic as well as by internal passenger movements.

The comprehensive transportation-land use studies provide substantial information relative to the numbers and directions of truck movements, both internal and external, but they do not furnish adequate data regarding the commodities carried or the origins and destinations of the commodities. It is vital that plans be made and techniques developed for obtaining such data.

We do not know, for example, the actual amount of goods required to supply the industrial and commercial establishments or the residential consumers in most cities, much less the volumes handled by each mode. Few of our present statistics, regardless of mode, are broken down into geographically meaningful areas. Just as economists can develop detailed input-output matrices for national areas but generally lack data for smaller areal units, so geographers and planners find data on flows of goods generally unavailable for subnational areal units such as metropolitan regions. Such data are at least as vital for physical planning as input-output data on flows of money and credit are for economic base studies.

The planning of highway locations in cities and metropolitan areas has heretofore been largely dominated by the requirements for person transportation; it is time that goods movements be given at least equal consideration. Without data on the flows of specific commodity groups and major commodities on the urban highways, even though the volume of truck traffic is known and can be extrapolated into the future, the detailed planning of the location, character, and extent of prospective new urban nodes and nucleii is seriously impaired.

Zoning, for example, must provide adequately but not excessively for commercial nodes at and near interchanges and access points along the expressway system, but at the same time it must discourage excessive traffic generation that would impair movement on the nearby access roads. It must provide sufficient but not excessive areas, in the right locations, for clusters of motels, automobile and truck servicing facilities, and retail and service centers that are or will be highway oriented. Also, the relaxation of limitations in many states against "double bottoms"—trucks with 2 or more trailers—gives rise to the problem of adequate provision for, and location of, marshaling yards for the truck-trains, analogous to the railroad classification yards that were, and continue to be, major users of land in and near the large industrial cities. Of particular concern, now, is the question of how to retain and, if possible, enhance the quality of the urban environment in spite of the proliferation of such facilities.

TRUCK TERMINALS

Within the urbanized areas, the intercity movements involve collection and delivery. This traffic shares the highways and streets with the internal movements. Both involve traffic between collection and dispersal points—warehouses, intermodal interfaces, and truck terminals on the one hand and ultimate origins and destinations on the other. With the development of intermodal, unitized cargo handling, including containers, many industries are freed from their former dependence on locations alongside railroads where they depended on private sidings. The railroad freight house and team-track terminal have largely been replaced by the intermodal COFC and TOFC terminal, which need not be, and preferably should not be, located close to the central core of the city. The decentralization of industrial and commercial establishments that generate freight traffic has been paralleled by the decentralization—or at least the movement to peripheral locations—of the freight terminal facilities. Except for heavy industries that depend on bulk movement of raw materials and fuels by rail or water, the highway and street systems have become much more important localizing forces than the railroads.

A major problem in some urban areas is the determination of the appropriate uses of the land formerly used for railroad terminal facilities, not all of which is so related to the general pattern or plan of the city or metropolitan area as to be best used for industry. Whereas many railroads pioneered, decades ago, in the development of organized industrial districts, today such carriers have tended to emphasize their real estate operations, involving not only industrial but diversified land development including commercial concentrations in the cores of the cities where obsolete terminal facilities are being replaced by noncarrier projects and, in some instances, by housing or

other noncommercial, nonindustrial developments in other portions of the regions. In many instances former industrial switching yards have been and are being replaced by nonrailroad uses, as the major classification yards and associated intermodal transfer facilities are being constructed, reconstructed, or enlarged on the peripheries of the built-up urban areas or well beyond them.

In line with these trends, containers and piggyback trailers need not and in many instances are "stuffed" not in proximity to major terminal concentrations but directly at the plants of the shippers. Consolidation, whether by over-the-road motor carriers or by forwarders, can take place in almost any industrial or heavy commercial area accessible by adequate highways. The railroad-oriented locations of carloading companies, formerly characteristic of areas in proximity to railroad classification yards, may be expected to decline in relative importance.

Similarly, the concentrations of motor truck terminals that have developed within the past 3 decades in the larger cities are undergoing rapid change. The proliferation in New York City of truck terminals in the lower west side of Manhattan and across the Hudson in northern New Jersey and the heavy concentration in Chicago of truck terminals on the Near Southwest Side close to the Loop are far from optimal. In the latter city, some of these concentrations were encouraged by the designation of specially zoned districts from which any land uses other than those associated directly with motor trucking were excluded.

Such motor truck terminal concentrations were advantageous in the sense that they permitted minimum over-the-street movements between terminals on interline hauls and transfers between terminals. Also, such locations, peripheral to the central business district but close to the warehouse-light manufacturing districts that surrounded it, allowed transfers of minimum lengths to be made between shippers and consignees on the one hand and the truck terminals—both carrier and forwarder operated—on the other. However, the changes of recent years in methods of merchandising, the rapid growth of industries and major retail centers on and beyond the urban peripheries, and the development of radial-circumferential systems of expressways in the metropolitan areas have caused outlying locations for such motor truck facilities to become increasingly attractive. These are accessible both to the radial routes and to the belt highways, connected in turn with the major intercity and interstate routes. Major shifts are now taking place in the locations of truck terminal and forwarder terminal facilities, which should be considered, not only for themselves but in terms of their effects on industrial and commercial location, in the process of projecting the results of comprehensive transportation-land use studies into the formulation and updating of metropolitan and city plans. As in the case of redundant railroad freight and passenger terminal facilities in the central cores of cities, the reuse of areas of declining importance as truck terminal sites demands investigation.

PORT TERMINALS

In many cities, waterfront cargo terminals have been of considerable significance in the development of land use and circulation patterns. Many cities have inherited remnants of nineteenth century facilities, and the associated concentrations of manufacturing and distribution facilities have now largely or entirely reached the end of their economic life. A large number of coastal, lake, and inland ports have as major elements of their renewal programs the redevelopment, primarily for nontransportation uses, of their downtown waterfront areas since manufacturing, wholesale distribution, water carrier general cargo terminals, waterfront rail freight terminals, and truck terminals have relocated well beyond the congested central areas. New York, Philadelphia, Chicago, Baltimore, Jacksonville, Miami, St. Louis, and San Francisco, among other cities, have in process major renewal programs along their downtown waterfronts; few if any of these involve continuation or rebuilding of freight terminals.

The new technology of general cargo handling—container ships and rapid intermodal transfer on the waterfronts, LASH ships in which barges are loaded aboard oceangoing vessels without break-of-bulk, and roll on-roll off ships, which is the maritime equivalent of rail piggyback—demands increased emphasis on good landward access to the

waterfronts by rail but more particularly by highway and on extensive areas for cargo handling on shore. At the same time the linear extent of berthage for ships in proportion to traffic volume is greatly reduced. A thousand-container ship, with a capacity of about 20,000 tons, can unload and load within a single working day and requires about 700 ft of berthage. Such a vessel contrasts with the conventional break-of-bulk cargo ship of perhaps 12,000 tons that would require a week for turnaround in a typical port and about 600 ft of berthage. Thus, the new vessels represent a quantum leap in scale economies. On the other hand, the vastly greater amount of cargo handled per day creates increased demand not only for freer movement of vehicles to and from the waterfront areas but also for vastly increased land areas. When container ships were first seriously considered, a decade ago, it was believed that 7 to 10 acres of land within the terminal behind the waterfront for each berth would be sufficient. The newer terminals are laid out with 20 to 25 acres per berth. Access roads also demand increased space; turnaround of a large container vessel may involve as many as 2,000 truck movements in and out of the terminal in a single day.

Few cities need be concerned, however, with the problems of development of and access to waterfront general cargo terminals. The tremendous economies of scale, combined with the high costs of construction and operation of the sophisticated modern ships will cause traffic to be concentrated in fewer but extremely efficient ports. Modern highways, together with railroad COFC and TOFC, facilitate the concentration of hinterland traffic at the most efficient ports, while at the same time such ports will continue to generate a major part of their waterborne traffic within and near their own metropolitan areas, as in the past. Other ports will have increasing difficulty in attracting both cargo and ships, and there is a real danger that some will find that their investments in container facilities for general cargo will be financially disastrous. Inland highway, railroad, and air freight facilities permit vast extensions of the competitive hinterlands of the major ports, and, in spite of extensive improvements in the harbor and inland waterway channels, shippers will increasingly tend to favor the major ports. Bulk traffic, on the other hand, will continue to be handled primarily at private facilities, usually in association with industries on adjoining waterfront sites. Such facilities, like those for general cargo, however, demand increasingly efficient handling equipment at the terminals. Major movements, such as those of coal in unit trains, will continue to be concentrated at a very limited number of specialized ports.

There is urgent need for a national port plan, which would indicate the magnitude of the nation's requirements for both general cargo and bulk ports. Such a plan would be of great assistance in preventing overinvestment in harbor and channel improvements, terminals, and inland access facilities. It should indicate for each coast, the Great Lakes, and the inland river system the extent of total port requirements, the approximate number of ports of each type that may be required, and their general locations with relation to the respective metropolitan areas and hinterlands. Proposals for such a plan, or even for a nationwide study of port requirements, has met with resistance; each locality and port organization expects to win for itself a major share of the available traffic. We have an interstate highway plan, a national airport plan, and are now developing a plan for railroad passenger service; a national port plan is equally needed.

AIRPORTS

Among the most important of the newer concentrations of industry in many metropolitan areas are those associated with major airports. The proximity of air terminal facilities, both for passenger travel and for cargo movements, is stimulating the development of new nodes in the urban fabric, not unlike those which were earlier associated with the centrally located railroad freight terminals and which more recently developed in proximity to large railroad classification yards. The Centex Industrial District, associated with O'Hare International Airport on the edge of Chicago, and the complex of industries in proximity to Los Angeles International Airport, for example, are comparable in many respects to the earlier developments of the Central Manufacturing District in Chicago and Los Angeles and the Clearing Industrial District in Chicago, all of which were originally developed to take advantage of the nearby complexes of railroad

freight terminal facilities. The traffic generated by the airports themselves as well as by the associated industrial phalanxes underline the necessity of considering major airports as attractive elements in the pattern of facilities for internal goods movement within metropolitan areas.

Although air cargo tonnage represents but a very small fraction of the total cargo movement to and from metropolitan areas, its importance is far out of proportion, first, because it is composed of high-value, concentrated goods and, second, because it is predominantly in the form of small shipments and generates large volumes of vehicular movement on the highways in proportion to the volume of the goods. Although few airports in themselves can generate sufficient traffic to justify special provision of rail passenger access facilities, the employment generated within major airports, the supplying of the airport personnel, and the symbiotically linked industries in the vicinities of the airports frequently require special provision of highway access. On the other hand, airports, like maritime ports, represent such high investments that few can generate sufficient cargo traffic to require special all-cargo flights by very large aircraft. Because ground transportation is generally required for numerous small shipments to and from airports, pickup and delivery services with airport industrial complexes and air freight terminals as major nodes can frequently combine air cargo with other LTL movements to their mutual advantage. It may be very useful to conduct studies of the traffic-generating potentials of such combinations of multimodal terminals in the vicinities of commercial airports.

SUMMARY AND CONCLUSION

Except for bulk traffic, goods movement in urban areas is dominated by the motor truck, and there is little prospect in the foreseeable future of any major technological change that would reduce the dominance of the freewheeling vehicle on the streets and highways. No other mode of transportation has this flexibility: the ability to serve, door-to-door, the numerous individual establishments and households that generate traffic. On the other hand, the truck, like the automobile, is a relatively uneconomic line-haul carrier. Therefore, in addition to furnishing line-haul service whether by common, contract, or private carrier organizations between cities, the truck has become the originating and terminating vehicle for the overwhelming proportion of intercity movements. The flexibility of the truck in originating and terminating movements is combined with the economies of scale of other modes, whether large truck units on the highways, railroad cars, ships, barges, or airplanes, for virtually all intercity and interregional movements of general freight. It has freed many industrial and commercial establishments from the necessity of locating along railroad lines, and has been a major contributor, along with the automobile, to the deconcentration of both residence and business. Urban density profiles—the gradations from city center to periphery—have less steep gradients, and the origins and destinations of freight movement have tended to become more dispersed than during earlier periods when rail transportation was dominant.

Although railroad lines and port terminal areas continue to be important for some types of industries, an increasing proportion of traffic-generating activity can choose from among many more alternative locations than ever before. For this reason, the availability of the ubiquitous truck has reinforced the necessity for relating the planning of land uses, the urban form and structure, to the location of transportation routes and terminals.

The emerging city is increasingly a multinodal one. Even though the central core may continue to be the largest in each of the respective metropolitan areas, its relative importance will continue to be reduced, with many of its functions taking place in the newer industrial and commercial nodes. Transfer facilities at intermodal terminal areas continue to be important for some types of industries, an increasing proportion of traffic-generating activity can choose from among many more alternative locations than ever before. For this reason, the availability of the ubiquitous truck has reinforced the necessity for relating the planning of land uses, the urban form and structure, to the location of transportation routes and terminals.

The emerging city is increasingly a multinodal one. Even though the central core may continue to be the largest in each of the respective metropolitan areas, its relative importance will continue to be reduced, with many of its functions taking place in the newer industrial and commercial nodes. Transfer facilities at intermodal terminals consitute new focuses of urban activity and new centers for the emerging highway networks. Such facilities include truck transfer stations, railroad and forwarding company piggyback and trailer transfer facilities, air cargo terminals, port terminals, and bulk storage facilities for fuels.

The comprehensive transportation-land use studies, developed from the earlier origin-destination studies and combined with real property inventories as essential parts of the urban and metropolitan planning process, have lagged in not giving as great emphasis to development of models of freight movement as they have to passenger movement. In addition, there is relatively little understanding of the patterns of movement of waste materials or of the cycling and recycling of the total complex of commodities and goods that enter, circulate within, and leave the urban areas. Substantial payoffs may be anticipated from studies of the flows individual commodities in the urban systems, of the relations of such flows to the spatial patterns of industrial and commercial activity and of land uses, of the demands on the transportation systems resulting from increased attention to the environmental conditions attendant on the transformation of economic goods into waste products and of the possible recycling of such wastes, and of the relationships between commodity flows on the one hand and personal movement on the other, both of which share the major routes and facilities serving urban areas.

The planning of future relationships among systems of freight transportation and the location of the various land uses must, furthermore, involve considerations of alternative patterns of movement in order to minimize the total volume of ton-miles generated, just as the more-or-less standardized transportation-land use studies that are now major parts of the planning process consider optimization of the networks of routes for passenger flows. Much of the experience in the development of techniques for studies of the latter can be transferred, with modifications, to studies of commodity flows. The principal difference is in the great variety of commodities, each category of which may involve specialized variables not applicable to the others. The stimulation of research on the development and applications of such studies would constitute a major result of this conference.

INFORMAL DISCUSSION

Donald M. Hill

Why is it so apparent that time and money given to goods movement should be equal to that given to studies of people movement when the primary responsibility for goods movement rests with private enterprise?

Mayer

Delivery and pickup of goods are an important elements in every form of activity that goes on in the city. The environmental effects, including air pollution, noise, and congestion, that goods movement generates are just as important as those generated by passenger movement. Because some of the facilities for goods movement constitute major land uses in themselves, for example, the port terminal areas, the truck terminal areas, and the cargo facilities at the major airports, and are indeed major elements of a city and metropolitan pattern, their location will have a dominant influence on all the other land use and activities that make up the city.

Hill

We do not tell drivers what route to follow or where to park their cars. Why do we think we can tell truckers what route to follow and what they should load and unload?

Mayer

We do tell drivers, do we not? We have all sorts of regulations. We have regulations on speed; we have prohibited turns in some intersections and that sort of thing. Trucks are another form of movement. We do have certain roads, such as parkways, that are prohibited to trucks because of their adverse environmental effects and because of the mutual incompatabilities of the various places to be served by these facilities. It seems to me entirely legitimate to consider truck movements as being in almost every respect parallel to passenger movements. The effect may be more widespread.

David Glickman

You are perfectly correct when you state that there is all kind of opposition to the proposals that have been made by various agencies. However, I wonder whether you are also correct in terms of your analysis of the issue behind your statement. You make the plea for a national port plan, and you suggest that a national port plan would be comparable in terms of national planning to the Interstate Highway System plans, national airport planning, and railroad passenger planning. I would suggest that none of these plans is a rational plan, determined on the basis of the most effective utilization of the facilities required. The proposed passenger rail plan has gaps and segments all through it. It involves an indeterminant expenditure of funds for segmented transportation. The national airport plan, as you call it, is not a plan designed to rationalize aviation movements. This is a plan to service demand as it now exists. This is a very different type of planning from that which you are conceiving of in terms of national port planning.

My second comment is that, in other nations where national port planning has been resorted to, the virtues, or the lack of virtues, are by no means determinant in this point of time. Some nations that have resorted to national port planning have, as you know, slid back. They have, in effect, modified the plans to such a degree that they no longer resemble national port plans. Within our federalized system of government, is national port planning the desired alternative to what we now have, which is essentially a structure of individual, competing ports organized locally and regionally and financed locally and regionally?

Mayer

I did not mean to imply that a national port plan would designate necessarily specific ports, but rather that it would be some kind of an estimate of the demand for ports, perhaps regionally or by companies, and not entirely analogous, obviously, to the airport plan or the highway plan. The Interstate Highway System is a national plan; it is a national network. I would rather not comment on Railpax because I agree with you completely; it has too many missing links and it is not a system.

I think the analogy of port development and competition in private enterprise is not entirely applicable because the ports are (the ports themselves as distinguished from the terminals) public and not private. The channels, also, are public. We do have to have some allocation of our resources, for example, in the federal development of channels. We also have to have some national or at least regional estimates of port requirements to guide investment. The investment in port facilities is very often by public authorities. Bond issues are either revenue bonds derived from the operation of these facilities and, hence, they have to be economically viable and not excessively developed, or they are generally obligation bonds that involve the credit of the local government, whatever it may be. These bonds are brought by institutional investors, insurance companies, and universities, whose own resources have to be allocated.

There is a real ever-present danger of overinvestment. I am not saying that the federal government should dictate which ports should be developed or how they should be developed, but I do think we need at least the first steps in the planning process, and that is some overall estimates of what the future requirements are likely to be in order that the decisions may be on the basis of information broader than just the specific local interests.

panel report

TERMINAL LOCATION AND COLLECTION AND DISTRIBUTION IN THE CITY CENTER AND SUBURBAN AREAS

Warren B. Lovejoy, panel chairman

The process of urban goods movement has the following 3 basic, readily identifiable aspects: movement of goods into and out of the urban or metropolitan area, movement of goods within the metropolitan area, and movement of goods through the area. These basic functions are, of course, closely related. At times they even overlap, but they each have their own peculiar characteristics and give rise to their own set of problems.

In most major cities, the movement of goods into, out of, and through the city areas is achieved by utilizing a combination of truck, rail, air, water, and pipeline modes. Movement within the city, however, is largely accomplished by truck. Accordingly, from the standpoint of metropolitan transportation, the great majority of the problems experienced in the movement of goods are not caused by the intercity or through phases of the operation. They arise from the operation of the terminals that provide the interface between intercity and local transportation facilities, the terminals that are required to handle the distribution of goods within the city, and the actual movement of vehicles, mostly trucks, that are used in the movement of goods to their points of destination or from their points of origin within the city.

This panel was concerned with the dual subjects of terminal locations and the collection and distribution of goods within the metropolitan area and not the problems that arise primarily from the intercity and through phases. The panel recommends 11 research projects for consideration by government, industry, research agencies, and universities.

The first project has to do with the entire subject of terminal location, including facilities that handle local, intermodal, intercity and even through freight and that have major impacts on metropolitan regions. We recommend that a government research project be designed to determine the factors that should be considered in the location of terminals for single-mode as well as for multimode operations. The research project should consider the terminals in a metropolitan region as an overall distribution system for the area. Therefore, we suggest that there are 5 basic areas for research into the subject of terminal location:

1. The first area is in the general category of terminal operator requirements. The terminal operator needs convenient modal interface because this is essentially the function he provides, access to markets, and proximity to areas where employees live or can live.
2. The second area relates to the compatibility of the terminal with adjacent land use. Terminal operations often produce congestion, noise, and pollution, and may have many other effects on the adjacent region.
3. The third area is the impact of the terminal or perhaps the lack of terminals on regional development, on employment opportunities, and on regional transportation costs. This is particularly important with reference to competition with other competing regions.
4. The fourth area is the effect of government policy on terminal location. Policies on tax structures, zoning, street construction, and other public services have a great impact on terminal location.

5. The fifth area is the possible multiple use of terminal areas. There may be an opportunity in certain types of terminals for air-right development and for multimode operation of terminals adjacent to each other.

The second research project is an analysis of terminal design and efficient terminal operating methods. We recommend that industry undertake this research because this is such an important component of the whole urban freight distribution system. The study should include the following: all types of terminals for all transportation modes; different kinds of terminal operations such as local cartage, retail, wholesale, and distribution; and different transportation functions such as bulk terminals, unit load terminals, and LCL or LTL operations. The study should analyze, from the standpoint of efficiency and cost, methods of loading and unloading, sorting and arranging, scheduling, vehicle marshalling, alleviating congestion, and effecting internal controls that are designed to produce orderly operations, reduce pilferage, and so forth.

The third project is an investigation of the whole concept of consolidated or joint terminal operations. This subject should be studied jointly by government and research organizations. Consolidation is a solution that people invariably suggest as a panacea for reducing city congestion caused by the movement of goods. Yet, it is a difficult process to effectively put into operation; few if any outstandingly successful joint terminal operations are presently in existence. Accordingly, a pilot study should be contemplated that would attempt to locate examples of joint terminal operation in 5 representative cities. The project should be designed as a very careful objective study of the costs and the benefits of joint or consolidated terminal operation. It should consider separately the possibilities of joint terminal operation for common or contract carriers and the possibility of consolidating the operations of private carriers as well. The project should investigate whether there are certain types of goods or certain types of operations that are particularly suitable for consolidated operation. It should look into the subject of who should own and operate such terminals and how they should be operated. Should they be partially operated by a governmental agency or by private industry? What should be the location criteria for a consolidated terminal operation? If this is a desirable solution, must there be some kind of compulsion from government, such as tax incentives, or some other type of nudging of private carriers to involve themselves in this type of operation?

The fourth project relates to shipping and receiving problems. We think that this should be a government research project that should be undertaken in representative cities to study congestion, time lost, and increased costs caused by shipping and receiving problems. Severe problems are encountered by carriers in shipping and receiving of the goods. The problem seems to be particularly severe in city centers, and the study should examine the possibility of zoning or building regulations for new buildings in cities that will result in more efficient pickup and delivery. In areas that are already built up, there may be a possibility for some types of mini or block terminals, perhaps in the form of exclusive space on the roads or some partial use of sidewalks in order to provide better opportunity for pickup and delivery. (This could be a possible TOPICS project.) The study should set standards for the amount of dock space required in buildings of different sizes and types in downtown metropolitan areas. It should investigate the feasibility of off-peak delivery schedules. Congestion pricing or some other means might possibly be used to reduce peak-hour congestion caused by both trucks and automobiles in city centers. Local cartage companies have problems with circuitous or poorly conceived suburban street designs, and the study should examine this and any other feature of the metropolitan area that creates pickup and delivery problems.

The fifth project is a study of paper work procedures for handling freight movements in urban areas. Government and industry should cooperate in a study of possible improvements in paper work that could simplify procedures and eliminate delays. In the New York area, for instance, one of the most important causes of delay in the handling of foreign trade is paper work. There are similar problems with intermodal movement of freight and with local pickup and delivery. Improving these procedures could solve some of the delays and cost problems related to the movement of goods in urban areas.

The sixth project is a study of truck operating costs as they are affected by operating conditions encountered in local goods movement. Industry, perhaps through a trucking association or a similar research group connected with industry, should conduct this research. The study should identify costs of fuel consumption, crews, oil, tires, and maintenance and repair for different types and sizes of vehicles. It should then attempt to determine how these costs are affected by number of stops, congestion, road conditions, load size, speeds, grades, and so forth. It should develop criteria that could better match vehicle types and sizes to specific conditions encountered on different routes and different tasks of freight movement in urban areas.

The seventh project is a study of the social cost of urban goods movement and could be done by a university or research agency. Public action may be called for if the location and operation of terminals or vehicle operations are associated with social or other costs that are not fully compensated for by these operations. Therefore, it is important to try to measure the social costs associated with them. Noise, air pollution, visual intrusion, safety hazards, impact on land values or land character, delays to traffic and pedestrians, increments in pavement construction and maintenance costs, and community disruption are examples of the kinds of costs that should be considered. If these costs are large enough to warrant public action, is it desirable to find ways to shift some of these costs to the operators, or must we take these costs into consideration in our whole study and theory of the problem of distribution of goods in urban areas?

The eighth project is to develop new and improved study methods and analytical techniques for the analysis of urban goods movement. The project should be undertaken jointly by government and by research agencies at the universities. The growing awareness of the magnitude and complexity of urban goods movement clearly indicates that the focus of planning must be widened to include an examination of the social, regional, and environmental impacts of transportation facilities and operations. Both region-wide planning and project planning approaches and methods must be aimed at understanding qualitatively and, wherever possible, quantitatively the full range of consequences of the various alternative plans that may be available. Decision-makers should have both nontransportation and transportation inputs on which to base decisions and determine courses of action in the metropolitan areas. The present methods of study, which have been developed over the years in passenger transportation planning for metropolitan areas, need to be examined to determine whether the whole focus should perhaps be shifted in order to provide a much broader spectrum of inputs and outputs concerning the impact of plans on the region.

The ninth project is an evaluation of the influence of regulation and legislation on terminal location and goods collection and distribution. This project is suited for a university or research institute. The study should determine the beneficial or harmful effects of municipal, state or provincial, or federal regulatory or tax legislation. Examples are the disparity of local urban regulations concerning vehicle sizes and weights and the various U. S. regulations on commercial zone sizes and geographic areas of permissible delivery of air cargo. The latter have an impact on terminal location and can be deleterious for the region that the terminals attempt to serve.

The tenth project concerns data requirements. Undoubtedly, new requirements will arise out of the studies and projects proposed here as well as others that will be undertaken as we begin to focus more and more on the subject of the movement of goods in urban areas. These data in many cases are expensive to acquire. Consequently, careful cost and benefit studies must be made of data requirements before a large-scale data collection program begins. Because members of the panel strongly disagreed regarding data collection programs, the panel decided, with one exception, not to specify data requirements but to let them emerge from specific research projects. The one exception is origin and destination information of freight and goods by all modes of transportation. Three data bases—national, regional, and state or provincial—are needed for this. The regional requirements are for detailed data that may have to be collected from non-national sources. National data can be much less detailed geographically, and state or provincial data are perhaps halfway in between the national and regional. Therefore, data gathering is bound to be an expensive operation, but it is something that has been lacking for a long time. We will very severely feel this lack as we concentrate efforts in the area of goods movement.

Finally, the eleventh project recommended is demonstration grants. No specific demonstration grants are proposed because these would more appropriately emerge from the research projects suggested. Government departments of transportation should be organized to administer and consider the whole subject of demonstration grants or research projects for freight movement. Although it may be presumptuous to suggest this kind of reorganization, it is necessary and there should be a focus in government that can be used in processing the demonstration grants and in approving governmental financial support that many of these research projects will need.

panel report

CHANGING STRUCTURE OF FREIGHT INDUSTRY AND NEED FOR CHANGES IN GOVERNMENTAL POLICIES AND PROGRAMS

James R. Nelson, panel chairman

The changing structure of the freight industry was construed by the panel to refer either to intracity freight or to the interface between intercity and intracity freight. It was also taken to refer to reactive changes, i.e., those changes that occur or should occur in response to changes in the characteristics of urban life. Most of the points in the report are, in fact, the product of an attempt to discover ways and means to alleviate the frictions produced by changes in the urban environment.

The report is divided into 4 main sections. The first contains a general outline of the problems explored by the panel. The second and third discuss special governmental problems in Canada and the United States, and the fourth gives a summary of possible actions on the part of government, business, universities, and research institutions in response to the problems outlined in the first 3 sections.

GENERAL PROBLEMS

This section contains 2 subsections. The first is devoted to problems of commodity and service flow within the city, and the second is devoted to interchanges with long-distance carriers. In the first, the emphasis is almost exclusively on trucking in view of its overwhelming importance for local freight movements. The second subsection is concerned with intermodal and interchange relationships. Because of the level of generality required, important problems of local transport (especially those involving movement of bulk commodities, those involving access to port facilities and land-water coordination generally, and those produced by local geography) receive scant consideration.

Intraurban

Modern shopping centers present fewer congestion problems for freight movements than older parts of the cities. We believe this to be important. An obvious reason is that shopping centers are new and are, therefore, presumably planned for the requirements of modern vehicle movements. A second reason, which probably needs to be stressed, is that shopping centers are in a sense macroeconomic. They have been constructed as a totality and can, therefore, be expected to have left little room for externalities. Presumably the person who built the center thought of all economic problems and commercial problems that would arise within the center. These centers may overload adjacent highways. They may even make housewives walk farther than they wish. But they are moving toward a total, self-contained response to both the supply and demand problems of the modern retailer. This brings out the deficiencies of central business districts that are in older portions of most cities and that grew up in a different era. They were generally and still are the product of small-scale approaches to land use. Thus the anarchic is added to the anachronistic.

The problems created are illustrated by a list of some of the main parameters of demand and supply as they relate to the local transportation of goods and services.

The underlying theme that one should keep in mind while perusing this list is that of congestion.

Demand

1. Nature of shipment;
2. Size of shipment;
3. Actual frequency of shipment;
4. Required minimum frequency of shipments, as with restaurants;
5. Characteristics of consignee or receiver such as large versus small industry, industrial versus residential, small versus large retail, 8-hour day versus 3-shift operation, CBD versus other, and termini versus processor and in transit;
6. Characteristics of shipper such as newspaper or plumber; and
7. Physical shape of city and political shape of metropolitan area.

Supply

1. Equipment size and distribution of size such as straight trucks versus tractor-trailers;
2. General versus specialized equipment;
3. Single stop versus multistop;
4. Intracity versus terminal intercity;
5. Single purpose versus multipurpose;
6. Private versus for hire;
7. Commodities versus service versus driver salesman;
8. Characteristic shipment size such as truckload, container, small shipment, or parcel; and
9. Use of "key stop" or other forms of night delivery.

There are policy implications with respect to these characteristics of demand and supply in the older city position. First, intraurban movements are much less a matter of regular and homogeneous tonnage flow than of particular, specialized starts and stops. Therefore, pricing actions and other local public policies, such as taxing, should be directed toward maximum effective use of existing streets and curbs. The creation of special loading zones may be less important than the creation of curbside parking places that are kept free during the business day, at least outside of rush hours, for the short stops required for pickup and delivery. Investment and regulatory policy should also be directed toward the encouragement, through zoning rules or tax inducements and penalties, of adequate off-street facilities in new structures.

Second, intraurban freight movements involve so many parameters on both the supply and demand sides that it would be generally inappropriate to introduce day-long embargoes on freight movement in favor of passenger movement, or of passenger movement in favor of freight movement. Either course would involve an arbitrary bias toward, or against, a miscellaneous group of transport activities. Zoning and other controls should be utilized to shape the entire environment in terms of development but not to replace economic incentives in the form of prices and other public actions as determinants of the mix of passenger and freight traffic.

Third, in view of the perpetual process of destruction and renewal that characterizes a dynamic urban economy, development on single lots or involving single structures may contribute only a little to the solution of freight transportation problems. In the absence of a shift toward large-scale development for this specific reason, government controls that may be applied in the form of zoning or pricing or taxation should be directed at area development.

Fourth, although the direction and social costs of urban goods movements are borne initially by the city, the resolution of many problems created by such movements can be realized only within the jurisdictional and the financial capability of some unit of government larger than the local authority.

Interchange and Intermodal Problems

For intermodal and intercity problems, problem-solving becomes more complex. For the first time, federal regulation appears and the truck is no longer the exclusive mode of transportation. Attention must also be given to interchange and transfer facilities. Also there is a great acreage and high value represented by railroad real estate in most cities. If the premise is accepted that improved intermodal facilities are required, then the capital problem of the railway industry demands special atten-

tion. Railroad earnings in recent years indicate that the industry would have trouble in raising new capital. Beyond this general problem lies the railroad dilemma. Either a railroad is in bankruptcy with resultant grave limitations on its borrowing power, or it is still solvent and hence committed to bond issues whose terms practically foreclose new borrowing if they do not actually take over the present property. Railroads do not borrow to improve ways and structures, including terminal facilities, and cash flow may or may not be adequate to finance any kind of improvement. Expecting the finance of a joint terminal to come from a trucking industry is also to expect a great deal, particularly with respect to an industry whose firms are small relative to railroads.

Some of the thorniest issues of intermodal competition involve both management and labor. United Parcel Service is an example of how an energetic and improvising management of a trucking company can move commodities in pickup and delivery services efficiently.

Testimony indicates that labor in the trucking industry has not interfered with productivity gains, unlike labor in other branches of the transportation industry. More than that, however, labor should work toward practices that will improve the efficiency of urban goods movement.

CANADA

Although the majority of identifiable problems related to urban commodity and service flows are the same in the United States and Canada, there were marked differences in the governmental and regulatory structures. In Canada, more direct and decisive action can be taken in the short run.

The government structure in Canada is vertical in nature with fairly well-delineated powers between levels. The federal level of government has responsibility for the regulation of all firms conducting extraprovincial, interprovincial, and international transport by air, railway, highway, water, or pipeline. By having jurisdiction over the extraprovincial firm rather than extraprovincial commerce, the federal government has the ability to extend its regulatory presence into the intraurban area.

The provincial governments generally have the responsibility for the regulation of all firms engaged solely in intraprovincial transport by highway or railway. Thus, this level of government has significant regulatory powers within the urban areas as well. Another significant power of the provincial governments, which has a direct bearing on urban goods movements, is that relating to regional planning and governmental structure within each province. These powers have been exercised to notable advantage, particularly with respect to planning, including transportation planning, in the creation of 3 metropolitan governments in Winnipeg, Toronto, and Ottawa. In these cases certain powers from the many city and local governments were taken away and given to a more encompassing government with responsibilities ranging across the whole metropolitan area. Typically these metropolitan areas range in size from 300 to 600 square miles. In the province of Ontario these powers have been further exercised to create even larger planning areas or regional governments. To date 6 regional governments have been established comprising areas ranging in size up to 5,000 square miles.

Because each level of government has clearly delineated powers, including certain planning powers, the problem of attacking urban land use or transportation planning in a homogeneous urban regional area is markedly reduced. Further, governmental structure in Canada does not appear to be too rigidly fixed. In addition to new metropolitan and regional government structures, there is currently under way a complete review of the split of constitutional powers between the federal and provincial levels of government. Consideration is also being given to the merits of merging the 4 Atlantic provinces into a single political unit. Thus, given demonstrated need or advantage, there would seem to be little in the institutional structure of Canadian governments that cannot be adjusted or modified in order to meet these requirements.

At the federal level, transportation policy and planning are concentrated within the Ministry of Transport. Within the Ministry the policy and planning for all surface

transportation originates within the Canadian Surface Transportation Administration. Similarly, the Canadian Transport Commission, subject to the ministry for policy guidance and direction, is responsible for the regulation of all modes of transportation and communication with the exception of radio and television. Thus, planning, policy, and regulation of all modes of transport are under a common jurisdiction and given guidance by a single National Transportation Policy, unlike the U.S. National Transportation Policy. It can be seen, therefore, that any federal policies or regulatory actions that might impair any desired change in the structure of the industry handling urban commodity flow can be relatively easily remedied.

The effects of differences in Canadian versus United States transport policy can also be seen by looking at the extensive common ownership or intermodal nature of the Canadian transportation industry. The 2 major Canadian railways could perhaps be called true transportation companies being extensively involved not only in rail operation but also in highway, express, air, steamship, and pipeline. Other companies such as steamship lines and airlines have entered the multimodal field as well with the result that by and large the transportation system is institutionally less compartmentalized and thus better able to use the right mode of transport in the right place at the right time.

In large part, because of the direct powers vested in the federal and provincial levels of government, swift and significant moves have been experienced or are currently being contemplated in the field of transportation and land use planning. The recently announced Montreal II airport development is a case in point. The planning and decision to create this facility involved only 2 levels of government with the federal government being responsible for the purchase and development of the 50,000-acre site along with certain city-to-airport access and the provincial government being responsible for the regional infrastructure and highway transportation problems associated with this development. A similar airport development is currently being planned for Ontario and, similarly, planning and implementation of the plans are being facilitated by the absence of multiple, horizontal institutional or political barriers.

Preliminary planning is currently being undertaken in 2 other significant areas. In one instance, the federal and provincial governments are questioning the whole concept of large urban centers as we know them today or as we project them to be in the future. The question being asked is simply, Does the present form of the city provide an environment that maximizes the quality of human existence? For comparative purposes, one alternative being looked at is the concept of a central core city housing the basic amenities and needs of a large metropolitan area but ringed by a series of satellite cities, perhaps up to 100 miles distant but connected to the central city by low-cost, high-speed ground or subground transportation. The steps to implementing such a scheme, if considered desirable, would be little more difficult than the current major airport developments already under way but, like new towns, offer unique opportunities to build in better commodity flow systems right from the start.

Another example of this type of planning is in the area of public ownership of railway rights-of-way. Such a move, should it be brought about, could have a significant effect on the multiple use of these rights-of-way in urban areas.

UNITED STATES

Special governmental constraints in the United States are stated briefly. The first is that historically state highway departments have always been responsible for highway construction and maintenance outside of urban areas. Increasing needs for highway funds within urban areas and increasing stress on uniformity of standards and continuity of traffic flow have tended to move this rural responsibility inward toward major population centers.

The second is that in most cases, the suburbs are growing and the central cities are standing still. Only 3 major cities—Miami, Indianapolis, and Houston—have managed to take over suburbs. Each metropolitan area in this country, therefore, has a problem of increasing differentiation of government and losing more and more of the wealth to the suburbs.

The third is that a number of metropolitan areas, such as New York, Chicago, Philadelphia, and St. Louis, extend across state lines.

The fourth is a question of research and development. Individual cities are usually not in a very good position to make comparative studies of how their transport problems rank on the national scale along with those of other cities.

ACTIONS

At the federal level, the panel endorses the suggestion of urban commodity flow demonstration projects. The Tri-State area would be an obvious candidate at an early date, but there should be at least 2 others to represent various sizes and types of cities in different parts of the country with different rates of growth.

Only the federal government can conduct the post-audit that is required of the large number of urban transport studies that have already been completed. There is a real question as to what the present condition is of the freight material of some of these studies. In addition to this post-audit, there is need for investigation of the requirements for statistical standards with respect to urban commodity and service movements and of the need for the compilation of certain time studies to keep survey data up to date and to register changes in urban conditions as they occur. This preparation of a data base should coincide with the demonstration projects.

The panel did not feel competent to examine the area of satellite cities but felt that federal investment policy in both new towns and highways must reflect an active interest in effecting safe movement of passengers and goods. With regard to data, the panel felt that emphasis on tons and ton-miles and flows was much less important than emphasis on number of stops, number of vehicles, and time consumed.

At the state level, the main issue is providing terminals and interchange points, and this raises the question of capital. The panel could not see in the present organization of the transportation industry where money for rail-highway interchanges was going to come from in every case. Either state or local finance may be required.

At the local level, there is clearly a need in older areas for measures that will achieve relatively uncongested transportation facilities so that these areas can compete with suburban activities. This involves both street space and curb space, for urban commodity flow makes specialized use of both (especially of parking space) that is not typical of the use made by passenger vehicles. Some regulation by outright prohibition will continue to be essential; but it would be unfortunate if cities neglected the pricing tools available to them to achieve more efficient use of streets and curb spaces. These pricing tools are especially important in view of the financial position of most central cities.

The panel was impressed with what business and unions had done in improving labor productivity in order to have fewer, faster trips and fewer, shorter stops, thereby relieving congestion. We were impressed by the success of the United Parcel Service in operating on schedule. We suspect much congestion could be eliminated in urban areas if other services operated on such a schedule. Many vehicles used in urban commodity transport are specialized and designed for short-radius and short-haul activities. Because congestion and pollution problems seem to be more acute for these kinds of activities, they provide excellent opportunities for demonstration projects by manufacturers with respect to vehicles.

The university and other research agencies should employ a systems approach in studies for older communities. There is a danger that attention to the city as a society may obscure its importance as an economy. We have the sociologists on the one end and the earthmovers on the other, and the whole question of what the city is all about gets lost in the shuffle. Thus, projections of need or requirements should be matched by studies of how, if at all, this need or these requirements may be met. Urban freight and commodity movements tend to relate to the workday, supply side of the city. They are essential to the city's existence and should be studied as such.

panel report

FUTURE INNOVATIONS AND CHANGING SOCIOECONOMIC STRUCTURE OF THE CITY

Benjamin Chinitz, panel chairman

Like all social scientists, we wrestled hard with the simple question of what is the problem and how do you know when you have one. In all candor, I must report that there were many moments during our discussion when it looked like we might not be able to define the problem and would have to admit that we were here under false pretenses. Because we were quite reluctant to come to such a conclusion, we worked very hard to persuade our doubtful members that urban goods movement did pose some important public policy issues. Three categories of issues resulted from our discussion.

The first general heading is externalities. This is, of course, the easy one. In the urban context, every activity has to be scrutinized from the perspective of its impact on related activities, positive or negative. Vehicular movement is generally regarded to be guilty until proved innocent. Noise, air pollution, accidents, and congestion are all negative by-products of urban goods movement, which are not neatly reflected in the costs of urban goods movement as confronted by the carrier, the shipper, or the consignee. That then is the first target for public policy.

The second area (and we did not have the benefit of a carrier representative on our panel) is that we suspected that urban goods movement was very likely not being managed efficiently. Given the state of the art, productivity could be higher; and given the nation's capacity for progress, the state of the art could be farther advanced. We were not quite able to pin down the source of this suspicion, even though some members of the panel felt that it was obvious and advisable while others insisted that research might indeed reveal that our suspicions were unfounded.

We had no trouble at all getting closer to our mandate in the third area. It is the notion that public policy addressed to externalities and internal inefficiencies would have to reckon with the impact of urban development on the nature of the goods movement job. We were not, however, prepared to relegate urban goods movement to a purely passive role in urban development. We also felt that the emerging public policy to direct urban growth and development along particular lines would have to reckon with the urban goods movement system as more than a trivial parameter shaping the evolution of urban areas and would have to be treated as a policy variable. It was our uninformed guess that very likely the urban goods movement was not being viewed in this light by the drafters of the emerging national urban growth policy. At the end of this report is a specific recommendation on that subject.

Panel members felt quite strongly that, although we were prepared to stake out these potential policy areas, we did not have, and by implication no one else had at this time, the data and the analytical techniques to support policy formation and implementation. As one of our members put it, we do not have and we urgently need a goods-movement planning process. Some of our panelists were so paralyzed by this preoccupation with ignorance that they could not address themselves to any other issues. Most of us were able to abstract from our ignorance and move on to consider many questions of which these were the first: Assuming no new major policy thrusts in the urban field, how will the urban area develop in the future and what implications will the pattern of development have for urban goods movement? What potential policy issues are suggested by these implications? This is the sort of speculation that is ideally suited to panel discussion.

We had very strong agreement on a common base and then some frills were contributed by various members. We expect the metropolitan area to continue to spread out with the most relative rapid growth occurring at greater and greater distances from the center. At the same time, the central city, and especially the CBD, will continue to peel off those activities that suffer most from congestion and obsolete freight-handling facilities while it retains a relatively strong position in those sectors in which office employment predominates. The loci of intercity freight movements will continue to shift outward, thus further accentuating the preference for suburban location for the assembly and distribution of freight and further diminishing the relative access of the central city population and industry to freight terminals.

We see 2 points here that may be of some importance with reference to urban goods movement policy. First, the planning of intrametropolitan highway networks may have to be increasingly sensitive to the interface between interurban and intraurban movement occurring at the periphery. Second, from an equity point of view, and from the related perspective of the central city, greater attention may be required to preserve the center's access to intercity movements. This is the broad base on which we all agreed.

Here are some further imaginative speculations that were advanced by members of the panel. One of our members urged us to be sensitive to the emerging pattern of interurban specialization, that is the notion of the highway system creating new patterns of specialization and trade, not just within a given metropolitan area but between neighboring metropolitan areas. For example, I have been trying to get a graduate student to work on a thesis on what is happening to the pattern of trade between Boston and Providence and, in turn, what the specialization of each of these central business districts is as a result of their being brought closer together in time by Interstate 95. I know how to deal with the change on a purely introspective basis. For example, I substitute downtown Boston for downtown Providence with greater frequency than I used to because it is such a simple matter to get to downtown Boston. I do not know how this shakes out considering all activities of downtown. I cannot argue very strongly that this is a feasible kind of exercise; moreover, the data base is weak. But in the context of our panel, this was a general proposition that was advanced for consideration.

The second suggestion related to the whole question of the new town that is emerging as a form of suburban development. We discussed the new town in that context rather than the new town in the wilderness, which was, as somebody said, effectively killed off by Alonzo in his paper, What Are New Towns For? But the new town as a way of organizing suburban development certainly has to be given serious consideration, and to our knowledge nobody is giving serious consideration to the urban goods movement implications of that development either from the point of view of the people planning the new town itself or from the point of view of the carriers and the industry that is providing the service.

A third speculation along these lines was the notion that we may be bending back in our development toward the old life-style pattern but on an entirely different basis. One can develop an image of a person living and working in a very sparse kind of setting and having all his interactions fed to him, so to speak, through communication. He talks to his colleagues on closed-circuit television. He may have to have paper and pencils delivered. Some of us felt that this may be a premature extrapolation of the kind of life we see on the horizons for ourselves.

Finally, the point was made that we ought to be thinking of the possibilities of slower growth in the future for metropolitan areas. The 1970 census has already yielded the first major metropolitan area with an absolute decline in population, and that is Pittsburgh, which was first in steel and now first in decline. These two facts are not unrelated. The suggestion was made that maybe the 1980 census will show some more. Combined with the competitive argument about where people would choose to live, there is just the simple demographic phenomenon of the declining birth rate. It used to be quite customary to talk about a 300 million population by the year 2000, and that, in turn, called for another 100 million people living in urban areas. This has now been scaled down to 270 or 260 million. The demographers tell us that, even if we instituted a zero population growth policy tomorrow, the dynamics of population growth are such that the population would reach 230 or 240 million before it would go lower.

Moving to these speculations about city form, we shifted to a direct assault on the first word in our mandate, which is technology, and its implications for urban goods movement. In terms of perspective technological developments, we found it most fruitful to speculate in particular about developments in communication. We saw 3 main potentials here. First, developments in communication and all of its aspects could be a major vehicle for improving the efficiency of urban goods movement. Second, improved communication offers potential for substituting communication for actual freight movements. These are not overwhelming, but they are not insignificant. Things such as ordinary advertising mail and newspapers, which are important freight items within the city, are vulnerable to substitution by improved communication. Harold Barnett, in a paper on the economics of the wired city, states that it is well within the state of the art now for every single household and every single enterprise to be connected by cable in such a way that they would have a virtually infinite capacity to receive communications of all kinds: television, telephone, and telegraph. He has worked out the cost estimates and considered all the questions of regulatory policies, resistance by various groups, and so forth.

Finally, we considered the indirect impact on the movement of freight that would occur if communications would substitute for movement of people. Obviously the primary effect would be on the passenger transportation network and problems, but indirectly there would also be some implications for movement of freight.

Let me summarize by suggesting some relatively specific research areas. Dialogue is now going on at the very highest levels with respect to what we want the country to look like geographically, what we want our urban areas to look like, and what we are going to do to achieve those goals. We urge the National Academy of Sciences, the U. S. Department of Transportation, and the Canadian Ministry of Transport to try to inject the dimension of urban goods movement into the thinking that is going on about urban growth policy. We are quite confident that it is not there now.

We call attention to the lack of information, the lack of data, and the lack of analytical techniques. There is a lot of work going on in all sorts of places about the urban future of this country, what is likely to happen, and how public policy can help things happen differently. It would be foolish to suggest that this particular effort should be saddled with larger responsibility of doing research in urban economics, which, obviously, is the responsibility shared by a lot of other people. The chances that these studies will worry about freight movement are not very great. They will not spell out what a given pattern of development means for movement of freight. They are more likely to spell out what it means for the movement of people. They are not likely to pay any serious attention to the reverse interaction, namely, how changes in the freight system might affect the likely development of cities. It is true that in the past they have affected development because in the past we were dealing with very large, discrete, dramatic kinds of things. Urban economists were sensitive to the fact that substitution of truck for rail had some important implications for urban development, but in the future when they deal with marginal changes, they are not likely to be trapped in their net. Therefore, we are not specifying 1, 2, 3, 4, or 5 research projects but recommend that efforts be made to get this dimension addressed in the ongoing research on urban development either by supplementing the work being done or by having projects that relate to these ongoing projects.

Finally, and this is my own suggestion and not that of the panel, I would reopen an old question that has been around for years in terms of the strategy for research, and that is the institute approach. I do not know the whole story, but I gather that back in the middle 1960's there was a serious dialogue going on in some parts of the government about a transportation institute. It never came to realization. An urban institute has come into being, but I do not think it bears the same relationship to the urban problems as an urban transportation institute would bear to the transportation problem and certainly not as urban goods movement would have to the urban area. There may be some benefits to this way of organizing research efforts. It does not mean everything gets done in that institute but that the institute can be an important intermediary between the government and the vast number of researchers at the universities and other places.

panel report

TECHNIQUES FOR IMPROVING COMMODITY FLOW BY APPLYING CURRENT KNOWLEDGE AND TECHNOLOGY

Robert C. Barnstead, panel chairman

The panel discussed ideas that appeared to be achievable in the near future. It was the firm belief of the panel that progress is made step-by-step rather than through any giant stride.

We first attempted to define an overall goal for urban goods movement, applicable to the short-term future, as follows: to provide an adequate level of service required by shippers and receivers of goods in urban areas and to minimize the costs and disbenefits by using current technology. To achieve this goal, we determined the following objectives: reduce interference in urban areas between goods movement and people movement, reduce noise, reduce environmental pollution, reduce costs, reduce social disruption, and effect more efficient land use. We discussed a number of ways of achieving these objectives by applying current knowledge and technology. Some of our recommendations are based on projected research studies and others on specific projects that, we believe, could be implemented.

To achieve the objective of reducing interference in urban areas between goods movement and people movement, we recommend 2 research studies to develop background information and a number of actual programs. The 2 studies include (a) a research study to assist in determining the major areas of concern through cost analysis of the causes, magnitude, and disbenefits of interference, and (b) a research study of the demand in terms of the mix of vehicles, types of goods, and delivery duration for loading docks for various types of buildings. The programs are as follows:

1. In a selected city, consolidate types of shipments such as by the common carriers or by certain types of private carriers. Through a franchise or licensing system, charge a fee to be paid by all vehicles including passenger cars and trucks using designated areas of the city. The objective here is to reduce the number of vehicles in congested areas by forcing consolidation of shipments and reducing the number of private vehicles.
2. To stagger the effect of peak movements of people and peak movements of trucks, undertake a feasibility study of after-hour delivery to stores and office buildings. The study should include the effect on families of employees required to work off-hours.
3. To separate goods and people movements, (a) on a scheduled basis designate streets for goods-movement vehicles by excluding private automobiles; (b) alternatively, on a scheduled basis designate streets to exclude goods-movement vehicles; (c) designate certain lanes on streets for the exclusive use of specified vehicles including trucks; or (d) designate other special traffic considerations within the structural framework of the municipal arterial system.
4. Study separate pedestrian circulation systems such as raising the level of sidewalks and entrances of stores and office buildings at a height above truck level.
5. Study underground or elevated conveyance systems for the movement of urban goods.
6. Encourage nonstreet loading and unloading through the development of adequate requirements in the design of facilities to handle freight in new buildings and in the designs for retrofitting facilities in older buildings.

To assist in the objectives of reducing noise and reducing environmental pollution, we propose that a study be undertaken of the operating characteristics of city trucks in use everyday in order to find the best alternatives of reducing noise and pollution. After the operating characteristics have been determined, solutions may become obvious such as the use of electrical equipment and propane equipment.

To assist in the objective of improving costs, we recommend (a) the encouragement of the use of modern management techniques including industrial-engineering techniques to improve materials-handling procedures, (b) the encouragement of the introduction of new equipment and better maintenance of old equipment, and (c) the development of methods to improve equipment utilization.

To assist in the objective of more efficient land use, we propose that a study be undertaken to identify goods-movement facilities where the disbenefits greatly exceed the benefits and to determine criteria for reclaiming land that is inefficiently used by freight facilities for use by other socially beneficial purposes or to improve the efficiency by exploiting multiple uses of the existing land facility to the extent that this is realistic. The intent is to reclaim inefficiently used land by shippers, receivers, and carriers and to find multiuses for presently dedicated land.

panel report

DEMAND FORECASTING AND DEVELOPMENT OF FRAMEWORK FOR ANALYSIS OF URBAN COMMODITY FLOW

Alexander French and Peter Watson, chairmen

The task of this workshop was to look at the possibility of forecasting demand for urban goods movement, outline an analytical framework, and suggest a series of studies. The efforts of the group resulted in the following 6 proposals:

1. Undertake resource allocation study of alternate levels of analytical resources to guide a research program likely to have high payoff to the urban planner, administrator, and other officials;
2. Make a comparative analysis of previous studies and available data that would be useful and provide a starting point for item 1;
3. Investigate, develop, and test methods of measurement now used or proposed for urban goods movement to identify the fundamental characteristics that are basic and can be summarized to other classifications (an example of one method of obtaining detailed information is given in Lieder's paper in this Special Report);
4. Review ongoing activities, such as the transportation census, at an early date to identify areas where modifications in procedures could prove useful for urban goods movement analysis;
5. Test, modify, and refine the general framework for the analysis and forecasting of urban goods movement that has been outlined; and
6. Review and undertake specific study projects that have been developed.

The first 4 proposals are believed to be almost obvious and essential first steps and require little discussion. It was felt that before embarking on any serious study of this problem, it was first essential to establish that a problem does exist and that resources devoted to its study would be well spent. To this end, it was suggested that a feasibility study be carried out to investigate the possible outputs of studies of urban goods movement and the uses that could be made of such outputs. One suggested starting point is a comparative analysis of the work that has already been carried out on urban goods movement. That a great deal of work has already been done is beyond question, but the diverse nature of the work and its location in a number of places ranging from professional and academic journals to trade journals make its assessment somewhat difficult. It is felt that a literature survey culminating in a critical assessment of the work already undertaken and the production of an annotated bibliography are certain to be of priority importance in this field. There are a great number of units, such as consignments, ton-miles, truck loads, and dollars, that are used to quantify goods movement. These should be reviewed in relation to data collection techniques and analytical uses to determine efficient fundamental data items and collection procedures. It is further suggested that some investigation be made of the activities of the U.S. Bureau of the Census. It is known that the bureau is involved in some data collection activities involving the movement of goods, and it is thought essential that such activity be coordinated with other government-sponsored activities investigating the movement of goods.

The analytical framework and the list of specific projects are more complex and will be treated in detail.

STUDY FRAMEWORK AND MODELING

Any discussion of demand forecasting inevitably leads to a discussion of modeling, and the output of this workshop is no exception. The building of the model or model system, however, is not a simple matter. The selection of the relationships to be modeled and the form of the models themselves depend to some considerable extent on the use to which they will be put and on the requirements of the organization that commissions them. The discussion that follows will, therefore, be couched in general terms in the hope that the model framework suggested will be sufficiently general so that it can be modified to take account of the needs of various commissioning organizations.

It is appropriate at this point to make a few comments on the types of models that may be built. It is possible to build micromodels or macromodels. A micromodel is concerned with explaining the relationships involved in the movements associated with one commodity or one building. In other words, a micromodel concerns itself with all the demand characteristics of, for example, television sets or with all the demand characteristics of an office building. A macromodel, on the other hand, concerns itself with the larger picture. It attempts to model the movements of all goods among all locations—industrial, residential, and commercial—within the urban area. It is felt that the study of the movements of goods in urban areas requires macromodels.

It is also possible to build short-run or long-run models. The building of a short-run model implies that we expect relationships to remain constant or change very little in the near future. Thus, it is only necessary to make predictions of the dependent variables in the model in order to predict the level of demand. In contrast, a long-run model renders the assumption of a constant relationship unattainable, and the building of a long-run model implies that we are interested in trying to forecast changes in the relationships that we are modeling. Although this is an interesting research topic, it is felt that the present emphasis should be on short-run modeling.

Finally, it is possible to build sequential or parallel modeling systems. A sequential modeling system means that the inputs to one model are the outputs of the previous model and that there is no interaction between other elements of the model system. For example, the standard urban transportation planning package assumes that trip distribution, generation, modal choice, and network assignment models operate sequentially and that the mode-choice decision is quite distinct from the trip-generation decision. A parallel model system would be designed in such a way that all the relationships in the system could be estimated simultaneously by the use of mathematical programming or other similar techniques.

It seems logical in an attempt to develop a model framework for goods movement to start with the framework for the analysis of people movement that already exists. Therefore, a discussion of the models used to forecast demand for passenger movement follows. A typical urban transportation planning package begins with a model to generate traffic from the various zones into which the area is divided. It does this by relating the number of trips observed to originate in a given zone with the characteristics of that zone. The characteristics may include income levels and land use. The model system proceeds to distribute these generated trips among the zones that compete as destinations. This is done by using a gravity type of model or an opportunity type of model. In concept, the characteristics of the zone are related in some way to the number of trips that have their destinations within those zones.

In terms of a model system to model demand for the movement of goods, this means taking the trip-generating and trip-attracting characteristics of the various units within the system, i.e., factories, offices, and residences, and generating from them the trips or shipments that would be made among the various units. The level of service desired by the system is established, and then these needs are allocated over the physical network. In the people-movement case, this is done by 2 models. The first of these assigns the desired level of trips between the different modes of transport

available, and the second assigns those trips being made by automobile over the alternative native routes through the road network. Although the trip-generation and trip-distribution models seem readily convertible for the analysis of goods movement, the modal choice seems less applicable. As has been heard before, most of the goods movement problems in urban areas are associated with trucks. This leads us to try to redefine a mode in such a way that the definition will not simply indicate the mode used, whether rail or truck or pipeline, but also indicate some of the characteristics of the service. For example, it may be possible to subclassify the truck mode into a number of alternatives, such as a truck carrying ready-mixed concrete, a truck carrying washing machines, or a small van carrying parcels. In order to distinguish the reclassified modes, the term "means" was coined.

Clearly, the problem of classifying the trucking mode into means is tied up with the problem of measuring urban goods movement. The question of units has previously been raised, but it is sufficient at this point to mention simply that it is still undecided whether goods movement should be measured in terms of ton-miles, consignments, weight, value, some combination of these, or some other measure. Having established the distribution of the goods between the various means available, we must allocate the movements thus obtained over the physical road network. A number of sophisticated computer techniques are available for doing this, but it is felt that they are likely to require modification because they tend to operate on the basis of finding minimal costs or minimal time routes through a network between 2 points. The fact that goods movement often involves multiple destinations, i. e., delivery trips, it is possible that the network assignment model will have to be modified. It is also likely that an interference model will be required to reflect the extent to which flows by one means influence the characteristics of flows by other means. For example, if parcel trucks and dump trucks are traveling on the same road, an increase in the number of dump trucks will adversely affect the operating characteristics of the parcel truck. Operations will slow down; waiting time, opportunities for collision, pilferage, and costs will increase. It is, therefore, necessary to build into the model some reflection of the way in which one movement will interfere with other movements.

Clearly, in order for such a model system to be useful to operators, their needs have to be built in. First of all, it is necessary for the system to output the costs of moving goods by different means and over different routes through the network. Second, it is necessary to build in some constraints based on the preferences of the shippers. The question of time reliability may be important for some goods, particularly for perishable goods because they must be delivered before a certain time. For other goods, arrival ahead of time may involve additional warehousing costs and be equally undesirable. Some shipment may be vulnerable to damage or loss; other shipments may not.

So far, the discussion has dwelt on possible comparison between people and goods movement and has introduced some of the features that a demand modeling system include. It is felt that the framework for analysis that follows includes the good features of the people-moving analysis system but is extended to cover some elements omitted by the people-moving analysis system and also to take particular account of some factors important to goods movement. This model framework was suggested by a proposal presented in this Special Report by Goeller. Figure 1 shows the conceptual framework for analysis, modeling, and forecasting.

Some urban transportation planning analysis procedures have been criticized for failing to take account of the effects of travelers' location decisions on their travel behavior. Because location decisions related to goods movement often involve explicit consideration of transportation characteristics, this framework begins with the location of industry. The first model in the system explains why industries locate in certain places. Such a model may relate industrial location to factors such as rents in various places, taxes, availability of labor, and costs of transportation.

After the location of industry is examined, the second step is to investigate the interindustry transactions. This involves examining the operations of each industry in order to see what kinds of demands it creates for goods and what kinds of products are produced. In other words, the model will tell us, if given the locations and types of

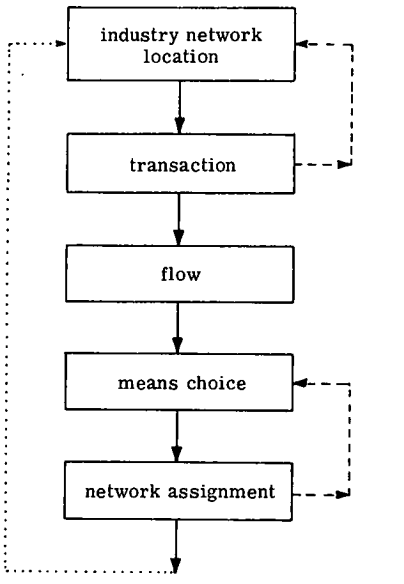

Figure 1. Conceptual framework for analysis, modeling, and forecasting urban goods movement.

industries, what output they will produce and what demand they will have from other industries. It should be noted at this point that the term "industrial location" is sufficiently wide to include the location of residential and commercial units. The first 2 models will indicate why different activities locate at different places and what demands they create and what outputs they produce.

The third model in the system is a flow model that will explain how the outputs of the producing units and the consumption of all units will be coordinated. Thus, if given knowledge of the production and consumption desires of the various activities, the flow model will show the flow of goods over the system that would be necessary to coordinate the production and consumption.

The fourth model in the system will allocate these flows to the different means as defined earlier. It is felt that the model that will do this will have conceptual similarities to the modal-choice model for person travel that is used in the urban transportation planning package.

Finally, when it is known what the flows will be and how they will be distributed over the means in the system, it is necessary to assign these movements to the network. Again a similarity to urban planning procedures is evident.

The framework that has been described in general terms is set up as a 5-model sequential system and is, as described, extremely general. It has, however, a number of properties that make it useful for the problem under consideration. As described, the model system is sequential, but it is thought that mathematical programming techniques can be used to convert the sequential system of models into a simultaneous system of models, thus making interactions among the models possible.

Also, the model is set up in 5 steps, but it is thought that some of these steps can be collapsed. In particular, it is possible to collapse the transactions and the flow models in order to produce a single model that generates the interunit flows from a knowledge of the production consumption properties of those units. It is also thought that it may be feasible to collapse the mean choice and network assignment models in order to allocate simultaneously to means and the physical network. Another interesting property is that the system can be recycled and solved by an iterative process. Having started with the location of industry, one can work through the system generating flows and allocate them over the network. It is then possible to investigate the way in which the level of flows generated by the models on the network affect the location of industry. Should the location of industry be changed, the flows from the new locations can be generated and reassigned over the network. It is thought that this iterative property will be most useful.

The final property of interest is that it is not necessary to work through the complete modeling system. It is possible to omit the industrial location model and, if there are fixed industrial locations, to look at the levels of demand in terms of flows desired between units. It is also possible to leave out the industrial transactions model and, by taking the consumption and production flows as given, to calculate the flows necessary to optimize the system. It is even possible to dissect the last stage of the modeling system and to look simply at the problem of the efficiency of routing through the network. Given movements by specific means, one can consider simply how to move them

most efficiently through the network. It is thought that this final property is most important. The panel feels that it is not necessary to find a once-and-for-all solution to the whole problem of urban goods movement. Different people can move in at different points and tackle different aspects of the problem. It is unlikely that the whole problem will be solved all at once, but it is thought that the modeling framework described is sufficiently flexible to allow progress to be made in small steps.

Having set up a framework for analysis of urban goods movement, one must specify the levels of activity at which it can be used. It is felt that there are essentially 2 levels at which this problem can be tackled. The first level has been called the "quick-and-dirty" model. It is clear that planners need results, not in 10 or 15 years but now, and it is essential that a model system, however crude, be evolved relatively quickly. In order to ensure development beyond the quick-and-dirty stage, a theoretical approach to the problem has been suggested. It is suggested that economists be put to work looking at the problems of industrial location and interindustry transactions and that computer specialists and mathematicians be set to work on problems of network assignment. In short, let some theoretical work be done on the problems with which we are dealing so that 10 years from now we are not still operating with the quick-and-dirty model and pretending that it is justifiable. It is necessary to use experience with the quick-and-dirty model in conjunction with the proposed theoretical work in order to develop a second-generation model and possibly a third-generation model so that the modeling procedure continues to improve and the information given to planners and other consumers of demand data are as good as possible.

PROJECTS AND STUDIES

A number of goals have been suggested for an urban goods movement study. One that seems generally accepted is stated in general terms such as ". . . improvements in the efficiency of activities as related to urban goods movement." There appear to be a number of objectives to be achieved on the way to this goal, many of which have not yet been recognized nor agreed on. On the other hand, there are well-identified strategies and tactics available for achieving the goals and objectives of an urban community. To sharpen the focus of some of the proposed projects it seems worthwhile to discuss these as they relate to the various elements of the analysis framework. These relationships are as follows:

Analysis Framework Element	Strategy and Tactics Available to Government
Location	Zoning Taxation of land Fees for and accessibility to services
Transactions	Antitrust laws Taxation of sales, inventory, and income Licensing and franchising
Flow	Licensing and franchising Policing Traffic operation
Means	Licensing and franchising Zoning and building codes
Network	Capital improvement Policing and parking regulation Zoning and building codes
All	Research and analysis Education and dissemination of information Funding

Because these strategies are in operation every day, the various elements of goods movement activities are evidently being modified to some degree. Thus, it is suggested that, in pursuing the projects discussed subsequently, attention be directed in the analysis to the elements that are sensitive to these and other identifiable strategies and tactics available to government.

Let us turn to research projects for an attack on these problems. The following projects are discussed in order of increasing complexity, and those listed first are studies through which a candidate for a master's or a doctoral degree might make a substantial contribution: (a) a study of a single commodity or commodity category in an urbanized area; (b) a study of an activity center, a single office building, or a single industrial park that is small enough in scale to be understood, measured, and analyzed and that involves different goods movements that can be traced and described; (c) a study of prototypical cities at a scale that can be analyzed comprehensively at a minimum cost and in which techniques can be tested quickly and economically; (d) examination of the goods-persons movement dichotomy to determine what the problems really are in using subways for moving solid waste or making certain deliveries, at night or other off-peak periods; and (e) development of a demonstration project to test the feasibility and effectiveness of various alternative shipment consolidation and clustering procedures including the procedures described in this Special Report by Wood to minimize vehicle-miles per ton delivered and achieve other efficiencies. Different prototypical cities referred to in (c) can be readily compared. Albuquerque, New Mexico, Sioux Falls, South Dakota, and Hagerstown, Maryland, have previously served in this role for other purposes and may provide extensive related data at minimum cost. It must be remembered that each city is unique, so that study of prototypical cities will help to develop techniques. Substantive relationships observed in 2 or 3 small cities are not expected to be applicable to other cities because of differences in industry mix, geographic orientation, and other variables.

EVALUATIONS AND OTHER STRATEGIES

There are important problems that cannot be specifically incorporated into a modeling system because they cannot be satisfactorily scaled. These are described as evaluations and are discussed in the following.

Environment impacts of various kinds have been mentioned. In addition to amounts of air pollution and noise, there are other annoying effects that are little understood; all of these must be identified, classified, and evaluated.

There are measurable impacts that would be relatively difficult to measure and feed into a model. In many cases a great number of measurable variables can be identified as "significant" in the statistical sense, but it is extremely difficult to devise a model that is realistically sensitive to more than 5 or 6 variables. Under particular conditions certain of these additional significant variables may be critical to a particular decision. These should be identified and evaluated subjectively.

If the cost-effectiveness study shows that extensive detailed urban goods-movement analysis is worthwhile, then a curriculum unit in the subject would be worthwhile. This curriculum unit would be designed to be adaptable to many types of undergraduate and graduate courses in business administration, transportation economics, planning, civil or industrial engineering, and other suitable fields.

The benefits and costs of staggered hours as related to urban goods movements should be investigated. From the discussion in this Special Report by Foreman and Weiss, there are costs and benefits to urban goods movement resulting from staggered hours, night delivery, and other scheduling adjustments. These procedures should be studied.

Finally, there is no point in developing modeling and analysis procedures if they are not useful in identifying and guiding desirable policy changes. As the discussions and findings of this conference are circulated and as some of the proposed studies are completed, goals can be identified and the need for policy change determined. Candidate policy changes should be identified promptly to provide helpful definitions and targets for other study efforts.

CONCLUSIONS

It is probably safe to say that this panel agreed that, in view of the resources currently involved in providing urban goods movement, an effort to obtain a better understanding of the costs and interrelationships is worthwhile. At the same time it was considered important to avoid the temptation to develop either overly simple or excessively complex procedures that do not provide useful solutions to the day-to-day problems facing urban planners and administrators. These include zoning, parking regulations, tax rates, and capital improvements. A number of study activities have been suggested for consideration. Only the first four—analysis of study payoffs, comparative analysis of previous studies, methods of measurement, and review of ongoing census activities—are recommended without qualification. It is noteworthy that analysis of study payoffs is listed first. This reflects the concern for efficient use of limited urban transportation analysis and planning resources in the face of rapidly increasing demands for these resources. In addition, a modeling framework has been suggested to help guide analysis of immediate problems toward a long-range forecasting capability.

APPENDIX

DEMAND FORECASTING AND DEVELOPMENT OF A FRAMEWORK FOR ANALYSIS OF URBAN COMMODITY FLOW: STATEMENT OF THE PROBLEM

Charles A. Hedges

The genesis of the Conference on Urban Commodity Flow was the interest of the U.S. Department of Transportation in the development of techniques and data to analyze and forecast the demand for the movement of goods within urban areas. Although sophistication in the treatment of passenger travel demand has been taken for granted for some time (or at least since the 1962 Federal-Aid Highway Act), explicit treatment of the demand for urban goods movement was not considered before 1968. In April 1968, the Bureau of the Budget (now the Office of Management and Budget) requested the Department of Transportation to inaugurate a continuing study of transportation demand forecasting. The department was instructed to "review current forecasting methods for the various modes to create a methodology for projecting a range of transportation demand," and to

> . . .improve the methodologies by. . .taking into account:
>
> A. Technological changes, including shifts between modes or substitutes for transportation (e.g., communication developments, industrial location)
> B. Feedback among variables
> C. Internal analytical consistency
> D. Sensitivity tests of the models and their use.

After we began to investigate urban goods movements, concepts such as feedbacks and interdependencies took on new meanings. Rightly or wrongly, we concluded that even more than for urban passenger travel urban goods movements cannot be understood apart from land uses, industry location, and interfaces with intercity freight (i.e., terminals), particularly over the long run. Interactions with people movement are obvious but at the same time more subtle than most realize. Urban commodity flow also is intimately related to larger questions such as those relating to urban form and environment.

It was the hope of the conference Steering Committee (and particularly the Canadian Ministry of Transport and the U.S. Department of Transportation) that the conference would produce ideas and suggestions for developing frameworks (models) to analyze and forecast the demand for the movement of goods within urban areas. It is anticipated that these notes will serve as a point of departure and provide some guidance to this end.

NATURE AND USES OF INFORMATION CONCERNING THE DEMAND FOR URBAN GOODS MOVEMENTS

The Nature of Demand

There has been a discernible trend in recent years for transportation analysts to treat the demand for transportation services as a functional relation between the number of units of a given transportation service consumed per time period and the major determinants of the number of units consumed. For urban passenger travel, for example,

the number of automobile commuting trips is related to the following characteristics of both automobile and transit trips: (a) different levels of price, e.g., vehicle operating costs, user charges, and fares; (b) door-to-door travel times; (c) socioeconomic characteristics of travelers, particularly income levels and automobile ownership; (d) service characteristics, e.g., privacy and transit schedules; and (e) land uses, particularly at the place of employment. A similar list of the logical determinants of the demand for the movement of freight can be developed. The characteristics of the commodities would constitute one obvious set. Fashion items, perishables, and waste materials all require different types of handling. Institutional considerations are probably more important in some instances, for example, the normal working hours of those engaged in transporting, unloading, and receiving freight.

The Uses of Demand Information

The data sets that describe the functional demand for transportation services contain a wealth of information. Among the potential uses of this information are the following: to explain existing relations between the volumes of a particular commodity carried between 2 areas and the key determinants affecting these flows, such as freight rates, shipment time, and land uses at the points of origin and destination; to predict the effects of changes in the key determinants, e.g., increased shipment time as a result of conflicts between freight vehicles and passenger vehicles; to forecast future demands for commodity flows in response to changes in city size and structure, transportation network, and income and population over time; and to evaluate the benefits and the costs of decisions that will affect commodity flows.

The Users of Demand Information

The potential market for better information concerning the demand for the transport of freight within urban areas is quite large. It includes the following:

1. Urban and regional planners who are concerned with urban form and structure and who must make estimates of the facilities required to transport both passengers and freight corresponding to different rates of urban growth, different types and intensities of land uses, and alternative industry locations;
2. Suppliers of transportation and terminal services who must make decisions concerning the types and the amounts of services to offer and the rates to charge;
3. Manufacturers of transportation equipment who must consider what types of equipment to market, including innovations such as secure containers for night delivery;
4. Labor unions that assess the market for labor services and the effects of demands for higher wage rates;
5. Regulatory agencies, e.g., state public utility commissions and the Interstate Commerce Commission, that assess the impacts of changes in rate structures and change the boundaries of terminal zones in urban areas or abolish them altogether;
6. Federal and state legislatures that determine the types and the amounts of user charges and financial assistance for carriers and terminal operators;
7. Federal Highway Administration that treats explicitly relations between urban goods movements and congestion, land uses and zoning ordinances, and industry location in the FHWA-approved urban transportation planning process;
8. Federal Aviation Administration and the Federal Railroad Administration that plan for the location of terminal complexes, anticipate the types of facilities necessary for these terminals, and provide links between these terminals and the urban shippers and receivers;
9. Urban Mass Transportation Administration that assesses the feasibility of urban transportation systems capable of serving both passengers and freight;
10. Office of the Assistant Secretary for Transportation and Urban Environment that evaluates urban transportation planning and considers the environmental effects, particularly air pollution and noise, of alternative technologies for moving commodities;
11. Office of the Assistant Secretary for Policy and International Affairs that develops policy and evaluates alternative federal-aid programs; and

12. U.S. Department of Housing and Urban Development that relates urban transportation requirements to urban growth and development.

MODELING THE DEMAND FOR URBAN GOODS MOVEMENTS

What Kind of Model Do We Want?

Just as a package of models is needed to forecast urban passenger travel demand, separate models probably will be needed to deal with different facets of the demand for urban goods movements. At some stage in estimating the demand for goods movements within an urban area, however, it appears that urban transportation planning requires a comprehensive framework to relate the demand for urban goods movements to the major economic activities. Such a framework, ideally, will have the following characteristics:

1. It will be behavorial or structural, i.e., it will describe the relationships between the specific transportation service demanded and the key determinants of the demand (as discussed earlier in the section on the uses of demand information);
2. It will be multimodal or at least be capable of handling more than the truck mode (even trucks might not all be treated as a single mode for some purposes);
3. It will include passenger as well as goods movements and show how and where the two conflict;
4. It will show the feedback effects of changes in policy variables (transportation investments such as increasing street or highway capacity affect land uses, and changes in land uses may produce significant changes in the types and quantities of goods used and in the demand for goods movement);
5. It will be dynamic, i.e., it will show the movement from one equilibrium to another in response to changes in policy variables; and
6. It will have general applicability, i.e., it can be applied to cities with similar topographical, demographic, economic, and transport characteristics.

The model should assist in answering the following types of questions: What are the effects of congestion on the demand for freight movements (both total demand and by mode), on land uses, and on industry location? What are the effects of changes in "institutional boundaries", such as zoning laws and commercial zones, on land uses, particularly as they relate to freight terminals? How efficient are existing and proposed networks under varying assumptions concerning the hourly distribution of freight and passenger traffic? How can interrelations among modes be determined in order to identify potentials for intramodal and intermodal consolidation and coordination? Is there a market for innovations in goods movements, and what are the savings that might be achieved from innovations? What are the alternatives for reducing the interface costs between intercity and intraurban freight movements? What will be the effects of changes in government programs and policies, e.g., truck size and weight restrictions, and in user taxes?

The Dimensions of Urban Goods Movements

So far, there have been few attempts to define the dimensions of urban commodity movements. Although it does not exhaust the number of items that might logically be collected, the following stratification scheme is suggested; more detailed stratifications are given elsewhere (1, 2):

1. Definition of urban goods movement: package goods, dry bulk, liquid bulk, and dry flowable;
2. Characteristics of freight: physical state (liquid, gaseous, or solid), density, bulk or package, nature (durable versus fragible, perishable versus nonperishable, hazardous versus inert, odorous versus odorless), and value;
3. Characteristics of freight handling: mode, packaging (including use of containers), size of shipment, break-bulk, and institutional constraints (labor unions, terminal zones, restrictions on loading and unloading);

4. Freight service characteristics: frequency of service, hours and days of service, average delays, average loss or damage, average speed, and rate per ton-mile based on Standard Transportation Commodity Code (STCC);
5. Characteristics of orgin and destination: geographic location and type of establishment (land use);
6. Mode (vehicle) characteristics: type of vehicle, size, weight, and load-carrying capacity; and
7. Direction of freight movements: internal (intraurban), through, inbound (imports), and outbound (exports).

Demand for Urban Movements Versus Demand for Urban Passenger Travel

The similarities are as follows: Both are sensitive to the level of economic activity within a metropolitan area; both have pronounced peaks during weekdays; except in the most densely populated cities, both are carried predominantly by motor vehicles and frequently over the same rights-of-way; and for both the bulk of the travel occurs during the daylight hours on weekdays.

The differences include the following: Demand for goods movement appears to be more sensitive to seasonal and cyclical influences; passenger peak volumes typically precede and are more pronounced than observed freight (truck) volumes; passenger movements usually are 2-way (round-trip) movements, while goods movements usually are a series of 1-way flows; trip ends for commodities are not as dispersed as those for passengers; trucks, particularly delivery trucks and those with 2 or more axles, make more trips per day than automobiles; demand for freight transportation services is much more heterogeneous than the demand for passenger transport (goods vary widely with respect to perishability, value, density, and the like); goods movements require more modal interchanges and transfers; documentation is essential in goods movements; a greater proportion of the drivers of freight vehicles belong to labor unions; and freight data are more difficult to obtain than passenger data. A more complete list of differences is given by Pixton (3).

Present Practice

How are goods movements treated in present urban (or regional) transportation (or transportation-land use) models?

1. Are the weights attached to goods movements representative of the market demand, and are goods movements treated explicitly; or is it implicitly assumed that the pattern of freight movements is adequately represented by passenger travel (i.e., goods and passengers have the same origins and destinations), that goods movements can be expressed in terms of numbers of truck trips, and that the latter may be reduced to equivalent numbers of passenger car units?
2. Are the interactions or feedbacks between transportation and land use recognized and treated explicitly?
3. Are the frameworks city-specific or general in their applicability?
4. Are the models intended to deal with specific points in time, or are they designed to include time as one of the variables; or are future demands estimated by multiplying past trends by a (constant) growth factor?
5. In addition to land uses, what other variables are treated explicitly, especially type and characteristics of commodity, amount (weight) of shipment, mode and type of vehicle, trip length, elapsed time from origin to destination, cost of movement (tariff structure), and terminal characteristics?

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FREIGHT TRANSPORT IN URBAN AREAS: ISSUES FOR RESEARCH AND ACTION

Bruce F. Goeller

During 1967, the Summer Program in Urban Transportation was conducted by the Rand Corporation under the joint sponsorship of the U. S. Department of Housing and Urban Development, the U. S. Department of Transportation, and the Rand Corporation. The program brought together persons of diverse professional endeavors—administrators, planners, architects, physical scientists, and policy analysts—to consider selected, outstanding topics in urban transportation in a series of working seminars. The primary intent was to identify those issues requiring near-term government attention (by all levels of government) and those deserving the attention of the research community.

One seminar considered freight transport in urban areas. It began with a problem paper to focus the discussion and continued during the 2½ days with discussion that probed various facets of the topic. This paper summarizes, structures, and synthesizes the ideas developed in those discussions. It is meant to provide a thorough list, in context, of issues requiring government and research attention for freight transport in urban areas. Accordingly, it poses the issues only in skeletal form: No priorities are assigned and no step-wise research programs are presented.

Admittedly, this paper is a "period piece": It lists issues for research and action, but vintage 1967. However, most of the issues raised in 1967 are still relevant and pressing today. (Some have been partially or totally ameliorated; e.g., there is now a special office in the U. S. Department of Transportation that deals with the freight data base issue, and containerization has progressed.) Thus, it should be fruitful to begin a 1970 study of urban commodity flow problems by examining a 1967 study of such problems to gain perspective and to see which ones still obtain.

In the United States, freight transport accounts for about 9 percent of the total annual expenditures for goods and services, very nearly as much as passenger transport. And yet while the problems of passenger transport have become subjects of great concern, those of freight transport have received relatively scant attention from either government or the research community. They should receive more. It is not logical to concentrate nearly all research attention on the passenger transportation subsystem when freight and passenger transportation together compose the transportation system for the nation and for individual urban areas. Complementary studies of both kinds of transportation and their interrelations are necessary if we are to better appreciate the economic and social consequences of transportation and transportation investments.

Moreover, with the expansion of urban areas and the decentralization of population and manufacturing to the suburbs, there has been a growing mismatch between the existing systems for freight transport and the developing patterns of freight demand. The ultimate effect may be to lower the efficiency of freight transport, to raise its social and economic costs, and to aggravate the already critical traffic problem within cities. Already freight transport manifests the following range of symptoms.

1. The transfer of freight among modes and among carriers is inefficient; e.g., the time spent handling freight in terminals often exceeds that spent hauling it between cities.
2. There is interference between freight and passenger vehicles; e.g., trucks engaging in curbside loading and unloading frequently impede the flow of passenger vehicles.

3. Valuable land is used inefficiently by freight terminals; e.g., railroad marshalling yards currently sprawl over large areas of some central cities, while many of their shippers and consignees are located in outlying areas.
4. Some freight operations produce noise and air pollution.

In the following discussion of these and related problems, primary emphasis will be on problems of intraurban freight transport, but interurban and international transport are also considered insofar as they interface with intraurban operations. The discussion will focus on 4 major problem areas: (a) movement of urban freight, (b) interaction of freight and passenger traffic, (c) urban form and quality, and (d) roles for government in urban freight transport.

In the discussion of these subject areas, the goal has been to identify the principal problems of urban freight transport and to suggest issues that require either near-term attention by government or freight-transport operators or long-term attention by the research community. It is hoped that investigation of these issues will afford new insights into the present and future problems of urban freight transport—their possible causes, consequences, and cures.

MOVEMENT OF URBAN FREIGHT

Although urban freight movement occurs continuously, it is nevertheless virtually impossible to describe adequately or to predict for the future. Available data on the subject are sparse, known relationships are tenuous, and existing research studies are fragmentary. Therefore, we must more fully understand the characteristics of freight movement and the factors influencing demands for it before we can properly assess the need for and the importance of improved freight-handling technology or management techniques, or many of the other issues raised in this paper.

Description of Freight Movement

To understand freight transportation, we must first identify and then quantify its significant variables. What do we know about freight movements in cities that differ in size, topography, and spatial pattern? An analysis should determine as fully as possible how these movements can be characterized by factors such as the following:

1. Demand generators (What volume of freight movement is generated within an urban area by factories, by residences, by retail and wholesale establishments, by service industries, and by transportation facilities, particularly seaports, airports, and rail hubs?);
2. Characteristics of freight (What are the significant characteristics—volume, density, value, origin and destination, shipment size such as number and weight of pieces, perishability, volatility, or fragility—of the freight moved? How do they vary with the different demand generators, particularly for freight in the commodity classes of high bulk, high value, general manufacturing, and merchandise?);
3. Kinds of movements (What part of the freight is to be transformed within factories in the urban area? What part is to be consumed within the urban area, shipped within the urban area, or shipped to other urban areas?);
4. Characteristics of flow (What are the types, performance, and mix of freight vehicles? What volumes will be carried by different vehicles at different times on different days in different parts of an urban area? What will be the duration and frequency of stops? What are the changes of carriers and of carrier modes?);
5. Length of movement (What part of the freight movements are intraurban, domestic interurban, or international? How does the length of movement correlate with other factors, such as the demand generators and freight characteristics?); and
6. Freight carriers (What part of the freight enters, leaves, or moves within the urban area by air, by truck, by train, by ship, or by pipeline? How do the factors listed here influence the selection of type and mode of freight carrier?).

The creation of a freight taxonomy does not in itself adequately describe freight movement. The analysis should also assess whether our present tools can adequately

measure such factors and their influence on freight demand. If not, then further analysis must be done to develop adequate tools that will enable us to characterize freight movement in terms of variables for which data can be gathered, leading to quantitative descriptions.

It would remain for later studies to quantify these variables for different urban areas, for different places within an area, and for different days, seasons, and times of day. A series of studies having specific goals and moderate scope would probably be more informative than a few big studies. However, if such information is to be of real utility, the urban areas considered should be representative of a range of urban forms and sizes. The studies of freight movement in these selected cities would be somewhat analogous to the origin-destination studies that have been done for passenger movement in various cities. Their results should help to indicate the relations among variables and provide meaningful background for planning.

Prediction of Freight Movement

We are concerned with predicting future patterns of urban freight demand so that we can plan and prepare for them. Future demands will depend on various social, economic, and technological trends for the major classes of urban freight (e.g., retail delivery and bulk industrial). For example, the currently predicted increase in the proportion of service industries in our economy could shift the composition of freight demand. The continuing decentralization of population could result in the further growth of suburban shopping centers and the decline of central-city retail freight demands. The predicted shift from fossil to fissile fuels could greatly reduce demands for coal and petroleum movements. Improved performance from new transportation methods and materials-handling techniques could markedly change the proportions of freight carried by rail, by road, by pipeline, and by air.

Future Trends—Before future demand trends can be predicted, we must determine what is known about the relationship between urban freight-transportation demand and trends in the following factors: level and composition of economic activity, manufacturing locations, technology, and transportation methods. An analysis is needed to identify the major trends in these factors and to assess their potential impact on urban freight demand in the longer term. For example, what would the 1990 demand for crude oil movement be after an earlier switch from fossil to fissile fuels? The analysis might profitably apply the Delphi method (1, 2) or similar techniques for the systematic use of expert judgment in addition to surveying relevant sources. It is also important to identify what additional information is required to better assess such trends and their potential effects.

Freight-Demand Model—A freight-demand model should be developed that explicitly identifies and relates the major variables that characterize freight, its movement demands, and its transport systems. (A question for early resolution would be the proper scope—urban area, urban region, or entire nation—for such a model.) The model would incorporate the factors that influence a shipper's choice of mode and carrier, including capacity, price, freight characteristics (e.g., high value or fragility), and level of service. Although such a freight-demand model would be highly aggregated, at least in its initial form, it would nevertheless serve as a useful tool for predicting the short-term impact on freight demand of proposed measures; it could indicate how a change in one mode's prices might alter the overall demand. Moreover, the very attempt to develop a freight-demand model would be useful in that it could make evident the weaknesses in our data and knowledge about relations among different demand variables.

Forecasting techniques presently applied in passenger transportation and in other fields may be useful in constructing this model. Specific consideration should be given to time-series analysis, computer simulation, and other mathematical-modeling techniques. The proper time horizons for freight planning should also be analyzed; that is, how frequently should freight-demand estimates or the data on which they are based be updated?

Performance Functions—In parallel with work on a demand model, research is also needed to develop supply-performance functions for freight-transportation systems in

the present and near term. These functions should indicate how travel time, the level of service to the shipper, or some other performance measure would change with movement volume and with the mix and characteristics of freight vehicles on the links of the freight system. The aim would be to develop a tool capable of predicting, for example, how the performance of a particular mode might vary with different vehicle mixes, or how the introduction of an improved-performance vehicle might change operational costs (and for whom). The research should attempt to identify selected case studies of value. For example, what happened to the level of service when White Plains, New York, excluded truck traffic during certain peak hours?

Costing Methods—The development and distribution of good costing methods (relating transport performance and operating costs to design and operational factors controllable by transport managers) should be undertaken to improve freight-management and planning capabilities. Better methods for making parametric trade-off comparisons of costs and benefits for alternative investments could materially improve the transport operator's ability to perform investment-return evaluations; it has been asserted, for example, that the primary reason railroads took so long to accept the diesel locomotive was that they were unable to cost it properly. Better methods for description and analysis of costs could help management improve efficiency and determine appropriate rates; for example, the inability to differentiate between the costs for freight and passenger movement when an aircraft carries both is a major problem of airline management personnel. Better cost data would aid in the setting of equitable rates and tariffs.

Data Base—What information about present freight movement and demand is necessary to make projections into the future and to make proper management decisions? Research is needed on the desirable composition and format of freight data (prices, costs, volumes, and movements) for all modes and carriers. Voids in the data should also be identified. Moveover, the data are often too highly aggregated to be useful for management or planning; sometimes different pieces of data are not comparable, and sometimes there are problems of data confidentiality. Research should be done on possibilities of a common freight-data reporting system that would emphasize collection and distribution of richer and better data for time-series analysis and other freight forecasting. Methods of data collection must be evaluated. Should the system gather its data in real time or by periodic updates? If by periodic updates, how often should they occur? In view of the competitive nature of freight transportation, it will be necessary to decide what limitations on data access might have to be imposed on carriers and shippers. There is also the question of who would manage such a system. Should the ICC, some other government instrumentality, or a private consortium?

Freight Management

Meeting the future demands for urban areas will require more than the development of improved vehicles or freight-handling technology. Existing problems, such as inefficiencies in central business district freight distribution and difficulties in tracing freight shipments, must also be overcome. The solutions to these problems, and to others that were raised, will require managerial as well as technological approaches.

Many problems and inefficiencies occur at interfaces between different freight-transport modes, different carriers, and different vehicles and at interfaces between intraurban and interurban freight. Each truckline that services an urban area normally picks up and delivers all the freight it carries, which results in duplication of routes and in partially loaded vehicles. Accordingly, it has often been suggested that effectiveness of freight transportation would be enhanced by greater consolidation of shipments, by greater coordination among routes and carriers in an urban area, and by better coordination between transport modes (interurban and intraurban). These enhancements can be achieved by the use of freight-transfer facilities such as union terminals and intermediate distribution centers. For different sections of an urban area, these facilities would handle both incoming and outgoing freight; shipments would be sorted and consolidated, then transferred to the appropriate vehicles.

Freight Terminals and Interfaces—The following issues pertaining to freight terminals and interfaces deserve special attention:

1. What are the present and prospective magnitudes of the problems of friction and inefficiency at interfaces between modes and between interurban and intraurban carriers? How can these problems be reduced?
2. What should be the characteristics of union terminals and intermediate distribution centers? Where should they be located? In what manner should zones of service be matched to sections of the urban area?
3. How can coordination and cooperation among transportation companies be encouraged? To what extent and in what ways should such coordination be encouraged by government action? Specifically, what are the trade-offs between coordination and competition? How can billing be handled for the load-swaps between carriers that may occur through such coordination? What labor problems could arise under these circumstances?
4. Should terminal facilities be publicly or privately owned? Will they better serve the public interest if they are profit-making or nonprofit?

These issues would best be explored through case studies of existing terminals and other analytic research; specific hypotheses or design concepts could be explored with demonstration projects.

Automation of Sorting and Routing of Freight—The plans of the U. S. Post Office for the automatic classification, labeling, sorting, forwarding, and delivery of assorted sizes and types of mail might well be paralleled for handling small-article freight. Research should be undertaken to examine various approaches to the automatic sorting and routing of freight to determine their practicality and potentiality for reducing present inefficiencies. Such questions as the following might be addressed: How would freight be given machine-readable labels showing origin, destination, fragility and perishability, methods of carriage, and so forth? To what extent might automatic routing be allowed to override a customer's preferences as to carrier or method of carriage, in the interests of efficiency? What compensatory payments might be required? What limitations on freight size or character would describe the items suitable for automatic sorting and routing?

Intermodal, Intercontinental Transportation Companies—Substantial problems and inefficiencies occur on the interfaces between different modes and carriers, and between interurban and intraurban freight, as well as in routing and tracing. In exploring ways to reduce these problems, it might be useful to investigate the potential service improvements that could result from allowing intermodal, intercontinental transportation companies to be established, in which the shipper would specify the level of service required and the company would choose the best method for achieving this level for the quoted price. Such investigation could reveal what barriers exist to the formation of such a company, why the barriers are there (e.g., to help maintain competition among modes and individual carriers), and whether they should be removed. (The growing role of "freight forwarders" should also be considered.)

Freight Technology

There have been many new developments in the technology of freight vehicles, warehousing, and materials handling, some of which require further investigation in order that their potential applications and problems be better understood. Also, because research or governmental encouragement can in many ways speed or direct development of some new technology toward a particular problem area, a number of freight-technology issues appear to merit attention. There are 2 general areas for research: (a) determination of what ways and to what extent new technology might reduce the interface problems between modes, between carriers, and, particularly, between interurban and intraurban freight movements, and identification of what, if any, desirable items are not yet under development; and (b) determination of what ways and to what extent new materials-handling and freight-movement technology might alter the present balance among the amounts and kinds of freight carried by rail, road, sea, pipeline, and air.

In addition to these issues, several others, more specific ones also deserve investigation.

Although the containerized movement of freight is widespread, it still presents problems needing research or government action. For example, a container-loading site requires expensive overhead cranes or special van lifts, and, because containers move between different carriers, different modes, and even different nations, problems of compatibility and standardization arise that can strongly affect the transfer of freight in and for urban areas.

Containerization—Studies of containerization should address the following questions:

1. Should there be global standards, national standards, or no standards at all for freight containers, for their modules (from small to very large), for their international designation, and for a uniform marking code?
2. Is it possible that development of more flexible materials-handling devices in conjunction with the establishment of maximum and minimum size restrictions on containers could make rigid standardization unnecessary?
3. If standards are desirable, how do the preferences and needs of shippers, carriers, and consignees differ and how can they be reconciled? (In particular, the needs of the shipper and consignee deserve special attention because they may have physically unusual cargoes, require special pallet sizes, or have limited-size loading docks.)
4. If standards are adopted, what steps should the government take to accelerate conversion? Should there be accelerated write-offs of nonstandard equipment? Should there be replacement subsidies? Would legislation preempting state laws and setting uniform highway trailer regulations be needed?

Palletization—An analysis should consider remedies for the interrelated problems of pallet return, accountability, and compatibility. For example, the efficiencies materials-handling techniques offered by pallets or forklifts are frequently reduced or lost entirely because of incompatibility between the size of shipper pallets and the requirements of carrier or consignee. As another example, the pallet owner often will not let pallets pass out of his control because of poor accountability and return procedures; in most such instances this means that freight must be transferred by hand from pallet to floor to pallet, or from pallet to pallet.

A study should be undertaken to survey the potential applications of continuous-movement systems and to assess their feasibility and desirability. In particular, an analysis should be made of the Swedish experience with pulverizing solid wastes at their residential and commercial sources and then transporting them by vacuum tubes to outlying plants for processing into mulch and land-fill. New methods of adapting freight to continuous movement should also be considered; for example, new techniques of sterilization and irradiation can extend the life of perishables such as milk sufficiently to make their movement by pipeline practical.

Lighter-Than-Air Vehicles—Lighter-than-air vehicles (LTAV's) have recently been employed in rough-country logging and transmission line tower installation and have proved to be cheaper than helicopters for those applications. Recent advances in flexible structures, power plants, controls, and helium technology ensure that a modern LTAV could be designed that would be as far advanced over the venerable blimp as the C-5A is over the DC-3. It appears that a modern LTAV could be useful in freight transportation, particularly for the movement of very bulky or heavy items (e.g., transformers) from their point of manufacture and assembly to their point of use. Accordingly, an LTAV of modern design for very low-cost, low-speed (less than 100 mph) delivery should be investigated. Present and prospective uses of V/STOL vehicles for interurban and intraurban movement of freight (and people) should be reexamined to determine whether any are better suited to a 1970 style of LTAV. The economies of nonlifting propulsion should be reevaluated in the light of latest knowledge, and the traditional problems of how to load, moor, and hangar an LTAV should also be restudied in the light of present technology.

Transfer of Technology—Existing technology (particularly in military applications) that might profitably be applied to freight-transportation problems should be evaluated. Military cargo technology, in particular, is highly advanced. Specialized V/STOL

techniques have been developed that permit quick, spot deliveries of palletized loads, often without any vehicle touchdown. Sophisticated tracing techniques are used for high-value parts, and a 3-ton, long-range electric truck has been successfully demonstrated.

Freight-Transport Engineering Information Center—Attention should also be given to the possibility of establishing a freight-transport engineering information center, somewhat analogous to the technology utilization program of the National Aeronautics and Space Administration, that would continuously examine military and civilian technology for developments applicable to civilian freight technology. The uses of such a center (Should it do developmental research?), its institutional form, and appropriate sources of financial support should be investigated.

Several other freight-technology issues exist that merit attention. However, these will be considered later in the more appropriate contexts of reducing the problems of urban congestion and of urban pollution and noise.

THE INTERACTIONS OF FREIGHT AND PASSENGER TRAFFIC

The preceding section was concerned with the interactions of different components of the freight-transportation system with each other and with the demands for freight movement. Here the discussion considers interactions between freight and passenger traffic, emphasizing the impact that freight traffic will have on passenger traffic in the near future. Although there are and will be some beneficial interactions (mentioned briefly later), primary concern is with determining the manner and extent to which freight traffic may interfere with passenger traffic and with finding potential solution approaches to reducing this interference.

Interference of Freight and Passenger Vehicles

Freight and passenger vehicles may interfere with each other on any guideway or in any terminal they share. At the present time, however, nearly all interference occurs on streets and highways where trucks compete with automobiles and buses for space and priority. Here freight vehicles may interfere with passenger vehicles in 2 principal ways. First, the presence of freight vehicles (which are often much larger than automobiles) effectively reduces the capacity of the streets and highways for moving passenger traffic. Second, trucks generally accelerate more slowly than passenger vehicles and frequently engage in curbside loading and unloading, which may either retard the flow of passenger vehicles or block it entirely.

The extent of capacity reduction and flow impedance may differ markedly among cities, depending on a multitude of factors characterizing the urban area, its transportation system, and its temporal and geographic patterns of freight and passenger movement. These factors include the following: size and performance of freight vehicles; purpose of journey (retail delivery, wholesale delivery, nondelivery business use, mail and parcel delivery, and services and maintenance); duration and frequency of stops for each type of journey; size of city; layout and width of streets; and character and utilization of public transit.

Description of Freight-Passenger Interference—Research is needed to develop methods to describe interference, determine its causes, and assess its severity and its economic and social costs. As a first step, specific attention is directed to the following questions:

1. What are reasonable indexes of capacity reduction and flow impedance, such as the time for a passenger's journey in the presence of freight traffic versus the time for the same journey in its absence? What are the social and economic costs of the interference?
2. What information do we need to evaluate these quantities? What information is available? What is known about the duration of curbside loading and unloading for different types of vehicles making different types of calls? How can we measure capacity reduction and flow impedance? Are traditional types of cordon-line surveys adequate? Can we really separate out the freight contribution to total congestion?

Interference Case Studies—The methods developed should be used to determine the relative magnitudes of capacity reduction and flow impedance for both intraurban and interurban traffic for several different cities, including New York, which is an extreme case. We must also find out how these magnitudes depend on factors such as time of day (particularly the peak hour), various city characteristics, section of the city, and presence of ports, airports, rail hubs, or other facilities serving as internal generators of traffic.

In the future, several trends in commerical growth and urban development seem likely to alter the magnitude of interference between freight- and passenger-vehicle traffic. For example, the growth of public transit could reduce automobile traffic in the CBD and thus reduce conflicts. For individual cities, and for cities in general, an analysis should be made to determine which trends seem likely to affect freight-passenger interactions and what impact the different trends might have.

Solution Approaches to Interference

There appear to be 4 potential solution approaches for reducing the interference between freight and passenger traffic: (a) consolidation of freight routes and shipments, (b) separation of freight and passenger traffic, (c) diversion of freight journeys from times and routes of high congestion, and (d) minimization of curbside loading and unloading. For each approach, specific attention is suggested.

Consolidation of Freight Routes and Shipments—Specific measures for consolidation and their relative effectiveness should be analyzed. Freight terminals, containerization, automated routing of freight vehicles, and other measures previously suggested to improve the efficiency of freight movement should also be examined to determine their collateral benefits in reducing interference and to find ways in which to make them more effective.

Separation of Freight and Passenger Traffic—The specific measures for separation of freight and passenger traffic and their relative effectiveness should be analyzed. Such separation might be achieved by the construction of separate and exclusive freightways, by banning freight vehicles from certain roadways, or by shifting a significant fraction of either freight or passenger movement to modes that move in exclusive rights-of-way or to nonsurface modes so as to lessen competition. An analysis should search for ways to exploit nonsurface modes for freight movement.

Of particular interest is underground transport in the central city. With rising surface-land costs, underground freightways, terminals, and loading docks could become practical (perhaps even for existing trucks) if tunneling costs were reduced. Reductions in interference plus aesthetic and social advantages would result from moving a substantial fraction of central-city freight through underground tunnels, either by special vehicles or by the pipelines discussed earlier. But would such advantages be worth their costs? (Tunnel movement of coal was tried in Chicago early in the century and was then discontinued as uneconomic.) An analysis should be conducted to assess the costs and problems of underground freight transport and to determine what items would be most suitable for underground movement and what means would be used to move them. Moreover, the development of long-distance, high-speed rock-tunneling machines could be encouraged and accelerated. Such machines would, of course, have applications to future passenger-movement systems and to other construction.

Diversion of Freight-Vehicle Journeys From Times and Routes of High Congestion—The specific measures for diversion of freight vehicles to times and routes of low congestion and their relative effectiveness should be analyzed. Such diversion might be accomplished by making alternative routes more attractive (e. g., by providing effective circumferential highways in urban areas). Potentially more effective in the near term would be the use of direct road pricing to make freight journeys more expensive on congested routes or to influence the time of day at which freight traffic operates. Permits, either issued free or purchased, could also be used to restrict access to congested routes or to divert freight traffic from peak-hour operation. Considerable research is needed on prices and permits. The basic questions are as follows: How expensive must prices or permits be to influence behavior? How might they be implemented? What broader social benefits or disbenefits are implied?

Movement Hours—The issue of traffic diversion raises questions concerning movement hours. Must urban freight travel during peak commuter hours? For some items, are these times merely the most attractive? To what extent might the following (and other) factors make the diversion of freight movement to nonpeak or nondaytime hours impractical: the necessity for immediate delivery (e.g., for perishables), the insistence on synchronization between business hours and delivery hours, and the willingness of drivers or shipping clerks to work nondaytime or shifted hours?

After-Hour Freight Drops—Shifting freight deliveries to nighttime or after-business hours might be made more practical if a freight-drop system were developed or exploited. Specially sealed freight modules could be left in delivery bins or put through freight slots (analogous to residential mail slots). This would permit freight deliveries to be made to a business even when none of its employees was present. After-hour deliveries could also produce earlier arrivals in some cases; e.g., air freight that arrived during the night might be delivered before a business opened for the day. As suggested later, it might even help minimize the curbside unloading time for some deliveries during peak hours. In view of the apparent utility of after-hour, freight-drop systems, research should be conducted to develop and evaluate alternative design concepts for such systems.

Minimization of Curbside Loading and Unloading—The specific measures for minimization of curbside loading and unloading and their relative effectiveness should be analyzed. Curbside operations could be minimized either by speeding up the process or by shifting it off the street. Incentives could come from the enforcement of sanctions against curbside loading and unloading or from use of a pricing mechanism to regulate the duration of curbside pauses. Both of these measures, of course, would involve investigating issues of implementation and enforcement.

Building Ordinances and Freight Facilities—The congestion caused by freight vehicles on the streets could be alleviated through building and zoning ordinances requiring in-building accommodations for trucks, trailers, vans, freight docks, and elevators. (These might be analogous to a current Los Angeles ordinance requiring one automobile parking space for every 500 sq ft of floor space.) Research should be undertaken to (a) examine the potential character and content of such ordinances, i.e., the requirement and enforcement issues, and (b) identify the necessary and desirable characteristics of in-building freight vehicle docks, turnarounds, and slot spaces. The basic need, however, is for a cost-benefit analysis to see under what conditions the benefits of in-building freight facilities would outweigh their costs. Such an analysis should explicitly consider the social and economic costs for retrofitting and revamping buildings in older central cities as well as those for new construction.

Underslung-Payload Vehicles and Straddle Carriers—Special vehicles will almost certainly be necessary if the process of curbside loading and unloading is to be speeded up. Particularly promising are concepts of underslung-payload vehicles and straddle carriers. Before urban freight vehicles can be developed by using these concepts, however, existing regulations on vehicle design and configuration must be liberalized so as to allow innovations in the rapid extraction and insertion of goods, and, particularly, in vertical dropoff and pickup. (Certain design regulations conceived for standard vehicle types impose implicit restrictions on new vehicle types or innovations, for example, the requirements that vehicles be able to withstand certain axial compression forces and the restrictions on the maximum turning circle.) Moreover, ordinances prohibiting street use of straddle carriers need to be revised to encourage the design of freight vehicles with fast pickup and drop-off capabilities. After these revisions, special straddle carriers and underslung-payload vehicles could be designed for use where curbside (or other) turnaround time is to be minimized. The potential of such vehicles for use in conjunction with the after-hour, freight-drop systems discussed earlier should also be exploited.

Truck Parking Sanctions and Fees—It has been asserted that many of the problems caused by curbside loading and unloading of trucks could be eliminated by proper use of police powers. The desirable character of sanctions against curbside pauses or the use of fees to regulate the duration of such pauses should be investigated. We must ask, How stringent should such measures be? How should they be implemented? What

amount of enforcement might be needed to institute new loading, unloading, and waiting restrictions?

Probable Future Interference

Except on the streets and highways, there is little interference between freight and passenger vehicles at the present time because other guideways carry one or the other predominantly. But what of the future? An analysis, probably in the context of the investigation of future trends raised earlier, should consider whether significant interference will be likely to occur anywhere besides the streets and highways in the foreseeable future (in the airspace, for example) and what steps might forestall this.

Beneficial Interactions

Not only interference but also beneficial and complementary interactions can occur between freight and passenger transportation, provided that we plan and prepare for them. Vehicles and terminals both offer opportunities that should be investigated.

Possibilities exist for combining freight- and passenger-movement systems; that is, vehicle systems designed primarily for carrying passengers could also be employed for hauling freight. The Chicago rapid-transit trains, as an example, are again being considered for use as mail carriers, a service they performed several decades ago. As another example, subways may have potential for the slack-hour distribution of newspaper bundles or smaller freight. Freight-passenger vehicle combinations such as these could help offset the costs of a public transportation system by increasing its utilization. They could also help reduce congestion by consolidating some freight movements into passenger-vehicle movements that are going to occur regardless.

Freight-Passenger Vehicle Combination—An analysis is suggested to determine the desirability and practicality of combination freight-passenger vehicles for urban freight transport. (Such vehicles could either be integrated vehicles that can carry freight and passengers simultaneously or convertible vehicles that can quickly change from freight to passenger configurations.) A survey should first be made of the costs and benefits that have been experienced with such systems, particularly those for the European "articulated bus," essentially a tractor that pulls either a freight or a passenger trailer. Next, the potential of various new vehicles (e.g., the skycrane with changeable freight and passenger pods) should be evaluated. The relative advantages of convertible and integrated vehicles should also be analyzed, along with the major problems of implementation, past and prospective. For example, will unions be opposed to passenger transport employees being directly involved in moving or handling freight, or will there be other labor problems? How will costs be divided between passenger- and freight-movement customers (particularly on a publicly owned system)?

Freight-Passenger Terminal Combination—Possibilities for combining freight and passenger transportation also exist in terminals. (Some combining has already been done at airports.) Such combination might produce economies of scale, increase utilization, and help defray public investments and operating expenditures. Therefore, the following multifaceted study is suggested: (a) An analysis should determine the desirability of freight-passenger terminal combination and would include identifying the modes and circumstances for which combination terminals would be attractive and which freight and passenger modes should be mixed (e.g., V/STOL and truck); (b) in this context, it should be noted that such combinations could provide new options for moving baggage (an air traveler, for example, might take the usual amount of baggage with him and have the excess follow on a special baggage plane or high-speed baggage train) and, thus, an analysis should also consider the practicality and potentiality of such options; and (c) problems of possible freight-passenger conflict must be considered, and an analysis should treat questions such as, What will happen if both passengers and freight are to be loaded from the same subway platform? How should the financing, support, and responsibility for combination terminals or transportation centers be apportioned among their many users (freight carriers, public and private passenger carriers, individual users, and political jurisdictions)?

URBAN FORM AND QUALITY

Thus far, the discussion has dealt primarily with the efficiency of freight transport and its impact on the movement of passenger vehicles. The program discussions also considered the broader impacts of freight transportation—social, economic, and developmental—and the ways in which these effects may be used in urban planning to achieve desirable urban form and quality. The issues suggested for consideration fall roughly into 3 broad areas: freight transport as a component of urban society, freight transport as a user of urban land, and freight transport as a tool for urban development. Each area will be considered in turn.

Freight Transport as a Component of Urban Society

Freight transport is an important integral component of urban society whose influence can profoundly affect the urban social environment. On the negative side, railroad yards can bring unsightly blight to central cities, and trucks can generate unpleasant noise and pollution. Although investigations of the social role of passenger transportation have been undertaken (and others have been suggested elsewhere in this paper), no comparable investigations of freight exist. Yet freight and passenger transportation together constitute the transportation system for an urban area; thus, complementary studies of both kinds of transportation are necessary if we are to appreciate the social consequences of transportation and transportation investments.

Social Costs and Benefits of Freight Transportation—An analysis is needed to identify and develop measures for the social costs and benefits of freight transportation and to find a means to relate freight transportation explicitly to urban form and quality. Such understanding is a major prerequisite if freight systems are to be considered in analyses of the social consequences of transportation and in cost-benefit evaluations of alternative transportation investments.

In this context, analysis should specifically assess the detrimental effects of freight transportation: How does it contribute to urban noise, pollution, and blight? Are these detrimental effects necessary by-products of technically efficient freight movement? If not, how can they be reduced?

Several concepts might be considered as means of reducing these detrimental effects, e.g., pipelines, underground freight movement, and electric vehicles. At present, considerable research is under way on electric passenger cars, all-electric buses, and electrified roads; but there is no comparable effort under way in the United States to develop electric power for freight movement.

Electric Freight Movement—Analysis is needed to investigate the desirability and practicality of developing electric trucks, electric vans, and other electric systems for the movement of urban freight in U. S. cities. It might be profitable to begin by reexamining the systems that have been proposed or experimentally developed for passenger movement and then discarded (e.g., high-speed overhead conveyors presented excessive boarding problems).

Social Costs of Business Location—A location in or near the CBD reduces costs for many businesses, while the congestion induced by the freight vehicles raises the social and economic costs of freight and passenger transportation for others. If information concerning the total social and economic costs of CBD location for various commercial and industrial firms were available through analysis, policy-makers could use this information in planning and zoning.

Interstate Highways—The contribution of freight transport to the cost-benefit evaluation of Interstate highways in urban areas has been incomplete. An analysis should remedy this by indicating how freight movement can be included explicitly in the highway location and design-decision framework, and how, if freight impact is included in highway design, the needs and contributions of freight movements might be better reflected, e.g., by the inclusion of priority ramps or special freight lanes.

Freight Transport as a User of Urban Land

Because freight transport is one of our largest industries, the use of substantial quantities of urban land by freight transport—as highways, railways, airports, and

railroad yards—is accepted without question as to the wisdom or efficiency of this use. Does freight transport need all this land? Can we not find better uses for some of it (particularly in central cities)? Does freight transport use the land it occupies efficiently, or could it do as well or better with somewhat different holdings? Research is needed to explore these issues and others that pertain to the most efficient use of urban land for freight transport. One topic of particular importance is the relocation of freight facilities to improve their efficiency or to reclaim valuable land for redevelopment. In this connection, research should establish what government investments (local and federal) would be appropriate to achieve more efficient freight-facility location and what investments should be used to help offset relocation costs for freight-distribution facilities as an aid to urban renewal and redevelopment. These explorations should be extended by also investigating the following topics.

Railroad Marshalling Yards—These yards currently occupy large areas in major cities. An analysis should be made of their operation, technology, and design. Findings could help establish whether they should be made much smaller and could also furnish data required when relocation to extraurban areas is examined. A particular focus would be on investigating the use of the third dimension, i.e., vertical stacking, as a basis for making more efficient use of land areas.

Freight-Terminal Location—As a second basis for the possible relocation of freight facilities, an analysis should be conducted to determine the optimum location of railroad freight terminals under present conditions of customer demand, routes, and traffic levels. The analysis should include an examination of the need for large marshalling yards in the core of urban areas and of the possible uses of presorted trains for distribution of goods within a city.

Land-Redevelopment Incentives—Railroads might be motivated to examine development opportunities for their current landholding in several ways. For example, they might be encouraged to improve the quality of their present facilities, develop their air rights (as a couple of railroads are doing), or relocate the facilities to other sites. What innovations in taxation are needed to motivate railroads to modify their present patterns or manner of land use? In addition to negative incentives such as taxation and social pressure, positive measures such as relocation allowances, tax write-offs, and other subsidies might provide land redevelopment incentives. These also should be investigated.

Abandoned Railways—An analysis should be made of the potential use of abandoned railways in urban areas. These linear areas might be suitable locations for schools, parks, greenbelts, industrial sites, or housing. Analysis should focus on how such development can be obtained. Can zoning or other measures encourage the railroads to develop these lands for industrial purposes? Should these lands revert to the government for development?

Freight Transport as a Tool in Urban Development

There is no question that freight transport has potential as a tool for urban development. Because freight transport feeds the population and industries of an urban area and carts away their wastes, it must therefore exert some leverage on the area's development. We need to assess the amount of leverage on development and the ways of employing it.

Locational Pressures of Freight Transport—Analysis is needed to answer the following questions: What are the locational pressures of freight-transport capability on manufacturing, on commercial facilities, and on residences? How do these locational pressures depend on transport modes, types of industry, and kind of housing? How strong are these pressures with respect to other locational forces (e.g., taxes, cost and availability of land, cost and availability of labor, and external economies)? The purpose of this research would be not to develop highly sophisticated locational-choice models, but rather to determine how such pressures can be used as tools of urban development. The basic question is, How can we integrate the planning of freight-facility locations and technology with urban planning and zoning?

Groupings of Industries—Freight movement among industries and its impact on the urban environment can be modified by location. As a basis for urban planning and zoning, it is suggested that the possible groupings of industries and the impact of alternative group arrangements on freight movements be studied. If the impact of groupings and locational factors were known, local governments could take appropriate zoning action.

ROLES FOR GOVERNMENT IN URBAN FREIGHT TRANSPORT

Government, at all levels, could play a wide variety of roles in urban freight transport. It might support the development of electric freight vehicles with research funds, or it might accelerate the retirement of obsolescent equipment by providing for tax write-offs. It might set standards for containerization or for other freight-transport components to help ensure their compatibility among different carriers and modes. It might regulate unsafe practices or seek to limit rates to an equitable level.

The basic problem, then, is to assess which roles government should play and to what extent. Which current roles should grow or continue? Which current roles should be discontinued? Which other roles should government consider? Some possible studies for investigation or action that could lead to a reasonable assessment of these roles are suggested in the following.

Application of New Technology

If freight transport operations—and, indeed, the nation—are to grow and prosper, proper advantage must be taken of opportunities afforded by new technology to improve efficiency or accomplish new tasks. Without government encouragement, excessive delays may occur in implementing new freight technologies. These delays can be reduced, however, by governmental encouragement of the innovation and implementation of new freight technology.

Analysis is needed to identify and evaluate the various instruments available to government at different levels for encouraging and accelerating innovation in freight (and related) technology. Suggested potential instruments are funds for research and development on vehicle propulsion systems and other appropriate areas; subsidies for equipment modernization; accelerated tax write-offs for obsolescent equipment; other tax breaks for modernization investments; altered regulatory structures that either favor or penalize technologically backward carriers; and legislated specifications or performance standards (e.g., container standardization might be quickly implemented if uniform highway trailer regulations were established for the entire nation). In evaluating such instruments, a specific attempt should be made to determine the particular situation or area of technology where each instrument was most applicable. As an example, legislated standards to encourage a particular innovation would produce thoroughly compatible modernization among carriers, whereas accelerated tax write-offs could produce highly individual innovations. The analysis should also consider criteria by which to identify technology deserving high priority for encouragement. This question might profitably be addressed in the earlier context of predicting key trends that will affect future freight demand.

Regulation

Although the government encourages some innovations in freight transport, it discourages others that it regards as undesirable—unsafe practices and inequitable prices, for example—through regulation. Questions arise as to the manner and degree of regulation appropriate for different carriers and modes in the freight system. Excessive regulation may restrict competition unduly, whereas insufficient regulation may allow undesirable practices to continue unabated. A question of major importance is that of determining the proper balance between the interests of the public and the interests of the freight transport industry, between freight transport "coordination" and competition. It is appropriate, in fact necessary, to periodically reconsider the effects of regulation on competition, service, and prices in the freight-transport industry. Within this broad area, several specific issues are suggested for initial investigation.

Tariff Simplification—Over the years a freight tariff structure has evolved that is so complex that literally millions of man-hours per year go into determining the rates for freight movements. At the federal level, for example, 8 different motor-carrier regions exist for the ICC-regulated carriers alone, with 8 different tariff structures set by 8 different bodies on the basis of 8 different tariff histories. At the state level, there are 50 bodies making their own intrastate tariffs. Thus, the heterogeneous tariff structure that exists has come about through gradual evolution, and it seems appropriate, therefore, to question whether it is adequately matched to today's needs. An analysis should be made of the possibilities for tariff simplification. The basic question for research and subsequent government action is this: If no freight tariffs existed, what simplified tariff structure would be most desirable and what administrative bodies in what institutional form should have the responsibility for it? Then, how might these tariff desiderata be adapted for the real world? Specifically, how should existing tariff structures be simplified to bring desirable changes in freight-transport competition, service, and prices? What is "desirable"?

Intraurban Freight Regulation—An analysis should be conducted to determine if any justification exists for the explicit economic (price-setting) regulation of intraurban freight transport. (Such regulation sometimes occurs where an urban area is made up of several municipalities.) This study would examine the historical basis and effectiveness of freight regulations in other, broader contexts to determine their relevance to this limited context. Specific attention would be directed to the following issues: Is regulation necessary to protect customer interests and transport-operator interests? Could service improvements be obtained? Can such regulations encourage the cooperation of different transport operators? Approaches other than government regulation should be considered as alternative solutions to problems for which intraurban freight regulation is proposed.

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REVIEW OF URBAN GOODS MOVEMENT STUDIES

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The majority of studies of goods movement in urban areas has been limited to those related to trucks because truck surveys have generally been included in urban studies. Origin and destination surveys have usually gathered data on truck movements, and some studies have included information on the commodity hauled. Commodities are difficult to inventory and hard to track, and experience is lacking on the methods of utilizing the data obtained. However, in some areas studies have been made that emphasized cargo movements.

The information concerning the flow of commodities into, within, and through the urban area is essential to total transportation planning. Very little data are presently available that will permit the planner to quantify the impact of goods movement on the transportation network, particularly the highway segment of that network. As industry and commercial interests decentralize in the urban area, the network of roads connecting the producer to the supplier and the supplier to the user will become increasingly important. Specific data on such items as generation of commodity trips, technological changes, transfer point characteristics, and characteristics of the commodity carriers will certainly aid the planner in his task of developing an efficient integrated transportation network. Some of the studies already have recommended organization of pickup and delivery service and more efficient terminal operation in transferring shipments between companies and modes to reduce congestion and save shipping costs.

This paper consists of a summary of research done on commodity flow by studies in the larger urban areas in the nation. The reports reviewed were those on file in the Office of Highway Planning of the Federal Highway Administration. The first section of the report draws on facts from studies reviewed to present a general picture of the current situation in goods movement. The second part summarizes the work of studies in the largest urban areas plus Connecticut. Supplemental information was also drawn from the data bank compiled by the Office of Highway Planning and from other sources of national statistics.

URBAN GOODS MOVEMENT: A PROFILE

Growth and Cost of Goods Movement

The American economy is partly structured on the principle of regional economic specialization; that is, specific areas are primarily involved in the production of certain raw or manufactured materials. Thus, Appalachia is a center of mining and steel manufacturing, while the midwestern and plains states serve as the breadbasket of the nation. The arteries by which products are transferred from one area to the consumptive points of other areas, as well as distribution within localities, constitute the nation's goods movement network. The 1968 National Highway Needs Report (3) submitted to Congress notes the influence on goods movement of the metropolitan form of urban development that allows "industries and businessmen a wider freedom of location choice, to exploit the advantage of changing merchandising, manufacturing, and distribution techniques." The importance of goods movement to the nation is reflected in the growth of freight movement and the increasing expenditures for this service.

The national figure of 1,838 billion ton-miles of goods in 1968 is 40 percent more than it was in 1960 and 70 percent more than it was in 1944, the peak war year. Government and industry forecast 3,000 billion ton-miles by 1980, an expected increase of 62 percent. In the New York Tri-State region freight traffic has grown twice as fast as the population since 1945, and the trend is expected to continue between 1965 and 1985. Figure 1 shows this growth of freight movement nationally by mode of transportation (1).

The cost of moving goods accounts for approximately 9 percent of the GNP or $350 annually to move 54 tons per person. In Chicago, 86 tons of goods are moved per resident per year. For every dollar spent on transportation services, 45 cents (1967) is spent on moving goods as compared to 55 cents on moving people. Table 1 gives the estimated national freight transportation expenditures for 1968 by mode (2).

Pipeline and Water Transportation

Figure 2 shows that pipelines transport about 21 percent of the nation's freight, while waterways transport about 16 percent (3). Pipelines are substantially increasing their share of ton-miles of goods hauled. Figure 3 shows that waterways handle relatively long hauls (4).

In the Detroit area, crude oil carried by pipeline increased 42 percent from 1960 to 1965. Likewise, natural gas shipment increased by 190 percent in 10 years.

Of waterborne freight, 85 percent of the total port of Detroit tonnage consists of raw materials. In the New York region, waterborne commodities are listed as petroleum and petroleum products, 60.9 percent; sand, gravel, and crushed rock, 13.4 percent; coal and coke, 10.1 percent; and miscellaneous, 15.6 percent. In Detroit, despite the opening of the St. Lawrence Seaway, only 3 percent of waterborne tonnage consists of overseas shipments. Figure 4 shows that this is true for all of the major Great Lakes ports, as well as Detroit, and also shows the growth of waterborne commerce in this important harbor region (5).

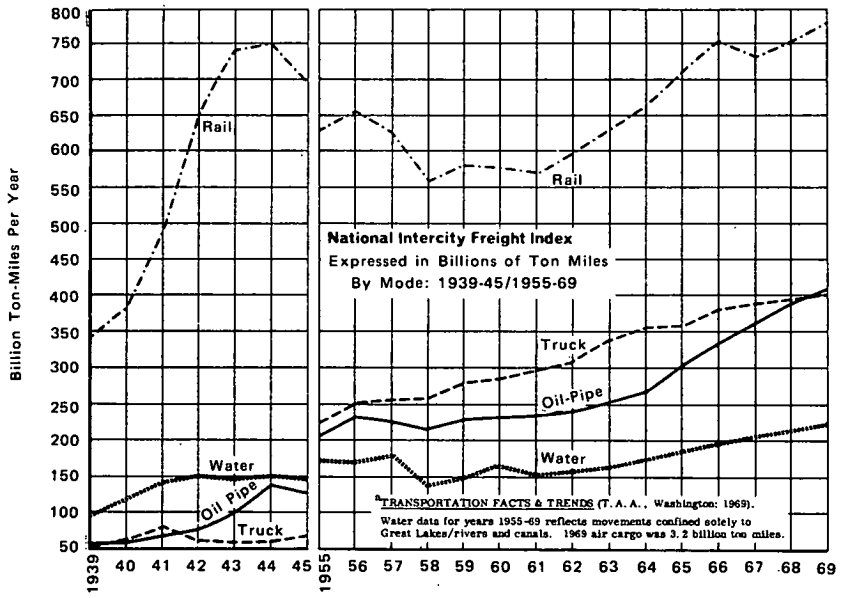

Figure 1. National intercity freight index.

TABLE 1

ESTIMATED NATIONAL FREIGHT TRANSPORTATION EXPENDITURES FOR 1968

Mode	Millions of Dollars	Mode	Millions of Dollars
Highway		Air	
Intercity truck		Domestic	593
ICC-regulated	12,400[a]	International	512[a]
Non-ICC-regulated	16,987[a]		1,105[a]
Local truck	27,146		
Bus	97	Other carriers[b]	
	56,630[a]	Forwarders and REA Express	643[a]
Rail	10,640[a]	Other shipper costs	
Water		Loading and unloading freight cars	1,081
International	3,607	Operation of traffic departments	337
Coastal and intercoastal	683[a]		1,418
Inland waterways	439[a]		
Great Lakes	210[a]	Total	76,953[a]
Locks and channels	373		
	5,312[a]		
Oil pipeline			
ICC-regulated	1,023		
Non-ICC-regulated	182[a]		
	1,205[a]		

Note: Includes mail and express.

[a]Revised.

[b]Domestic ICC-regulated carriers; amounts are operating revenues remaining after payments for other carriers' services.

Railroads

Figure 3 shows that a major portion of the ton-miles of goods in the nation are carried by railroads. Railroads are second only to air transport in average length of haul, with an average haul of slightly more than 500 miles. However, the railroads' share of intercity freight transport has decreased from approximately 56 percent in 1950 to 43 percent in 1965. In this time span, total U.S. rail freight tonnage leveled off after 1958. Moderate increases began in 1968 because of changes in the rate policy, equipment innovations, and redesigned distribution systems.

About 45 percent of rail tonnage lost by New England railroads between 1950 and 1957 consisted of mine products, namely coal, because consumer markets shifted to petroleum and gas, which are more readily shipped via pipeline and water. Less-than-

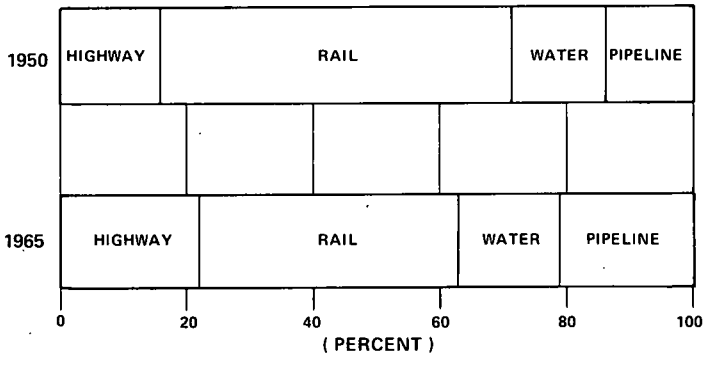

Figure 2. Ton-miles of intercity freight transport by mode.

carload shipments decreased by 60 percent as trucks took over these smaller shipments. Manufacturing and miscellaneous products are reported to constitute over 60 percent of total New England rail revenues.

Air Cargo

Air is the most rapid mode of transportation and carries less than two-tenths of one percent of goods tonnage in the United States. However, air cargo is the fastest growing major segment of commercial aviation. According to FAA statistics, scheduled air carriers handled 1.3 million tons at airports in 22 large metropolitan areas in 1965. Air cargo activity is expected to increase to 19.7 million tons by 1980, an increase of 1,377 percent. In the Tri-State region, increases of this magnitude have required large growth in sophisticated industrial items or changes in rate structures.

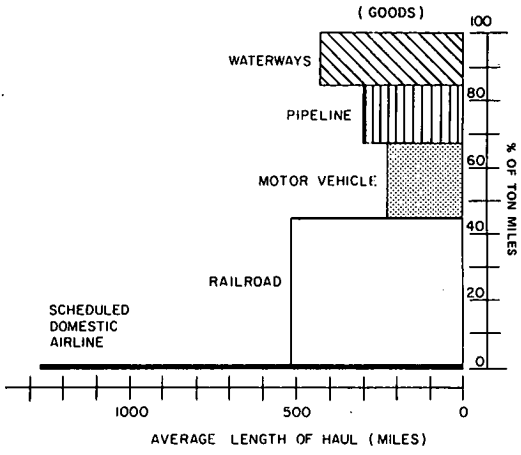

Figure 3. Intercity goods movement in the United States by mode in 1964.

Between 1960 and 1965 air cargo activity in the Baltimore-Washington area increased by 122 percent, while passenger activity increased by 78 percent. At Friendship International Airport the increase reached 171 percent compared to 140 percent in passenger activity. By 1985 air cargo in the Baltimore area is expected to grow to 328,000 tons.

A Detroit study reports that machinery parts and equipment lead in the commodities shipped by air nationally, while over 50 percent of the cargo at Detroit's airport consists of automobile parts and accessories.

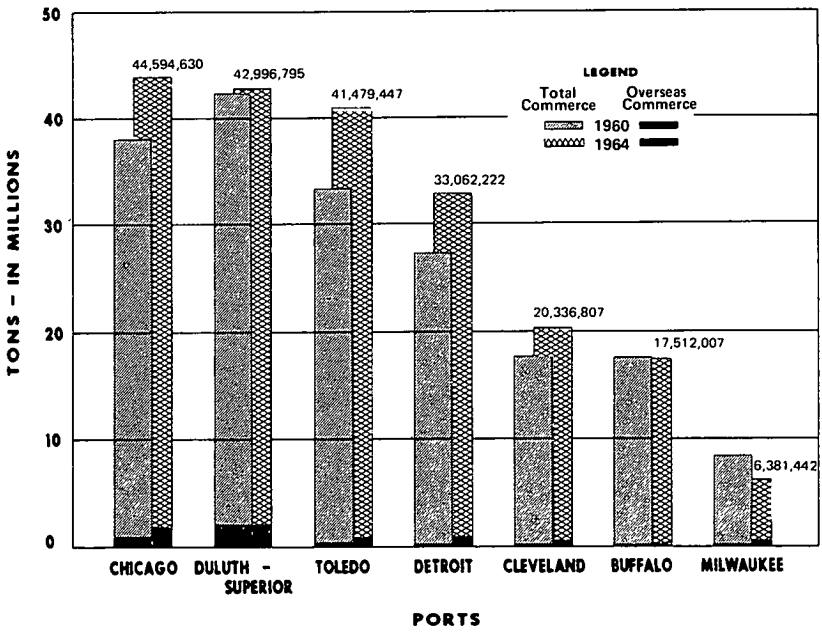

Figure 4. Waterborne commerce of major Great Lakes ports.

Trucking

Growth of Trucking Industry—Ton-miles of truck freight increased by 450 percent intercity and 150 percent locally in the New York region between 1945 and 1968 and by 60 percent intercity in Kansas City between 1953 and 1963. The city has projected a 97.4 percent increase in freight hauled by truck (1966 to 1990), requiring 39 new terminals on 468 acres.

In Milwaukee (1950 to 1965), there has been a 28 percent increase in trucks available and an 87 percent increase in automobiles available. A further 36 percent increase in truck registration is expected in the area by 1990. In Pittsburgh (1958 to 1980), truck registrations are projected to increase by 47 percent compared to an increase in automobile registrations of 66 percent. According to a Chicago study, truck registration will have to increase slightly faster than population in order to move the goods and provide the services required by the increased spending of the average family.

The same Chicago study showed that truck trips projected from the base of person trips were 67 percent more than the 1956 total, 3 percent greater than the growth rate of truck registrations. The 1960 study suggested that increased productivity in the trucking industry—through improved management and terminal operations, more efficient routing, and larger trucks—may well double the average output per trucking worker by 1980. A Baltimore study estimated that, of a 55 percent increase in truck trips by 1980, 58 percent will consist of panel, 2-axle, light-truck trips, and 25 percent will consist of heavy-truck trips.

Truck Size and Capacity—A light truck (panel or pickup) is equivalent to a passenger car in street occupancy, while a tractor trailer combination may equal as many as 4 cars in street space. Less than 5 percent of the New York region's trucks are tractor semitrailers, but they move nearly one-third of all truck tonnage. In Chicago, there is a growing proportion of semitrailers and a lessening proportion of panel trucks; large trucks have become a more important element of the truck fleet in the past few decades.

The capacity of semitrailer vans, which are important in general freight, ranges from 1,800 to 2,400 ft^3, while semitrailer units of all types combined have an average capacity of 2,150 ft^3. The mean load of trucks in the Chicago metropolitan region is estimated at 11.6 tons. In intercity traffic in the New York area, common carriers haul an average load of 10.5 tons and an average shipment of 1.3 tons, while contract and special carriers have an average load of 11.4 tons and an average shipment of 6.0 tons. The New York study notes that common carriers are most efficient for intercity travel because they can secure backhauls (as opposed to private carriage), they make relatively few stops, and they carry fairly heavy loads. However, common carriers require local counterparts to handle pickup and delivery.

Truck Cargo—In the New York region, the bulk of internal truck freight consists of construction materials, fuels, and foods; 46 percent of the tons transferred on a given day are consumer oriented. Figure 5 shows the distribution of freight moved by truck (6). In Detroit, 80 percent of the loaded trucks carry manufacturing products; 42 percent of moving trucks are empty. A Milwaukee study shows that 65.7 percent of the business and industry trucks are in use; that is, on an average weekday 1 truck in 3 does not make a trip. The Tri-State Transportation Commission also reports that one-third of the truck fleet is idle on a given day and that nearly one-half of those trucks that move do not carry freight. However, it should be noted that a number of these trucks may be old and inoperable, or specialized equipment, such as snowplows. These figures suggest a need for better coordination to obtain more efficient use of the existing truck fleet.

The commodities hauled tend to affect the distance hauled. In the New York region, the average length of haul per ton for higher unit value freight is longer than that of lower unit value freight such as petroleum, sand and gravel, and coal.

Characteristics of Truck Trips—A Chicago investigation showed a very low rate of truck registration per 1,000 population; similar findings have resulted in New York and Pittsburgh area studies. A District of Columbia report showed few truck trips per person in larger areas; the range is about 200 to 300 truck trips per 1,000 population.

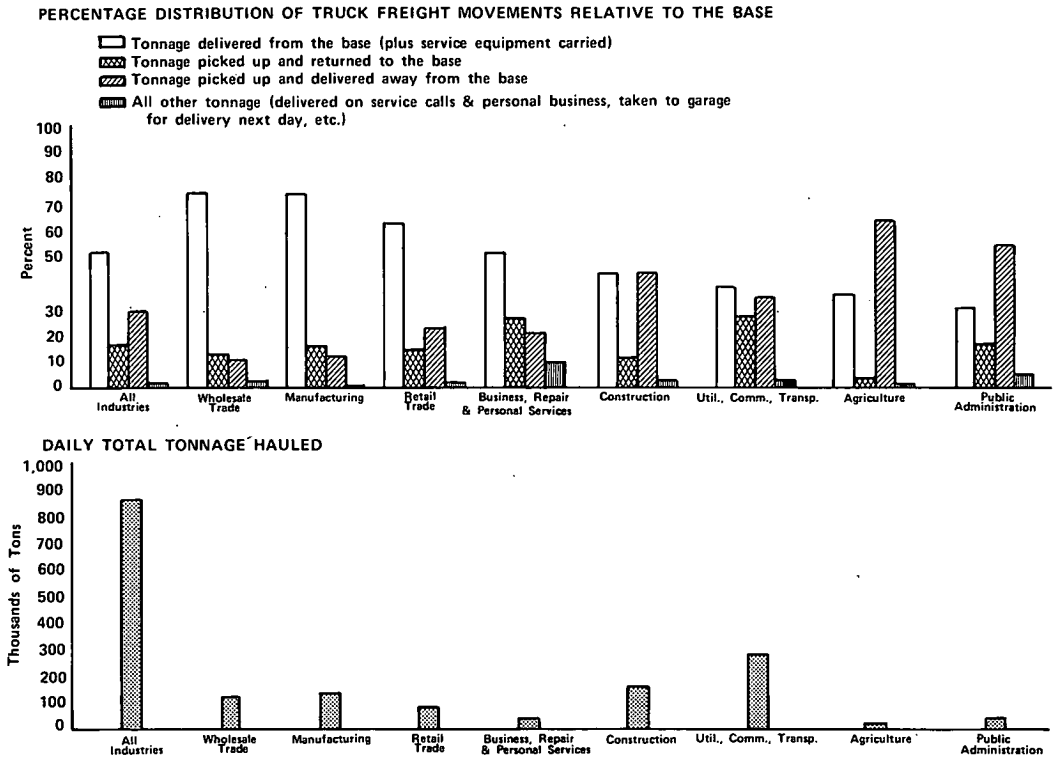

Figure 5. Truck freight movements in the New York City region.

In the District of Columbia report, it was concluded that 16 percent of all vehicle trips made in urban areas on typical weekdays are truck trips, but only 11 percent of all vehicle trips made during peak hours (4 to 5 p.m.) are truck trips. Figure 6 shows the internal truck trip distribution in Milwaukee (7); Figure 7, in Pittsburgh (8); and Figure 8, in the Tri-State region (9).

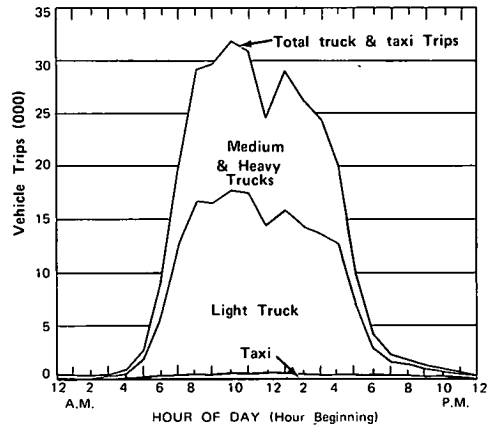

Figure 6. Hourly variation of unweighted truck and taxi trips by vehicle type in 1963 in Milwaukee.

Most truck trips occur during regular working hours. Although the 85 percent of all vehicle trips that are made by passenger cars is the dominant element, trucks are more important as units in the traffic stream than these figures suggest. For example, a Chicago area transportation study reported that in 1956 there were 854,000 truck trips made daily within the study area. Measured in units equivalent to automobiles, this figure was expanded to 1,476,000 automobile-equivalent trips. Weighted in this fashion, truck trips comprised 21.9 percent of all weighted vehicle trips made on the average weekday.

There were 8 average trips per truck per weekday for business and industry in Milwaukee. The average motor truck in an urban area, according to the District of

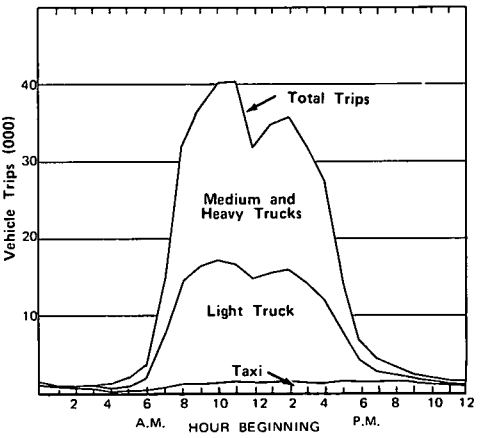

Figure 7. Hourly distribution of internal truck and taxi trips (weighted) by vehicle type in Pittsburgh.

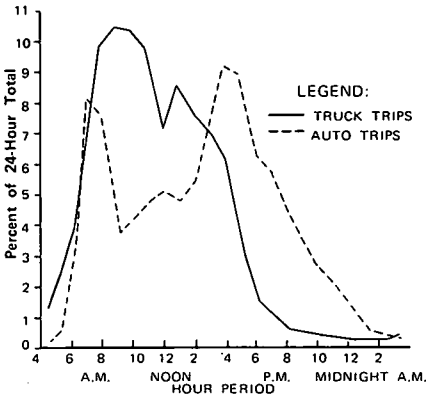

Figure 8. Peak traveling hours of trucks versus automobiles by time of trip origin in the Tri-State region.

Columbia report, makes 6 trips per day. Of the internal truck trips in Milwaukee, 57.7 percent were made by light trucks, 37.8 percent by medium trucks, and 4.4 percent by heavy trucks. The average trip length for light trucks is about 7 minutes per trip, with a large percentage of 3 to 5 minute trips indicating mostly intrazonal movement. The average trip length for heavier trucks is 13½ minutes with no sharp peaking in the 3 to 5 minute range. Figure 9 shows the percentage of internal and external automobile and truck trips (unweighted) by trip length in the Pittsburgh area (8); internal truck trips peak at about one mile in length, while external truck trips are more evenly distributed by length. In New York, the average length of an intercity haul is 167 miles inbound and 136 miles outbound. Internal truck trip length for business and industry in Milwaukee is 4.9 miles. The New York Tri-State region lists the average trip length for single units as 2.22 miles and tractor semitrailers as 9.56 miles. Only about 20 percent of trucks travel more than 200 miles from base. The great majority of truck trips, 70 percent, are local (within urban areas or to and from adjacent counties). Only 30 percent of truck trips are intercity. Thus, trucks are used for comparatively short distances where they have a distinct time advantage over other modes of goods transportation.

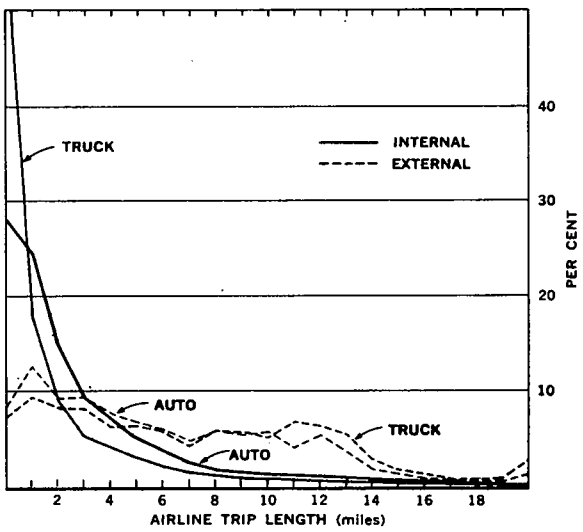

Figure 9. Percentage of internal and external automobile and truck trips (unweighted) by trip length.

Truck Trips and Land Use—A summary of the spatial distribution of truck terminals and trip destinations by land use, as found by a Milwaukee study, is given in Tables 2 and 3. Approximately 293,000 trips were made on an average weekday by trucks garaged within the study region.

A Chicago study showed that truck trips are closely related to

TABLE 2

LAND USE AT GARAGING ADDRESS OF TRUCKS IN MILWAUKEE

Land Use	Percent of Trucks
Commercial	41
Industrial	12
Transfer and pickup, including truck terminals and transfer warehouses	14
Governmental and institutional	9
Other, including residential, recreational, and agricultural	24

TABLE 3

LAND USE AT TRUCK TRIP DESTINATIONS IN MILWAUKEE

Land Use	Percent of Trucks
Commercial	36
Residential	29
Industrial	13
Transportation, utility, and communication	10
Governmental and institutional	6
Other, including recreational and agricultural	6

person trips at each land use type in a stable way. Detroit studies concluded that internal truck trips are very similar to the pattern of internal passenger cars, because light-truck trips are dominant in urban areas (estimated at 75 percent in a District of Columbia report) and have patterns similar to automobile trips. According to the Chicago findings, residences, public buildings, and public space require a fairly small amount of goods or truck-borne services. The estimates for these land uses were 370 weighted truck trips per 1,000 person trips in 1956, which are expected to remain constant to 1980. Manufacturing and commercial activities, where goods are fabricated and sold, have more truck trips, about 499 weighted trips per 1,000 person trips in 1966 and forecast to be 518 per 1,000 person trips in 1980. Transportation and wholesale land uses, primarily goods-handling activities, show the highest peak of truck trips, 575 weighted truck trips per 1,000 person trips in 1956 and 607 per 1,000 person trips by 1980.

The same study concludes that, as more person trips are made to any area in the future, comparatively more truck trips will be made. For example, if more people travel to industrial, transportation, and commercial land, probably more goods will be produced, transferred, and sold, and proportionately greater truck movements can be expected. Likewise, more person trips to homes, schools, and parks will require more delivery and maintenance vehicle trips.

A Pittsburgh analysis, however, carefully points out that the converse may not always hold. With the declining density of industrial employment, the number of person trips to a particular site may decline, while production and the number of truck trips required remains relatively constant. In Pittsburgh, truck trips to commercial land are expected to increase 63 percent (1958 to 1980), and trips to industrial and residential land are expected to increase 53 percent. It is estimated that these 3 land uses combined account for about 95 percent of the total gain in trips, as they represent the flow of raw materials and finished goods from the source to plants, to stores, and ultimately to homes. Trips to transportation land use, public buildings, and public open spaces will account for a small portion of trip gains, it is concluded, as they more often represent infrequent service calls rather than daily distribution of consumer goods.

Truck Activity in the CBD—Trucking activities cause a considerable portion of the CBD congestion. Improvements are needed that will benefit freight movement as well as increase CBD accessibility. According to a District of Columbia report, only 1.5 percent of trucks parked in the CBD of the cities studied were double-parked, but the problem is

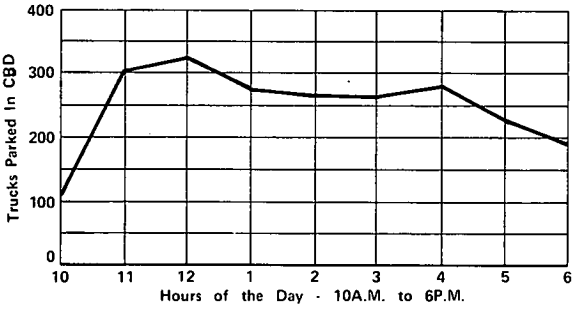

Figure 10. Accumulation of parked trucks in the Central Business District of New Orleans.

TABLE 4

TRUCKS PARKED BETWEEN 10:00 A.M. AND 6:00 P.M. IN NEW ORLEANS BY FACILITY TYPE

Facility Type	Number of Trucks	Percent
Loading zone	365	16.7
Other legal curb	472	21.6
Illegal curb	1,032	47.3
Off-street	313	14.4
Total	2,182	100.0

TABLE 5

TRUCKS PARKED IN LOADING ZONE BETWEEN 10:00 A.M. AND 6:00 P.M. IN NEW ORLEANS BY TRIP PURPOSE

Trip Purpose	Number of Trucks	Percent of Zone Users
Shopping	8	2.2
Business	56	15.3
Work	63	17.3
Sales and service	62	17.0
Loading and unloading	165	45.2
Other	11	3.0
Total	365	100.0

more serious than this figure suggests because a single double-parked truck may block a whole lane of traffic. Of the trucks parked in the CBD, about one-fourth were in loading spaces, and slightly less than 6 percent of the total curb space was used by trucks. The heaviest amount of truck parking is between 11 a.m. and 4 p.m.

The parking of trucks in the New Orleans CBD is shown in Figure 10 by hour of day and given in Tables 4 and 5 by parking facility and trip purpose. More than 47 percent of the trucks parked were parked illegally; the difference between this figure and that of the Washington, D.C., report could be caused by less enforcement of parking regulations; less space available for truck parking, perhaps due to fewer alleys; and more truck traffic. The data given in Table 5 show a poor utilization of loading space in New Orleans.

In a Dallas report, trucks are included in future plans for the CBD. Trucking activity in the CBD varies seasonally. For example, the volume of goods handled in the last 12 weeks of the year is double the year's daily average. Smaller stores in the CBD often cause more congestion than department stores because they require curb space (department stores have receiving docks), require contact with the shop owner (department stores have receiving clerks), and have smaller stock space and, therefore, require more frequent replenishing.

In Chicago one loading space is required for every 100,000 sq ft of office, hotel, apartment, institutional, and hospital buildings, and one for every 42,000 sq ft of other land uses.

The Dallas report offers several suggestions for improving freight distribution in the CBD: Place time limits on use of curb space; restrict hours of truck loading operation; coordinate freight distribution (possibly by limiting the number of carriers licensed to deliver in the CBD); and pass zoning ordinances requiring off-street truck parking in new or rebuilt structures.

STUDIES OF URBAN GOODS MOVEMENT

Tri-State Region Including New York, New Jersey, and Connecticut

The Tri-State Transportation Commission has done extensive research into freight traffic of the region. Data gathered from 15,000 interviews showed the bulk of commodities carried were construction materials, fuel, and food (6). The Tri-State region has about 1 truck for every 41 inhabitants; nationwide, there is 1 truck for every 14 persons. The regional truck fleet is comprised of 430,000 vehicles, makes 3 million daily trips, and carries 206 million tons annually (9). Reports published by the Commission relate to survey findings and projections of freight movements at terminals and transfer facilities (15, 16) and by truck (11, 12), by rail (11, 13, 18, 20), by water (11, 14), and by air (19). Trends and projections of freight movements in the region are based on the 1965 traffic as shown in Figure 11 (17).

Los Angeles

In the Los Angeles area, 2 truck origin-destination and commodity surveys were conducted in 1960 (21). The survey of commercial or proprietary trucks, systemati-

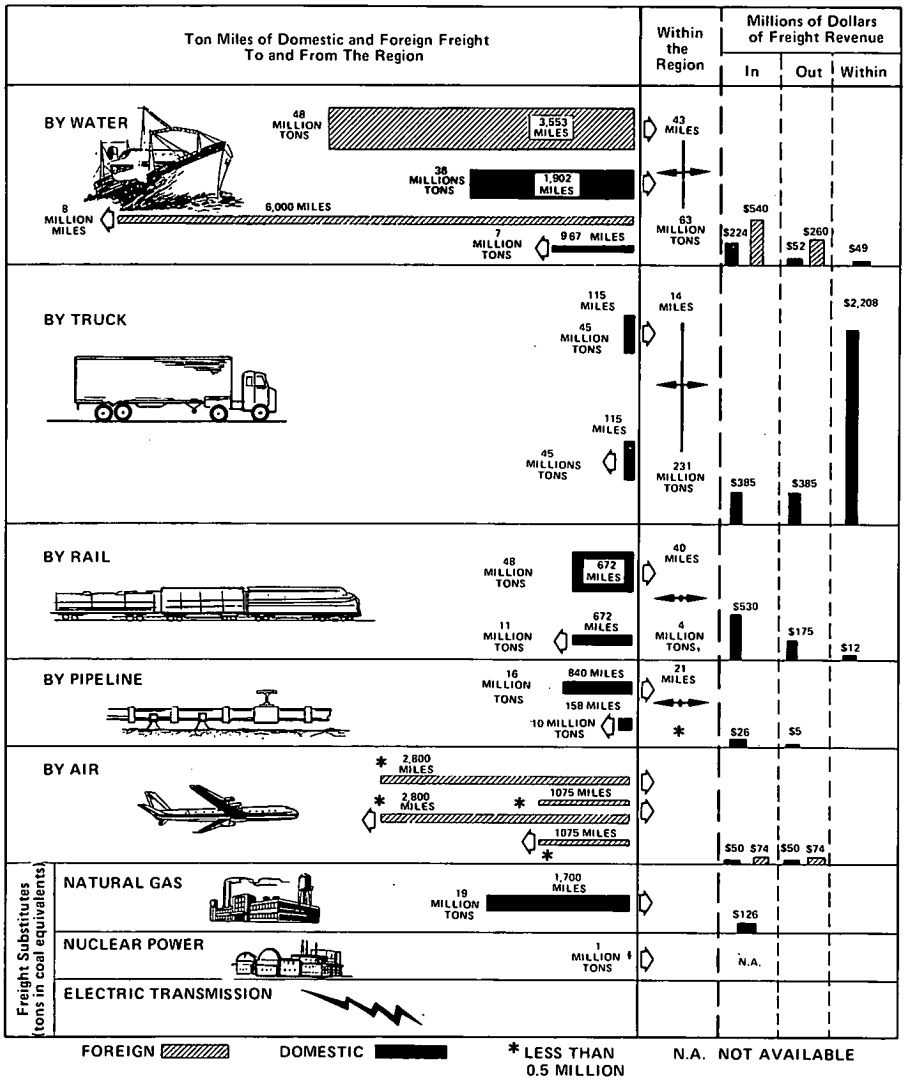

Figure 11. Freight traffic of the Tri-State region in 1965 by mode of carriage.

cally sampled from registration records, consisted primarily of mailed questionnaires. Direct interviews were conducted only with firms having 10 or more trucks. Owners of for-hire trucks, sampled from the Board of Equalization registration, were directly interviewed. An external cordon survey was also conducted. Based on 1960 truck data and 1980 automobile projections, the total number of 1980 trucks in use was estimated. Truck trips for 1980 were projected by using 1980 total trips and obtaining the weekday trips per truck in 1960.

Chicago

The regional freight study in the Chicago area is composed of a short-range and a long-range program (1). Estimates from these programs will be used to guide future freight facility investments. Interviews and mailed questionnaires were used to obtain the following for each mode of freight: current facilities; estimated volume of goods

movement into, out of, through, and within the region; future estimated demands (1969 to 1975); and new or retired facilities planned. The result of the short-range study is an interim plan consisting of a listing and forecast of freight facility development for 1975 and an atlas of freight facilities (5 modes). The following information is being gathered for the long-range study: types of commodities; types of vehicles; volume of goods; origin-destination of commodity and vehicle for trips generated by land use, planning zones, major terminal complexes, employment, population, and other activities; time of travel; trip frequency; and trip length. Internal, external, and through trips will be distinguished.

The second part of a 3-part study is concerned with estimating the amount, kind, and location of travel likely to take place within the Chicago area in the year 1980 (22). The estimates are based primarily on data from the inventories of the metropolitan region taken in 1956.

Detroit

In the Detroit area, because each mode seems to be better suited for transport of particular commodities, competition among modes is reduced. Comparatively little truck traffic is susceptible to diversion to other modes, and forecasting of future truck traffic can be seen as a function of economic growth indicators.

An inventory of modes and terminals (5) revealed that in Detroit, automobile parts and accessories composed 50 percent of the commodities shipped by air. Relatively little information resulted on harbors, railroads, and pipelines. Truck terminals in the area were located, sized, and appraised as to rail accessibility. Data on truck traffic obtained from the state indicated a larger increase in truck traffic than in automobile traffic. About 79 percent of the truck trips had origins and destinations in Michigan and Ohio, where trucks have a distinct economic advantage over other modes for shorter distances. Manufactured goods were carried in 80 percent of the loaded trucks; 42 percent of the trucks were empty.

Although trucks comprise only 15 percent of the traffic, their special characteristics cause them to have a greater effect on the traffic stream. These characteristics vary greatly from a panel truck to a tractor-trailer combination. The dominance of light trucks produces internal truck trip patterns similar to those of automobiles.

Boston

In a report devoted to goods movement by rail (23), data from the Interstate Commerce Commission were cited to show a decline, particularly acute in the eastern district and especially the northeast, in the volume of freight carried by rail. It was noted, however, that railroads carry more than twice the ton-miles of any competing mode of transport, reflecting the longer hauls of railroads. The report analyzed data from a 1959 survey of the New England freight market to point out specific factors that help explain this decline. The greater emphasis on speed and dependability for today's markets that maintain smaller inventories, coupled with the deterioration of railroad service (excessive delay in classification yards, poor switching service, uncoordinated freight schedules, and holding for tonnage), makes rail an impractical mode of transport for many goods. Small shipments tend to minimize the bulk rate advantage of railroads because the cost of loading from rail sidings is expensive for small tonnages. The report concluded that the high cost of freight traffic was due to overcapacity and, consequently, a poor utilization of railroad locomotive power and fixed facilities.

Washington, D.C.

In 1969, a truck origin-destination survey was conducted by using a 4 percent sample, approximately 4,000 vehicles (24). Data were collected for coding and tabulation on trips, vehicle types, vehicle capacity, vehicle ownership, and vehicle usage. Although the information is not yet available, it will be analyzed to obtain an accurate description of the truck fleet, measure the truck component of total vehicular trip activity, and measure the amount and nature of commidities moved by truck. Data from earlier

studies on trucks and goods movement in the District of Columbia were analyzed to obtain information on truck trips, cargo movements, land use and truck movements, truck parking, and truck-highway relationships or the cost of operation related to speed. The report (28) identified the following benefits to be realized by trucks operating on improved highway facilities: reduced vehicle operating costs, reduced labor costs, and reduced vehicle ownership costs. It noted that public and private costs for goods and services movements have constantly increased and warned that future growth and increased density of population will intensify the supply problem. Attention to the following 3 areas of goods and services movement was recommended: planning of terminal and transfer facilities; routing of truck movement on selected highway facilities; and design, allocation, and regulation of parking and loading spaces. The report emphasized the need for greater attention to the relationship of goods and services movements to all aspects of transportation systems.

Pittsburgh

According to the findings of a Pittsburgh study (25), the percentage increase in truck registration will not be as great as the increase in automobile ownership. Therefore, the truck proportion of vehicle travel may decrease. However, the decrease may be small because there will be a more rapid gain in the number of larger trucks (increasing weighted travel) and more efficient utilization of all trucks (increasing travel per vehicle). The expected distribution of truck trips, like that of automobile trips, reflects the decentralized pattern of future person trips. Much of the information from this study has been presented earlier in this report.

Cleveland

In an origin and destination survey in 1963 in Cleveland (26), data were obtained on owner of truck, type of business, principal commodity hauled, garage address, and type of truck. The external survey was made by standard roadside interview. Later, a screenline check disclosed panel trucks well reported but combination and other trucks underreported.

St. Louis

In St. Louis, interviews were conducted with owners of 6,890 trucks that made 42,592 trips to obtain the following data: type of truck, gross vehicle weight, industry and business of owner, day's total mileage, origin and destination of each trip, time of trip, land use at origin and destination, on- or off-street parking, and commodity hauled. Analysis of the data revealed that most truck trips occurred between the rush hours and that the majority were service-delivery or freight-handling trips (27). Figure 12 shows the distribution of truck trips between zones versus off-peak driving time be-

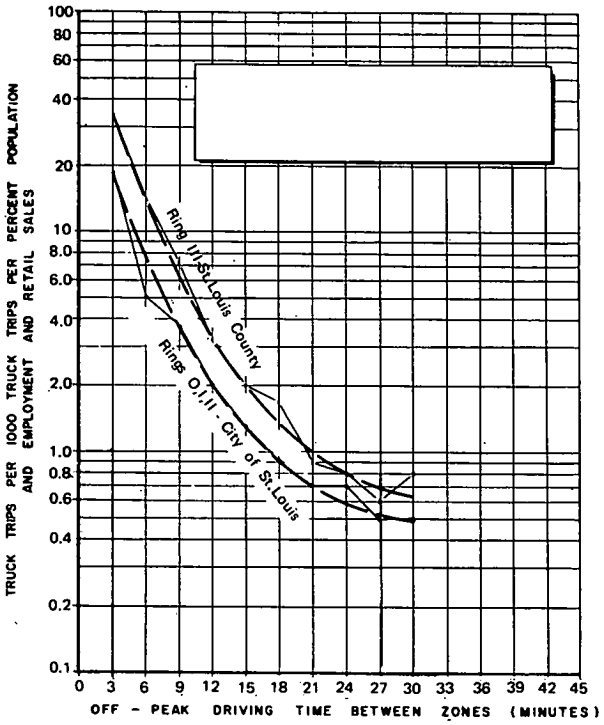

Figure 12. Distribution of truck trips between zones in St. Louis in 1957.

tween zones. Estimates were made of 1970 and 1980 intrazonal and interzonal truck trips.

Baltimore

In a Baltimore study, data from secondary sources were examined for usefulness in supplying the necessary information for analysis and proposing of solutions (4). Analysis of the data revealed certain broad characteristics of goods movement that should be useful in planning for future needs in transportation.

The first characteristic of goods movement named in the study is that it is more rational and susceptible to analysis by economic theory. Length of haul, frequency of dispatch, travel time, and cost of service are all taken into account by the shipper in determining the mode of transport. The study concluded that national issues more radically affect the movement of goods than of persons. Changes in goods produced—which are more varied, more valuable, less bulky and heavy per unit, and less durable—and changes in production—including larger units of production, better quality control, tighter scheduling, and more responsiveness to market demands—are factors affecting goods movement. Changes in the regional economies, which appear to be more self-sustaining, are reducing the amount of long-haul service needed. In addition, the locational preferences of industrial plants have shifted from the inner city.

In view of these factors, the study concluded that the system of goods movement has become more complex and interrelated and is no longer so capable of shaping the future demands of its services as it has been in the past, during the westward push of the railroads in the last century, for example. The study emphasized the requirement of increased coordination of services and cooperation among suppliers.

A portion of an airport study was devoted to air cargo, which was named the fastest growing major segment of commercial aviation. The study made no recommendations for planning for this projected increase in goods movement by air (28).

Milwaukee

An origin-destination survey was conducted in Milwaukee (7) to obtain information on trips, garaging address, vehicle type, business and industry of owner, and principal commodity. Plots were drawn of the spatial distribution of truck garaging locations and destinations (Tables 2 and 3). The majority of the trips occurred during working hours. The study also listed trip generation as a function of land use.

From analysis and projection of observed trends in registration of each truck type, changes in population levels, and changes in commercial and industrial development, this study forecast truck registration for 1990 as an increase of 36 percent over 1965 (29). Future truck trip generation was estimated by utilizing the relation between trip-making and land use. The Fratar expansion method distributed the truck trips. External trips at the time of the 1965 survey accounted for 15 percent of the truck traffic and will constitute 12 percent in 1990.

Dallas-Fort Worth

A study for the Dallas CBD forecast future freight needs based on anticipated employment and floor space and on present truck-stop characteristics (30). Figure 13 shows the future demand for truck loading spaces in the CBD. To accommodate future freight activity, the study suggested a plan that would include a truck tunnel under the inner core of the CBD and that would free surface streets in the area of truck traffic, free some valuable street grade areas for other uses, and be less restrictive on pickup and delivery services (Figs. 14 and 15).

Officials of several large trucking companies were interviewed in the course of another study (31) in order to obtain their opinions and suggestions in regard to the adequacy of terminals and routes. Generally, there was great satisfaction with the Interstate and local highway and street systems, except for only one quadrant of Fort Worth. From the truckers' point of view, loading and unloading sites were considered adequate. However, it was indicated that this point of view might change if the legal

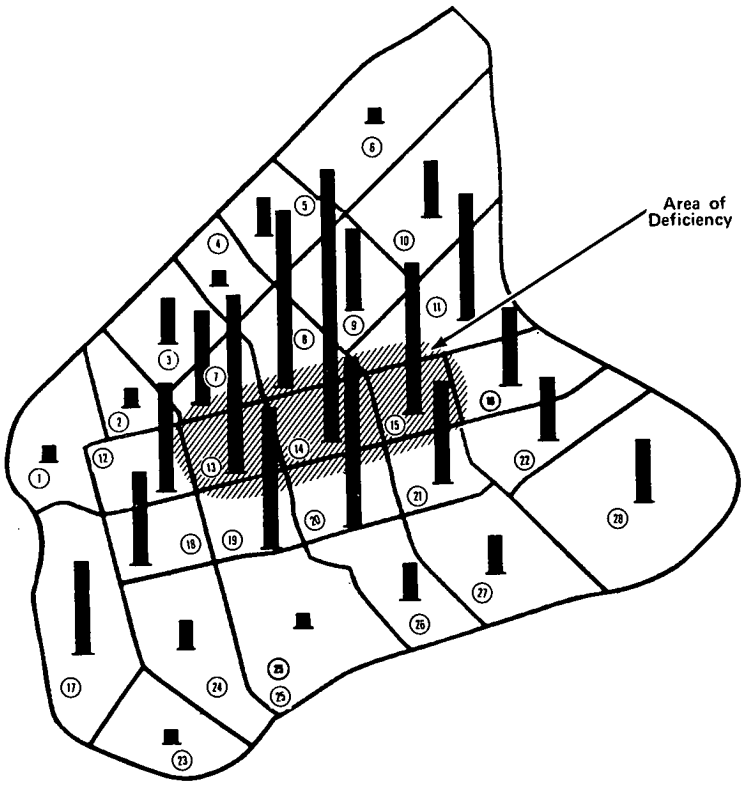

Figure 13. Future demand for truck loading spaces in the Dallas CBD.

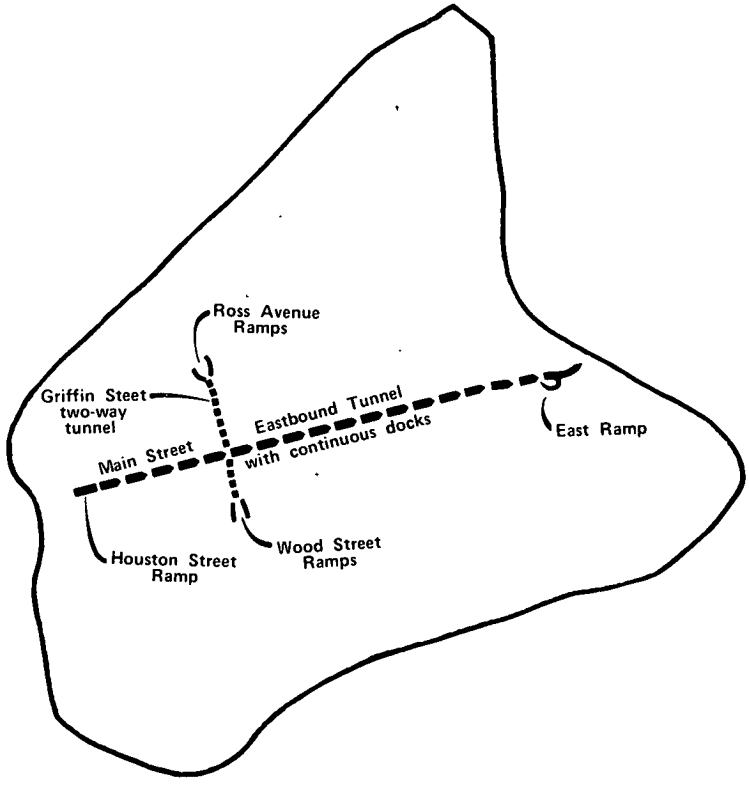

Figure 14. Proposed tunnel under Dallas CBD.

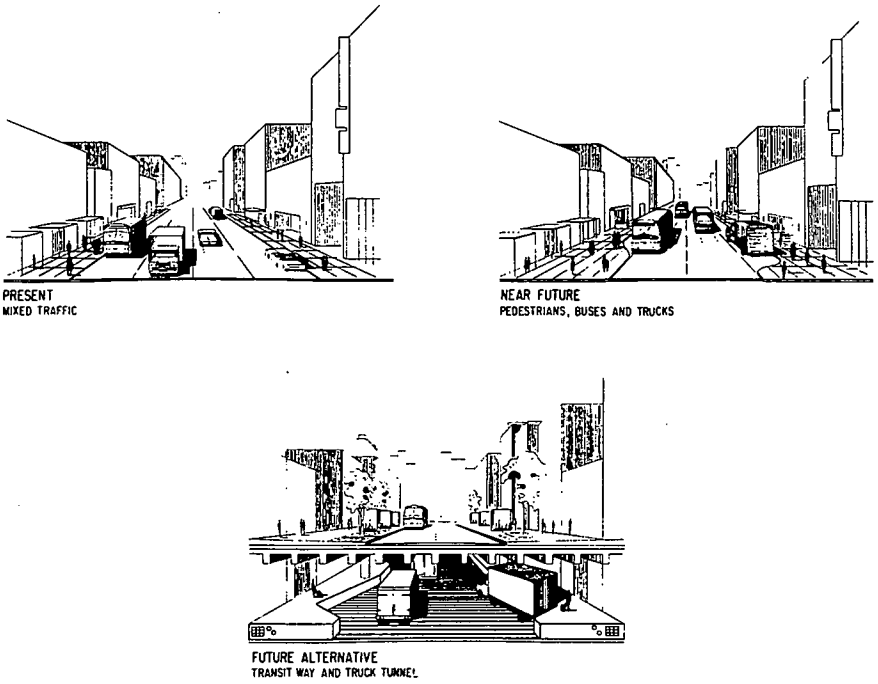

Figure 15. Short- and long-range proposed improvements for traffic in Dallas CBD.

use of sites were enforced. Loading and unloading problems were said to have been prevented by delivery arrangements with the traffic sections in both cities, but it was noted that major traffic problems will exist as long as on-street, across-the-sidewalk loading and unloading is the only means of servicing adjacent properties.

Kansas City

1990 projections for Kansas City indicate a 97.4 percent increase in freight hauled, requiring construction of 39 new terminals (468 acres). The report (32) recommends that (a) a large tract of several hundred acres on the fringe of the urban area and near a freeway be designated for locating many individual terminals and (b) consolidated pickup and delivery service be provided within the CBD. According to the report, these steps would improve efficiency of interline transfers and reduce the volume of pickup and delivery traffic in the CBD.

Denver

The truck portion of a 1962 Denver study (33) included an external and internal survey. Data collected in the external survey were type of truck and amount of load (by fraction of volume). In the internal survey, the following information was gathered: owner's name and address, registered weight of truck, origin and destination of trip, purpose of trip, and time at midpoint of trip.

Connecticut

The following data were collected by interview in a survey in Connecticut (34): vehicle type and body, industry, business, origin and destination of trip, land use at origin and destination of trip, trip purpose, and arrival and departure time. Truck travel patterns were established by obtaining data for the previous day's travel. Some

TABLE 6
GROWTH IN AUTOMOBILE AND TRUCK TRIPS IN 13 CITIES

City	Study Year	Target Year	Projected Increase in Internal Truck Trips (percent)	Projected Increase in Internal Automobile Trips (percent)	Projected Annual Increase Based on Study Year Truck Trips (percent)	Projected Annual Increase Based on Study Year Automobile Trips (percent)
Los Angeles	1960	1980	112	111	5.6	5.6
Denver	1959	1980	104	72	5.0	3.4
Washington, D.C.	1955	1975	56	59	2.8	3.0
Chicago	1956	1980	69	89	2.9	3.7
New Orleans	1960	1980	54	85	2.7	4.2
Baltimore	1962	1980	56	78	3.1	4.3
Minneapolis-St. Paul	1958	1985	125	167	4.6	6.2
Kansas City	1957	1980	62	72	2.7	3.1
Buffalo	1962	1985	78	95	3.4	4.1
New York	1963	1985	48	60	2.2	2.7
Houston	1960	1980	296	297	14.8	14.8
Seattle	1961	1985	92	90	3.8	3.8
Milwaukee	1963	1990	55	82	2.0	3.0

interviews were repeated each day for 5 days to estimate more accurately commodity movement. Railroad data, collected during a 4-month study, were type of commodity, origin and destination, number of cars, and weight of each inbound, outbound, and local shipment. Data collected at 8 key locations furnished information on the movement of goods into and out of Connecticut.

Data obtained in these surveys were analyzed with additional data from the U. S. Bureau of the Census, the state labor department, and the Tri-State Transportation Commission. Trip length distribution curves were plotted for various commodity groups. From the 1960 data, projections were made of internal truck goods movement, external truck goods movement, and goods shipment by railroad (35). Total rail shipments were assigned by using the Univac assignment package.

New Orleans

As an important part of an overall transportation study, a parking survey of the central business district was performed in compliance with procedures recommended by the Federal Highway Administration. A report of the survey (10) includes existing and projected future parking demands and needs and immediate and long-range parking programs for the central business district. Information on truck parking in the CBD has been presented earlier in this paper.

Other Cities

A report of a Cincinnati study (36) briefly mentioned that trucks were in the survey but contained no recommendations or major findings on goods movement. Reports on file from 10 other large cities were examined, but very little information was found that could be summarized and included in this report.

National

The information in the data bank of the Office of Highway Planning has been compiled from urban planning data of urban transportation studies requested by the office in 1964 and 1966 and submitted by the state transportation and highway departments. Only those urban areas for which substantial amounts of data were submitted are included. The data show that out of 25 cities researched for this report 22 had made internal truck traffic counts and 13 had projected internal truck trips. The average annual growth rate of internal truck trips projected for the 13 cities combined is 3.6 percent based on the various study years. For automobiles, the average is greater at 4.3 percent. Table 6 gives the individual projections for each of the 13 cities.

In a report by the Federal Aviation Administration (37), aviation activities at 173 airports within the large hubs and open to the public were reviewed, analyzed, and projected through 1980. The purpose of this effort was to develop forecasts for use in planning physical airport facilities and finances required to meet the needs of 1980 and to develop long-range metropolitan airport master plans. Air cargo (domestic and international) and cargo facilities (number of gate positions, square yards of apron areas, square feet of cargo building, number of spaces, and square yards of vehicular loading and unloading area) were listed for each of 22 metropolitan areas classified as large hubs (communities that generate 1 percent or more of the nation's scheduled air carrier domestic enplaned passengers).

SUMMARY

1. In 1968, 1,838 billion ton-miles of intercity freight movement took place in the United States. Government and industry forecast 3,000 billion ton-miles by 1980, a 62 percent increase.

2. The cost of moving goods accounts for approximately 9 percent of the GNP, or $350 annually to move 54 tons per person.

3. Pipelines transport about 21 percent of the nation's freight, while waterways, which carry mainly raw materials, transport 16 percent.

4. Railroads transport about 40 to 45 percent of the nation's freight in ton-miles, and rail freight has leveled off since 1960, after a previous decline. Poor utilization of equipment and overcapacity have contributed to the higher cost of freight traffic by rail.

5. Air cargo is the fastest growing major segment of commercial aviation, but it transports less than two-tenths of one percent of the goods tonnage in the United States.

6. Truck freight in the New York region has increased 450 percent intercity and 150 percent locally from 1945 to 1968.

7. Truck registration will have to increase slightly faster than the population in order to move the goods and provide the services required by the increased spending of the average family.

8. Less than 5 percent of the New York region's trucks are tractor semitrailers, but they move nearly one-third of all truck tonnage, and the proportion of larger trucks is growing.

9. On a given day in New York, nearly one-half of those trucks that move carry no freight.

10. Trucks account for about 15 percent of all unweighted vehicle trips in urban areas on typical weekdays.

11. Trucks are used for comparatively short distances (only 30 percent of truck trips are intercity) where they have a distinct time advantage over other modes of transportation and where they are necessary to complete the final segment of long hauls by air, ship, rail, and pipeline.

12. Most truck trips occur during working hours, and few are made during peak hours (4 to 5 p.m.).

13. Light trucks (panel or pickup), which have trip patterns similar to those of automobiles, account for as much as 75 percent of urban truck trips.

14. Truck activities appear to cause a considerable proportion of the congestion in the CBD, and improvements, such as enforced regulation of loading zones, coordination of freight distribution, and ordinances requiring off-street truck parking in new or rebuilt structures, are needed.

15. Public and private costs for movements of goods and services have constantly increased, and future growth and increased density of population will intensify the supply problem.

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MAIL SURVEY TO COLLECT TRUCK-COMMODITY DATA

Nathan Lieder

This paper presents some results of a mail survey designed to test procedures for collecting truck commodity data from a sample of truck registrants. The results of an earlier test based on Kansas data were reported in another report (1). The first test showed that respondents to a mail questionnaire will yield data on commodity carried and on truck movement and that more than one mailing would be required to obtain a satisfactory response rate. The present study tested both questionnaire design and follow-up procedures.

SAMPLE DESIGN

Three states, Missouri, New York, and Wisconsin, participated in the study. A sample of 819 truck registrations was selected in each state. Two restraints were placed on the sample. The first was that one-third of the sample, or 273 trucks, should have licenses for more than 26,000 lb gross weight. The remaining two-thirds, or 546 trucks, should have licenses for no more than 26,000 lb gross weight. The second restraint was that the sample numbers should be distributed throughout the entire file of registrations.

Four questionnaires of increasing complexity, shown in Figures 1 and 2, were tested in each state. The differences in data obtained are as follows:

1. Form C-1, the simplest, yielded data on commodity type, commodity weight, and mileage;
2. Form C-2 yielded data on commodity type, origin and destination, and mileage;
3. Form C-3 yielded the same data as form C-2 plus data on commodity weight; and
4. Form C-4, the most complex questionnaire, yielded data on commodity type and weight, origin and destination, land use, and type of service performed.

Forms C-1, C-2, and C-3 asked identical questions concerning vehicle characteristics. Form C-4 requested more detailed data on vehicles than did the other 3 forms.

Each of the 4 forms were assigned to one-fourth of the samples in each state. Forms for the 819 samples in a state were mailed over a 13-week period, 63 per week. One-third of the 63 mailings were taken from the sample of trucks registered at more than 26,000 lb gross weight. Information was requested for travel performed during a specified 24-hour period of 3 to 4 days after the form was mailed. These periods were uniformly distributed over the 7 days of each week of the 13-week period.

After the selection of the sample, the telephone numbers of a predetermined one-third of the registrants were determined where possible. The numbers that were found were called, generally on the day following the assigned data period. Registrants were reminded to complete the questionnaire and return it. A reminder letter was mailed to another predetermined third of the sample, generally 2 days after the original mailing. The mailed reminder should have reached the registrant during the assigned travel day or during the following day. The remaining third of the samples was not reminded during the first week to respond to the questionnaire. A follow-up inquiry and questionnaire were mailed to each nonrespondent one week after the original mailing. One week

FORM C-1

FORM APPROVED
BUDGET BUREAU NO. 1-04-569027

WISCONSIN STATE DEPARTMENT OF TRANSPORTATION
in cooperation with
U. S. FEDERAL HIGHWAY ADMINISTRATION
Bureau of Public Roads

TRUCK USAGE STUDY

License # _____
M _____
Y _____
W _____

The license number at the right identifies a motor vehicle which you registered in
The following questions concern its use together with any trailer during a 24-hour period starting at: 2 A.M. on _____ (DATE)

1. What kind of vehicle is it? (CHECK ONE)	☐ Truck only ☐ Truck & Trailer ☐ Tractor & Semitrailer ☐ Tractor, Semi, & Full Trailer ☐ Other: _____ (PLEASE DESCRIBE)
2. How many axles does it have?	☐ Axles (COUNT ALL AXLES OF VEHICLE OR VEHICLE COMBINATION—INCLUDE FRONT AXLE)
3. Was the vehicle driven at any time during the 24-hour period starting at 2 A.M. on the date specified above?	☐ Yes . . . . GO TO ITEM 4 ☐ No . . . . . PLEASE RETURN QUESTIONNAIRE
4. How many miles was the vehicle driven during the 24-hour period starting at 2 A.M. on the date specified above?	Miles _____
5. Did the vehicle make any stops to pick up or deliver items during the specified 24-hour period?	☐ Yes ☐ No

6. List the kinds of items—up to five—that took up the most space in your vehicle for all trips during the specified 24-hour period. Also list the weight—estimate if necessary—of each kind of item and the miles your vehicle carried them. *If you cannot estimate the weight, list the number or quantity of items and the measure of the quantity. Examples: 500 gallons, 10 cubic yards.*

(IF YOU DELIVERED OR PICKED UP THE SAME KIND OF ITEM AT MORE THAN ONE POINT DURING THE 24-HOUR PERIOD, PLEASE ENTER YOUR ESTIMATE OF THE AVERAGE DISTANCE THE VEHICLE CARRIED THAT ITEM.)

Bulkiness of Commodity	*Kind of Item* (EXAMPLES: FURNITURE, CANNED GOODS, ETC.)	*Weight in Pounds or the Quantity and Measure*	*Miles Carried*
Item taking up the most space			
Second bulkiest item			
Third bulkiest item			
Fourth bulkiest item			
Fifth bulkiest item			
Remainder of loads	*Remainder of loads*		

THANK YOU. *PLEASE RETURN QUESTIONNAIRE*

C-1

6. On the first line below, list the location of the vehicle at 2 A.M. if the vehicle was parked then. But if the vehicle was on the road at 2 A.M., list the location of that trip's starting point. On the other lines, list the locations at which items were picked up or delivered during the 24-hour period starting at 2 A.M. on the date specified above.

In addition to location, list the principal commodity carried in the vehicle between each delivery-pickup point, and the distance between successive points.

Space is provided for five locations. If more than five stops were made to pickup or deliver, please note the information on a spare sheet of paper and return it with this form.

Location Sequence	*Location Description:* (ADDRESS, CITY OR COUNTY, STATE)	*Principal Commodity Carried to that Location* (EXAMPLES: SAND, CANNED GOODS, GASOLINE IN 55 GAL. DRUMS, EMPTY)	*Distance from Previous Location*
At Trip Start			XXXXXXX
1st Stop			
2nd Stop			
3rd Stop			
4th Stop			
5th Stop			

THANK YOU. *PLEASE RETURN QUESTIONNAIRE*

C-2

6. On the first line below, list the location of the vehicle at 2 A.M. if the vehicle was parked then. But if the vehicle was on the road at 2 A.M., list the location of that trip's starting point. On the other lines, list the locations at which items were picked up or delivered during the 24-hour period starting at 2 A.M. on the date specified above.

In addition to location, list the principal commodity carried in the vehicle between each delivery-pickup point, its weight, and the distance between successive points. *If weight is unknown, list the number or quantity of items and the measure of the quantity. (Examples: 500 gallons, 10 cubic yards, 100 cases, etc.)*

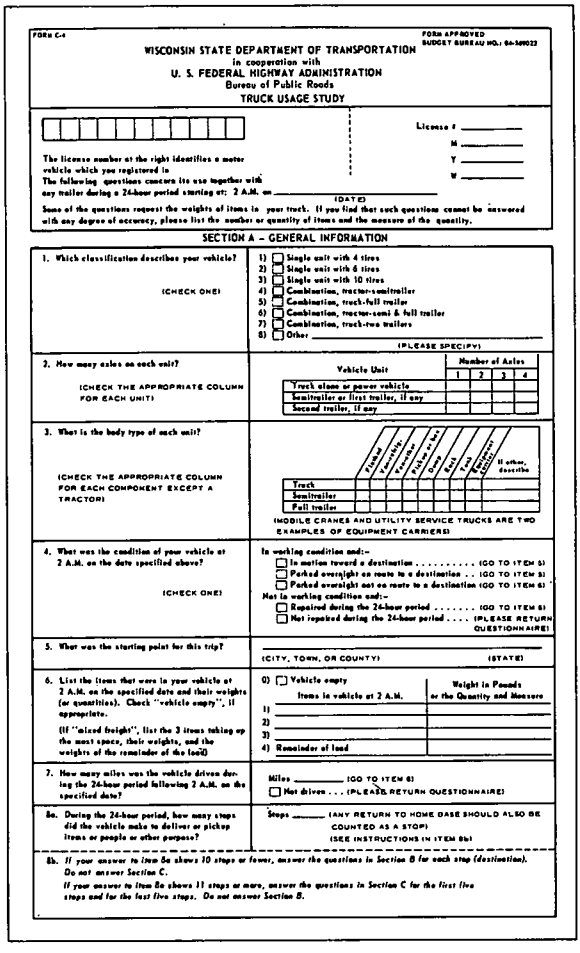
Space is provided for five locations. If more than five stops were made to pickup or deliver, please note the information on a spare sheet of paper and return it with this form.

Location Sequence	*Location Description:* (ADDRESS, CITY OR COUNTY, STATE)	*Principal Commodity Carried to that Location* (EXAMPLES: SAND, CANNED GOODS, EMPTY)	*Weight in Pounds or the Quantity and Measure*	*Distance from Previous Location*
At Trip Start				XXXXXXXX
1st Stop				
2nd Stop				
3rd Stop				
4th Stop				
5th Stop				

THANK YOU. *PLEASE RETURN QUESTIONNAIRE*

C-3

Figure 1. Survey forms C-1, C-2, and C-3.



FORM C-4

FORM APPROVED
BUDGET BUREAU NO.: 04-S00022

WISCONSIN STATE DEPARTMENT OF TRANSPORTATION
in cooperation with
U. S. FEDERAL HIGHWAY ADMINISTRATION
Bureau of Public Roads
TRUCK USAGE STUDY

License # _____
M _____
Y _____
W _____

The license number at the right identifies a motor vehicle which you registered in
The following questions concern its use together with any trailer during a 24-hour period starting at: 2 A.M. on _____ (DATE)

Some of the questions request the weights of items in your truck. If you find that such questions cannot be answered with any degree of accuracy, please list the number or quantity of items and the measure of the quantity.

SECTION A – GENERAL INFORMATION

1. Which classification describes your vehicle? (CHECK ONE)
1) ☐ Single unit with 4 tires
2) ☐ Single unit with 6 tires
3) ☐ Single unit with 10 tires
4) ☐ Combination, tractor-semitrailer
5) ☐ Combination, truck-full trailer
6) ☐ Combination, tractor-semi & full trailer
7) ☐ Combination, truck-two trailers
8) ☐ Other _____ (PLEASE SPECIFY)

2. How many axles on each unit? (CHECK THE APPROPRIATE COLUMN FOR EACH UNIT)

Vehicle Unit	Number of Axles 1	2	3	4
Truck alone or power vehicle				
Semitrailer or first trailer, if any				
Second trailer, if any				

3. What is the body type of each unit? (CHECK THE APPROPRIATE COLUMN FOR EACH COMPONENT EXCEPT A TRACTOR)

	Platform	Stakes/Rack	Tanker/Hopper	Refrigerator	Pick-Up or Van	Dump	Mixer	Tank	Logging Equipment	If other, describe
Truck										
Semitrailer										
Full trailer										

(MOBILE CRANES AND UTILITY SERVICE TRUCKS ARE TWO EXAMPLES OF EQUIPMENT CARRIERS)

4. What was the condition of your vehicle at 2 A.M. on the date specified above? (CHECK ONE)
In working condition and:–
☐ In motion toward a destination . . . . . (GO TO ITEM 5)
☐ Parked overnight en route to a destination . . (GO TO ITEM 5)
☐ Parked overnight not en route to a destination (GO TO ITEM 6)
Not in working condition and:–
☐ Repaired during the 24-hour period . . . . . (GO TO ITEM 5)
☐ Not repaired during the 24-hour period . . . . (PLEASE RETURN QUESTIONNAIRE)

5. What was the starting point for this trip? _____ (CITY, TOWN, OR COUNTY) (STATE)

6. List the items that were in your vehicle at 2 A.M. on the specified date and their weights (or quantities). Check "vehicle empty", if appropriate.
(If "mixed freight", list the 3 items taking up the most space, their weights, and the weights of the remainder of the load)

	Items in vehicle at 2 A.M.	Weight in Pounds or the Quantity and Measure
0) ☐	Vehicle empty	
1)		
2)		
3)		
4)	Remainder of load	

7. How many miles was the vehicle driven during the 24-hour period following 2 A.M. on the specified date?
Miles _____ (GO TO ITEM 8)
☐ Not driven . . . (PLEASE RETURN QUESTIONNAIRE)

8a. During the 24-hour period, how many stops did the vehicle make to deliver or pickup items or people or other purpose?
Stops _____ (ANY RETURN TO HOME BASE SHOULD ALSO BE COUNTED AS A STOP)
(SEE INSTRUCTIONS IN ITEM 8b)

8b. *If your answer to item 8a shows 10 stops or fewer, answer the questions in Section B for each stop (destination). Do not answer Section C.*
If your answer to item 8a shows 11 stops or more, answer the questions in Section C for the first five stops and for the last five stops. Do not answer Section B.

SECTION B – FOR TRUCKS WITH NO MORE THAN 10 STOPS

FIRST DESTINATION

a) Where was the vehicle first driven after 2 A.M.?
b) What type of place is it?
c) How many miles is this place from where the vehicle was at 2 A.M.?
d) Did your vehicle get there within the 24-hour period after 2 A.M.?
e) What was the purpose for this stop? (CHECK ONE)
f) Please list the items delivered and their weights (or quantities).
g) Please list the items picked up and their weights (or quantities).
h) Was your vehicle driven elsewhere within the 24-hour period?

To: _____ (CITY, COUNTY) (STATE)
☐ (ENTER THE NUMBER SHOWN BELOW FOR THAT PLACE)
Miles _____
☐ Yes . . . (GO TO ITEM e)
☐ No . . . . (PLEASE RETURN QUESTIONNAIRE)
1) ☐ Deliver or pickup commodities – (GO TO ITEM f)
2) ☐ Transport driver or passengers – (GO TO ITEM h)
3) ☐ Refuel, eat, or rest – (GO TO ITEM h)
☐ Yes . . . (GO TO NEXT BOX)
☐ No . . . . (PLEASE RETURN QUESTIONNAIRE)

SECOND DESTINATION

a) Where was the vehicle driven next?
b) What type of place is it?

To: _____ (CITY, COUNTY) (STATE)
☐ (ENTER THE NUMBER SHOWN BELOW FOR THAT PLACE)

SECTION C – MULTISTOP TRIPS (FOR TRUCKS WITH 11 OR MORE STOPS)

FIRST DESTINATION IN MULTISTOP OPERATION

a) Where was the vehicle first driven after 2 A.M.?
b) What type of place is it?
c) How many miles is this place from where the vehicle was at 2 A.M.?
d) What was the purpose for this stop? (CHECK ONE)
e) Please list the items delivered and their weights (or quantities).
f) Please list the items picked up and their weights (or quantities).

To: _____ (ADDRESS OR OTHER LOCATION) (STATE)
☐ (ENTER THE NUMBER SHOWN BELOW FOR THAT PLACE)
Miles _____
1) ☐ Deliver or pick up commodities – (GO TO ITEM e)
2) ☐ Transport driver or passengers – (GO TO NEXT BOX)
3) ☐ Refuel, eat, or rest – (GO TO NEXT BOX)

SECOND DESTINATION IN MULTISTOP OPERATION

a) Where was the vehicle driven next?

To: _____ (ADDRESS OR OTHER LOCATION) (STATE)

For Multistop, First 5 And Last 5 Stops

NEXT TO THE LAST STOP IN MULTISTOP OPERATION

a) Where was the vehicle driven next?
b) What type of place is it?
c) How many miles is this place from the previous place?
d) What was the purpose for this stop? (CHECK ONE)
e) Please list the items delivered and their weights (or quantities).
f) Please list the items picked up and their weights (or quantities).

To: _____ (ADDRESS OR OTHER LOCATION) (STATE)
☐ (ENTER THE NUMBER SHOWN BELOW FOR THAT PLACE)
Miles _____
1) ☐ Deliver or pick up commodities – (GO TO ITEM e)
2) ☐ Transport driver or passengers – (GO TO NEXT BOX)
3) ☐ Refuel, eat, or rest – (GO TO NEXT BOX)

LAST STOP IN MULTISTOP OPERATION

a) Where was the vehicle driven next?
b) What type of place is it?
c) How many miles is this place from the previous place?
d) What was the purpose for this stop? (CHECK ONE)
e) Please list the items delivered and their weights (or quantities).
f) Please list the items picked up and their weights (or quantities).

To: _____ (ADDRESS OR OTHER LOCATION) (STATE)
☐ (ENTER THE NUMBER SHOWN BELOW FOR THAT PLACE)
Miles _____
1) ☐ Deliver or pick up commodities – (GO TO ITEM e)
2) ☐ Transport driver or passengers
3) ☐ Refuel, eat, or rest –

THANK YOU. *PLEASE RETURN QUESTIONNAIRE*

TYPES OF PLACES

1. Railyard
2. Airport
3. Boat dock or pier
4. Store or market
5. Truck terminal
6. Warehouse other than a truck terminal
7. Factory building
8. Office building
9. Barn or silo
10. Animal pens
11. Garage, service station
12. Truck stop
13. Other non-residential structure
14. Residential structure
15. Construction site
16. Farm field or other field
17. Quarry, gravel pit, stone crusher, etc.
18. Forest
19. Other type of place

Same Data For Up To 10 Destinations

Figure 2. Survey form C-4.

1. LICENSE NUMBER	TRUCK USAGE PILOT STUDY CONTROL CARD - 2	2. IDENTIFICATION NUMBER STATE / MONTH / DAY / WEIGHT / SEQ. #

ACTIVITY CONTROL

3. DAY OF WEEK: Sunday

4. TYPE OF ACTIVITY	SCHEDULED 5. DAY	SCHEDULED 6. DATE	7. EXPLAIN IF ANY ACTIVITY WAS NOT COMPLETED AS SCHEDULED
(A) MAIL	Wed		
(B) PHONE REMINDER	Mon		
(C) MAIL FOLLOW UP - 1	Wed		
(D) MAIL FOLLOW UP - 2	Wed		
(E) SUBSTITUTE TRAVEL DAY	Sun		
(F) CUT-OFF DAY	Wed		

10. OTHER REG. DATA
(A) YR. MODEL
(B) MAKE
(C) BODY TYPE

11. NOTES:

REG. NAME:
REG. ADDRESS:

TEL. NO.

8. DATE RECEIVED:

9. FINAL RESPONSE STATUS (CHECK ONE)	ANSWERED ALL OR IN PART	REFUSED	TRUCK SOLD OR WRECKED	UNDELIVERABLE	DATA NOT AVAILABLE	RECEIVED AFTER CUT-OFF	NOT RECEIVED

Figure 3. Control card (control cards 1 and 3 were for mail reminder and no reminder).

later, if no response had been received, another questionnaire was mailed but a substitute travel day was assigned that was exactly 2 weeks later than the original one.

Any response received after the third week was classified as a nonresponse. However, had a respondent indicated that data were unavailable for a time because the vehicle was on the road, the response would have been accepted even though received after the cutoff date.

Each participating state was sent a set of sample control cards that indicated the type of questionnaire to mail, the type of reminder to use, and the 24-hour data period to be assigned. An example is shown in Figure 3. Detailed procedures, schedule of activities, progress report forms, and form letters sent to registrants are included in the Appendix.[1]

In Missouri and Wisconsin, mailing started during the week of Monday, September 15, 1969. In New York mailing started during the week of Monday, May 4, 1970. Because the New York data have not been completely processed, this report presents an analysis based on the data from the other 2 states. A supplementary report based on New York's data will be issued as soon as possible. The entire analysis is based on the unweighted results of the sample. The data were obtained from forms mailed during a 13-week period from September to December 1969.

RESULTS

Comparison of Responses

Table 1 gives the distribution of acceptable responses. A response was classified as acceptable if it was received before the cutoff date and answered at least in part or indicated that the truck had been either sold or wrecked. The total number of responses

[1]The appendix to the orginal paper is not reproduced here but is available in xerox form at cost of reproduction and handling from the Highway Research Board. When ordering, refer to XS-35, HRB Special Report 120.

for each form are approximately the same for each type of reminder. However, Figure 4 shows that mail and phone reminders yielded small gains at the end of the 3-week period over no reminder. Moreover, a comparison of the number of responses received within each week following the first mailing shows that mail and phone reminders induced quicker replies. Memory bias is thereby reduced. A mail or phone reminder should, therefore, be incorporated in any subsequent study.

The total acceptable returns show little difference in response for forms C-1, C-2, and C-3, which are the simplest to complete but do not yield as much information as form C-4. The average number of acceptable responses per form for the first 3 forms was 173.5. The average number for form C-4 was 160.5, 92.5 percent of the first average. This loss must be balanced against the additional information obtained with

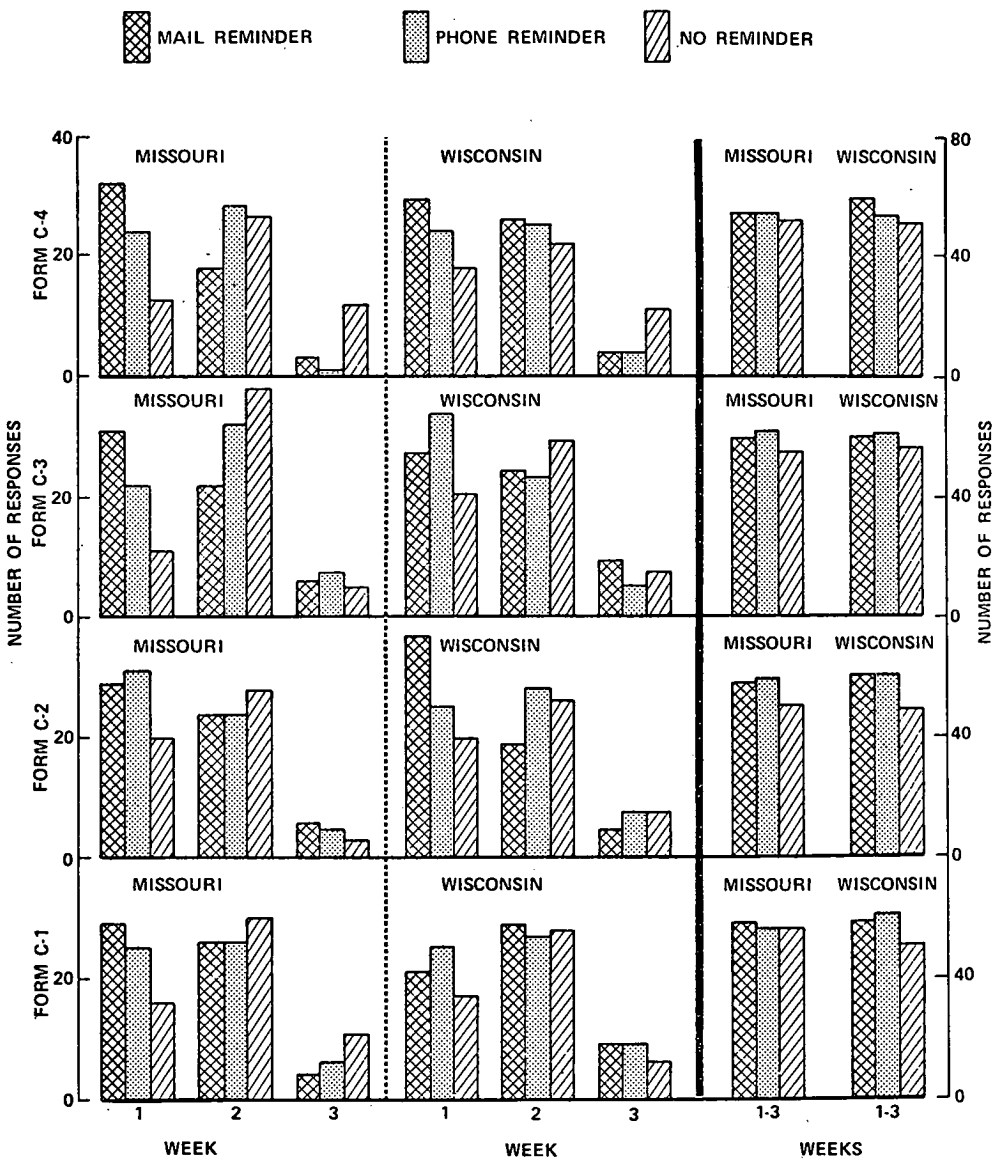


Figure 4. Acceptable responses by type of form and reminder.

TABLE 1

NUMBER OF ACCEPTABLE RESPONSES RECEIVED BEFORE CUTOFF DATE BY FORM, PERIOD RECEIVED, REMINDER, AND STATE

Form and Week Received	Mail Reminder		Phone Reminder		No Reminder		All Responses	
	Missouri	Wisconsin	Missouri	Wisconsin	Missouri	Wisconsin	Missouri	Wisconsin
Form C-1								
1st week	29	21	25	25	16	17	70	63
2nd week	26	29	26	27	30	28	82	84
3rd week	4	9	6	9	11	6	21	24
Total	59	59	57	61	57	51	173	171
Form C-2								
1st week	29	37	31	25	20	20	80	82
2nd week	24	19	24	28	28	26	76	73
3rd week	6	5	5	8	3	8	14	21
Total	59	61	60	61	51	54	170	176
Form C-3								
1st week	31	27	22	33	11	20	64	80
2nd week	22	24	32	23	38	29	92	76
3rd week	6	9	7	5	5	7	18	21
Total	59	60	61	61	54	56	174	177
Form C-4								
1st week	32	29	24	24	13	18	69	71
2nd week	18	26	28	25	27	22	73	73
3rd week	3	4	1	4	12	11	16	19
Total	53	59	53	53	52	51	158	163
All forms								
1st week	121	114	102	107	60	75	283	296
2nd week	90	98	110	103	123	105	323	306
3rd week	19	27	19	26	31	32	69	85
Total	230	239	231	236	214	212	675	687

Note: Included are responses for trucks sold or wrecked as well as incomplete responses on truck's status on travel day.

TABLE 2

NUMBER OF NONRESPONSES BY FORM, REMINDER, PERIOD STATUS WAS DETERMINED, AND STATE

Form and Week Status Determined	Mail Reminder		Phone Reminder		No Reminder		All Responses	
	Missouri	Wisconsin	Missouri	Wisconsin	Missouri	Wisconsin	Missouri	Wisconsin
Form C-1								
1st week	2		2		3	2	7	2
2nd week	1		1		1		3	
3rd week								
After cutoff date	7	8	7	8	8	16	22	32
Total	10	8	10	8	12	18	32	34
Form C-2								
1st week	2		1		3	2	6	2
2nd week	1						1	
3rd week			1		1		2	
After cutoff date	7	7	7	7	12	12	26	26
Total	10	7	9	7	16	14	35	28
Form C-3								
1st week				1	1		1	1
2nd week	1		2			1	3	1
3rd week			1				1	
After cutoff date	7	9	5	5	14	12	26	26
Total	8	9	8	6	15	13	31	28
Form C-4								
1st week	1	1		1	1	1	2	3
2nd week	2		1	2	1		4	2
3rd week						1		1
After cutoff date	14	9	13	13	13	14	40	36
Total	17	10	14	16	15	16	46	42
All forms								
1st week	5	1	3	2	8	5	16	8
2nd week	5		4	2	2	1	11	3
3rd week	–		2		1	1	3	1
After cutoff date	35	33	32	33	47	54	114	120
Total	45	34	41	37	58	61	144	132

Note: Included are the following 5 categories: refused, undeliverable, data not available, never received, and received after cutoff date.

form C-4 and possibly better quality data as will be indicated later in this analysis. The overall response rate for acceptable returns was 82.4 percent for Missouri and 83.9 percent for Wisconsin.

Table 2 gives the distribution of nonresponses. This classification includes refusals, undeliverable addresses, data not available, questionnaire never returned, and questionnaire received after cutoff date. The status of most nonrespondents could not be determined until after the cutoff date. Extending the period for accepting responses will result in a better response rate. This must be balanced against the cost per additional response and possible loss in accuracy because of memory bias. The returns have not been analyzed to provide information on this point. However, it is believed that the period for acceptable responses of 3 weeks should not be extended.

In Missouri, the number of samples for each type of reminder varied slightly from the 273 established in the study design as follows: 275 samples, mail reminder; 273 samples, phone reminder; and 272 samples, no reminder. An error in the preparation of control cards in Washington caused this minor deviation from the study design. The slight imbalance does not affect the analysis.

Stops per Vehicle

Some trucks engaged in local pickup and delivery, generally in urban areas, make many stops during a 24-hour period. For this study, multistop vehicles of this type were defined as vehicles making more than 10 stops within a 24-hour period. Forms C-1 and C-4 were designed to reduce the response burden for the activities of multistop vehicles. However, form C-1 does not provide information on the total number of stops.

Data given in Tables 3 and 4 show that most responses yielded data for vehicles making fewer than 10 stops within a 24-hour period. The average number of stops for the combined data of both states is 4.02 for non-multistop vehicles and 19.32 for multistop vehicles. Of the 259 vehicles reported, 38 or about one-seventh made more than 10 stops within a 24-hour period. Any mail questionnaire on truck movements that provides space to enter data for 10 stops should be adequate for about six-sevenths of the cases. Special provision must be made for the remainder.

The data provide no clear indication of whether vehicles registered in the heaviest weight class average fewer stops per 24-hour period than lighter vehicles not engaged in multistop operation.

TABLE 3

NUMBER OF TRUCKS MAKING FEWER THAN 10 STOPS, NUMBER OF SUCH STOPS, AND NUMBER OF STOPS PER TRUCK BY STATE, REGISTERED GROSS WEIGHT, AND FORM

State and Registered Gross Weight (lb)	Form C-2			Form C-3			Form C-4			All Forms		
	Number of Stops	Number of Trucks	Stops per Truck	Number of Stops	Number of Trucks	Stops per Truck	Number of Stops	Number of Trucks	Stops per Truck	Number of Stops	Number of Trucks	Stops per Truck
Missouri												
6,000 or less	19	7	2.71	37	9	4.11	23	6	3.83	79	22	3.59
6,001 to 18,000	9	3	3.00	24	9	2.67	26	9	2.89	59	21	2.81
18,001 to 24,000	18	5	3.60	5	1	5.00	8	4	2.00	31	10	3.10
24,001 to 30,000	28	5	5.60	38	8	4.75	11	3	3.67	77	16	4.81
30,001 to 48,000	43	9	4.78	41	9	4.56	31	7	4.43	115	25	4.60
48,001 to 70,000	35	4	8.75	18	4	4.50	0	0	–	53	8	6.62
70,001 or more	6	1	6.00	24	5	4.80	4	2	2.00	34	8	4.25
Total	158	34	4.65	187	45	4.16	103	31	3.32	448	110	4.07
Wisconsin												
6,000 or less	29	7	4.14	0	0	–	11	4	2.75	40	11	3.64
6,001 to 18,000	59	13	4.54	24	8	3.00	39	11	3.55	122	32	3.81
18,001 to 26,000	43	10	4.30	30	5	6.00	38	6	6.33	111	21	5.29
26,001 to 30,000	12	2	6.00	11	3	3.67	14	5	2.80	37	10	3.70
30,001 to 48,000	1	1	1.00	19	6	3.17	14	4	3.50	34	11	3.09
48,001 to 70,000	17	4	4.25	32	6	5.33	28	5	5.60	77	15	5.13
70,001 or more	8	5	1.60	8	3	2.67	5	3	1.67	21	11	1.91
Total	169	42	4.02	124	31	4.00	149	38	3.92	442	111	3.98

TABLE 4

NUMBER OF TRUCKS MAKING MORE THAN 10 STOPS, NUMBER OF SUCH STOPS, AND NUMBER OF STOPS PER TRUCK BY STATE, REGISTERED GROSS WEIGHT, AND FORM

State and Registered Gross Weight (lb)	Form C-2			Form C-3			Form C-4			All Forms		
	Number of Stops	Number of Trucks	Stops per Truck	Number of Stops	Number of Trucks	Stops per Truck	Number of Stops	Number of Trucks	Stops per Truck	Number of Stops	Number of Trucks	Stops per Truck
Missouri												
6,000 or less	34	1	34.00	0	0	–	11	1	11.00	45	2	22.50
6,001 to 18,000	11	1	11.00	0	0	–	0	0	–	11	1	11.00
18,001 to 24,000	0	0	–	15	1	15.00	0	0	–	15	1	15.00
24,001 to 30,000	52	2	26.00	0	0	–	37	2	18.50	89	4	22.25
30,001 to 48,000	53	3	17.33	25	2	12.50	46	3	15.33	124	8	15.50
48,001 to 70,000	19	1	19.00	0	0	–	11	1	11.00	30	2	15.00
70,001 or more	0	0	–	0	0	–	0	0	–	0	0	0
Total	169	8	21.12	40	3	13.33	105	7	15.00	314	18	17.44
Wisconsin												
6,000 or less	0	0	–	0	0	–	0	0	–	0	0	–
6,001 to 18,000	25	1	25.00	43	1	43.00	11	1	11.00	79	3	26.33
18,001 to 26,000	0	0	–	42	2	21.00	0	0	–	42	2	21.00
26,001 to 30,000	0	0	–	40	2	20.00	14	1	14.00	54	3	18.00
30,001 to 48,000	69	3	23.00	74	3	24.67	28	1	28.00	171	7	24.43
48,001 to 70,000	24	2	12.00	26	1	26.00	24	2	12.00	62	5	12.40
70,001 or more	0	0	–	0	0	–	0	0	–	0	0	–
Total	118	6	19.67	225	9	25.00	77	5	15.40	420	20	21.00

Coding

The first pilot study in Kansas showed that respondents provided sufficient details on commodities carried to make possible assignment of 4- or 5-digit commodity codes. Respondents in Missouri and Wisconsin provided equally good detail (Table 5). Only non-multistop data are tabulated because it was assumed that any problem in coding would show up with data for those vehicles. Inclusion of multistop data might have obscured problem areas.

One of the major objectives of this study is to determine if origin-destination of truck commodity movements can be determined by mail questionnaire. Another objective is to measure the ton-miles of commodities moved on highways. The 2 basic questions are (a) Will the respondents report origin and destination data and weight data? and (b) Even if reported, will the weight data be sufficiently accurate for use in calculating ton-miles?

TABLE 5

COMMODITIES TRANSPORTED BY TRUCKS MAKING FEWER THAN 10 STOPS BY STATE, REGISTERED GROSS WEIGHT, AND CODE ASSIGNED

State and Registered Gross Weight (lb)	2-Digit Code	3-Digit Code	4-Digit Code	5-Digit Code	Commodity Given Code Not Assignable	Commodity Not Given	Noncommodity Transport[a]
Missouri							
6,000 or less			18	70	5	7	117
6,001 to 18,000			20	50	0	1	49
18,001 to 24,000			8	27	0	1	5
24,001 to 30,000			19	43	0	1	6
30,001 to 48,000			8	83	1	5	7
48,001 to 70,000			0	42	0	0	1
70,001 or more	–	–	1	23	0	0	2
Total	0	0	74	338	6	15	187
Wisconsin							
6,000 or less			2	38	0	3	105
6,001 to 18,000			25	111	1	2	27
18,001 to 26,000			13	125	0	0	0
26,001 to 30,000			8	33	0	0	4
30,001 to 48,000			1	27	0	1	3
48,001 to 70,000			1	67	0	0	0
70,001 or more	–	–	3	18	0	0	1
Total	0	0	53	419	1	6	140

[a]Use of truck for personal transportation and for movement of tools and equipment to the job. Any future study will use separate codes to distinguish between the two uses.

Examination of the returns showed that origins and destinations can be accurately determined for large areas such as counties and cities. In many cases, although not all, respondents supplied street addresses. For this study, codes were assigned for county, city, and SMSA. No attempt was made to code to block or other small area. In any case, geographic coding proved very time consuming.

Carried-Load

Table 6 gives a comparison of average carried-load as indicated by data obtained in the summer of 1968 for the Annual Truck Characteristics Study and the data available on forms C-3 and C-4. Form C-1, if correctly filled out, provides the total weight for the bulkiest commodities carried during a 24-hour period rather than the weight carried between each stop. Form C-2 does not collect weight data. Form C-3 yields for each stop the weight of the principal commodity carried to that stop. However, many trucks carry only one commodity between stops. It was hypothesized for the analysis of average carried-load that weight of principal commodity carried to a stop could be equated, with acceptable error, to total weight carried to the stop. Form C-4 yields values of carried-load because the respondent supplied weight of commodity delivered and weight of commodity picked up at each stop. The values for each stop obtained from forms C-3 and C-4 were treated as independent observations for comparison with the truck weight data because a truck may be weighed anywhere along its route.

In some instances, respondents reported the number of items or quantity of a commodity and the weight had to be computed on the basis of density and size of load.

The values of average carried-load given in Table 6 for data from forms C-3 and C-4 seem reasonable. In many cases, the values are within the range of averages obtained on main rural roads and on urban roads. Much of the difference may be attributed to the small sample size for each vehicle type. Form C-3 yields few or no data on average carried-load for the lighter, single-unit vehicles. This provides one indication that form C-4, which is quite complex, elicits more accurate response than the less complex forms.

It was provisionally decided that respondents could report weights or data from which weights could be computed sufficiently accurately for acceptable estimates of ton-miles. However, this should be evaluated again with a larger sample of observations.

Ton-Miles

Tables 7 and 8 give data on ton-miles for broad categories of commodities and by origin and destination as reported on forms C-3 and C-4 in Missouri. Tables 9 and 10 give the same information as reported in Wisconsin.

TABLE 6

AVERAGE CARRIED-LOAD BY STATE, VEHICLE TYPE, AND DATA SOURCE

State and Truck Type	1968 Study, Table W-3			Pilot Study	
	All Main Rural Roads	Urban Roads	Main Rural and Urban Roads	Form C-4	Form C-3
Missouri					
Panel and pickup	1,039	1,225	1,089	1,080	1,480
Other 2-axle, 4-tire	996	2,460	1,512	900	
2-axle, 6-tire	6,175	3,851	5,713	7,180	
3-axle, single unit	17,057	17,362	17,111	18,250	18,520
2S1	9,377	10,603	9,549	6,410	2,435
2S2	16,930	16,618	16,893	25,330	20,550
3S2	28,932	28,830	28,921		33,040
Wisconsin					
Panel and pickup	802	514	719	483	
Other 2-axle, 4-tire	844	697	811	1,150	
2-axle, 6-tire	5,109	3,495	4,795	6,097	
3-axle, single unit	12,079	17,763	13,285	15,019	25,380
2S1	8,005	3,575	7,663	18,000	12,700
2S2	17,278	13,423	17,071	12,564	36,820
3S2	30,738	32,561	30,802	31,350	38,330
2-2	5,026	5,800			4,500

TABLE 7

TON-MILES OF COMMODITY MOVEMENTS REPORTED ON FORM C-3 IN MISSOURI BY COMMODITY TYPE AND ORIGIN AND DESTINATION

Commodity		Intrastate Movement				Interstate Movement			Total
2-Digit Code	Category	In One City	City to City	City to County	County to County	City to City	City to County	County to County	
01	Farm products		80.0	375.0	492.5			2,616.0	3,563.5
11	Coal	0.6							0.6
13	Crude petroleum, natural gas, and gasoline		416.0						416.0
14	Nonmetallic minerals except fuels	29.2			60.0				89.2
20	Food and kindred products	33.3	200.5	7,462.3	297.8	467.5			8,461.4
22	Basic textiles	29.8							29.8
24	Lumber and wood products except furniture	0.9		6,680.0	45.0				6,725.9
25	Furniture and fixtures	9.7							9.7
26	Pulp, paper, and allied products	31.0							31.0
28	Chemicals and allied products	33.3			23.0				56.3
29	Petroleum or coal products[a]	274.7	57.0	324.0	4,034.6	1,246.0			5,940.3
30	Rubber and miscellaneous plastic products	1.5							1.5
31	Leather and leather products	6.4							6.4
32	Stone, clay, and glass products	246.9		66.0					312.9
33	Primary metal products	238.0	201.5		35.0	32.8			507.3
34	Fabricated metal products except those coded 35, 36, and 37	14.9	20.0		47.2				82.1
35	Machinery except electrical	3.2		12.8					16.0
36	Electrical machinery, equipment, and supplies		27.3						27.3
37	Transportation equipment	8.9		1.5					10.4
39	Miscellaneous products of manufacturing	3.6		122.5					126.1
40	Waste and scrap material					320.0			320.0
41	Miscellaneous freight shipments	350.4		126.5					476.9
42	Shipping containers returned empty			558.0					558.0
	Total	1,316.3	1,002.3	15,728.6	5,035.1	2,066.3		2,616.0	27,768.6
	Code not assignable	11.4		7.2	1.0				19.6
	Commodity not specified		540.0						540.0

[a]Weight-distance available but not origin-destination, 4.0.

TABLE 8

TON-MILES OF COMMODITY MOVEMENTS REPORTED ON FORM C-4 IN MISSOURI BY COMMODITY TYPE AND ORIGIN AND DESTINATION

Commodity		Intrastate Movement				Interstate Movement			Total
2-Digit Code	Category	In One City	City to City	City to County	County to County	City to City	City to County	County to County	
01	Farm products			595.5	56.2		40.5		692.2
14	Nonmetallic minerals except fuels	447.0		675.0	2.0				1,124.0
20	Food and kindred products	61.0	678.3	764.4	571.9				2,075.6
22	Basic textiles	17.8							17.8
24	Lumber and wood products except furniture				22.8				22.8
27	Printed matter	5.9							5.9
28	Chemicals and allied products	423.6			28.0				451.6
29	Petroleum or coal products	158.8	101.3	82.8					342.9
31	Leather and leather products	3.1							3.1
32	Stone, clay, and glass products	373.0	30.0	1,747.0					2,150.0
33	Primary metal products	28.1							28.1
34	Fabricated metal products except those coded 35, 36, and 37	5.6							5.6
35	Machinery except electrical	10.2				200.0			210.2
36	Electrical machinery, equipment, and supplies	167.2							167.2
39	Miscellaneous products of manufacturing	4.0							4.0
40	Waste and scrap material	5.0							5.0
41	Miscellaneous freight shipments		867.5		70.0	25.0			962.5
	Total	1,710.3	1,677.1	3,864.7	750.9	225.0	40.5		8,268.5

TABLE 9

TON-MILES OF COMMODITY MOVEMENTS REPORTED ON FORM C-3 IN WISCONSIN BY COMMODITY TYPE AND ORIGIN AND DESTINATION

Commodity		Intrastate Movement				Interstate Movement			Total
2-Digit Code	Category	In One City	City to City	City to County	County to County	City to City	City to County	County to County	
01	Farm products			4.5	250.5				255.0
14	Nonmetallic minerals except fuels			2,030.4	720.3				2,750.7
20	Food and kindred products[a]	29.9	36.8	20.0	365.9	4,163.0			5,715.6
23	Apparel and other finished textile products	1.2							1.2
24	Lumber and wood products except furniture			5,065.0	1,515.0				6,580.0
29	Petroleum or coal products	515.0	2,556.4	2,266.0					5,337.4
32	Stone, clay, and glass products	245.0	14.7	170.0	154.0				583.7
33	Primary metal products			22.0					22.0
34	Fabricated metal products		50.0	527.5					577.5
35	Machinery except electrical			11.2		300.0			311.2
40	Waste and scrap material	27.8							27.8
	Total	818.9	2,657.9	10,116.6	3,005.7	4,463.0			22,162.1
	Code not assignable			5.0					5.0

[a]Weight-distance available but not origin-destination, 1,100.0.

For this analysis, a movement was classified as city to city even if the cities were adjacent. Some of the interstate ton-miles in Missouri represent travel between Kansas City, Missouri, and Kansas City, Kansas, as well as between St. Louis, Missouri, and East St. Louis, Illinois. In a full-scale study, essentially local interstate movements should be distinguished from relatively long-distance trips.

No attempt has been made to expand these data to statewide estimates. The sample is too small to yield precise estimates of totals. The tabulations show the potential for detailed analyses that a successful large-scale study could make possible.

A measure to compare the quality of the ton-mile data from form C-3 with those from form C-4 is the percentage of the total ton-miles that is based on computed values of weight or distance. Table 11 gives the contribution of computed values to the ton-mile distributions given in Tables 7, 8, 9, and 10. The sum of the ton-miles for Missouri and Wisconsin from form C-3 is 50,495.3. Of this total, 17,102.3 ton-miles or 33.9 percent is based on computed values of weight or distance. The sum of the ton-

TABLE 10

TON-MILES OF COMMODITY MOVEMENTS REPORTED ON FORM C-4 IN WISCONSIN BY COMMODITY TYPE AND ORIGIN AND DESTINATION

Commodity		Intrastate Movement				Interstate Movement			Total
2-Digit Code	Category	In One City	City to City	City to County	County to County	City to City	City to County	County to County	
01	Farm products			2,664.1	333.9		152.5		3,150.5
14	Nonmetallic minerals except fuels	12.2	15.0	1,005.0	1,728.0				2,760.2
20	Food and kindred products	110.2	1,345.4	1.0		1,668.8	1,200.0		4,325.4
24	Lumber and wood products except furniture			210.0	367.5				577.5
25	Furniture and fixtures	1.8	1.5						3.3
27	Printed matter					1,188.0			1,188.0
28	Chemicals and allied products	10.0	16.5						26.5
29	Petroleum or coal products	1,058.5		128.0	25.8				1,212.3
32	Stone, clay, and glass products	529.6	195.0			2,750.0			3,474.6
33	Primary metal products	0.2	1,050.0						1,050.2
34	Fabricated metal products except those coded 35, 36, and 37	31.6	361.3	307.1		198.8	3,471.3		4,370.1
35	Machinery, except electrical			1.6	1.0				2.6
36	Electrical machinery, equipment, and supplies		1.5						1.5
41	Miscellaneous freight	1.5	1.5						3.0
42	Shipping containers returned empty	11.0	85.7			37.5			134.2
	Total	1,766.6	3,073.4	4,316.8	2,456.2	5,843.1	4,823.8		22,279.9

TABLE 11

TON-MILES BASED ON COMPUTED VALUES OF WEIGHT OR DISTANCE FOR BOTH STATES BY FORM AND ORIGIN AND DESTINATION

Form and Item Computed	Intrastate Movement				Interstate Movement			Total
	In One City	City to City	City to County	County to County	City to City	City to County	County to County	
C-3								
Weight	137.9		2,908.2	1,663.4				4,709.5
Distance	326.7	636.8	716.0	6.9	1,713.5		2,616.0	7,115.9
Weight and distance[a]	866.3	43.0	3,686.1	677.4				5,276.8
Total	1,330.9	679.8	7,310.3	2,347.7	1,713.5		2,616.0	17,102.2
C-4								
Weight	597.5	875.7	3,380.7	411.6				5,265.5
Distance	18.1		91.5		200.0			309.6
Weight and distance	1,059.6	657.5		139.5	25.0			1,881.6
Total	1,675.2	1,533.2	3,472.2	551.1	225.0			7,456.7

[a]See footnote to Table 7.

miles for both states from form C-4 is 30,548.4. Of this total, 7,456.7 ton-miles or 24.4 percent is based on computed values of weight or distance. The difference in the percentages indicate that the form C-4 elicits more detailed responses on weight and distance than does form C-3. Because the need for such data is very great, any future mail survey on truck commodity movement should adopt the more complex questionnaire despite the slightly reduced response rate noted earlier.

Table 12 gives the distribution of the percentage of ton-mile movements in each ton-mile class and the cumulated percentage distribution. More than half the reported movements do not exceed 20 ton-miles. About two-thirds of the movements do not exceed 40 ton-miles. About ten percent of the reported movements exceed 200 ton-miles.

Origin and Destination

Table 13 gives for the unweighted sample data the percentage of truck trips with load and the percentage of the corresponding ton-miles, by origin and destination. Loaded truck trips with one or both ends in an SMSA constitute 50.4 percent of the total loaded truck trips. These trips also produced 50.4 percent of the total ton-miles. That correspondence might be changed but not markedly if the trips with unknown origins and destinations could be appropriately classified. The data also show that loaded truck trips with both ends within a single city produce a relatively small proportion of the ton-miles.

The drop in the proportion of ton-miles for interstate trips with both ends in an SMSA when compared with other interstate trips may be partially accounted for by the presence of the St. Louis and Kansas City SMSA's in the 2-state sample. These SMSA's include territories in adjoining states.

TABLE 12

TON-MILE DISTRIBUTION BASED ON DATA FROM FORMS C-3 AND C-4 IN MISSOURI AND WISCONSIN

Ton-Miles	Percent	Cumulated Percent	Ton-Miles	Percent	Cumulated Percent
0.01 to 10.0	42.00	42.00	60.01 to 70.00	3.28	74.76
10.01 to 20.00	11.75	53.75	70.01 to 80.00	1.93	76.69
20.01 to 30.00	6.17	59.92	80.01 to 90.00	0.77	77.46
30.01 to 40.00	6.17	66.09	90.01 to 100.00	2.31	79.77
40.01 to 50.00	3.08	69.17	100.01 to 200.00	9.64	89.41
50.01 to 60.00	2.31	71.48	200.01 or more	10.59	100.00

TABLE 13

TRUCK TRIPS WITH LOAD AND TON-MILES OF COMMODITY MOVEMENTS FOR MISSOURI AND WISCONSIN BY ORIGIN AND DESTINATION

Origin and Destination	Trips (percent)	Ton-Miles (percent)	Origin and Destination	Trips (percent)	Ton-Miles (percent)
Intrastate trips—neither end in an SMSA			All other intrastate trips	5.6	19.7
Both ends in one city	7.3	0.8	Total	95.2	70.4
Each end in a different city	2.5	2.8	Interstate trips		
City-county combination	14.9	22.3	Neither end in an SMSA	1.1	9.6
County-county combination	23.3	12.5	One end in an SMSA	1.1	12.2
Total	48.0	38.4	Both ends in an SMSA	2.1	6.2
Intrastate trips—both ends in a single SMSA			Total	4.3	28.0
Both ends in one city	31.6	5.3	Unknown	0.5	1.6
Each end in a different city	3.8	2.0	Total	100.0	100.0
City-county combination	3.1	2.4			
County-county combination	3.1	2.6			
Total	41.6	12.3			

SAMPLE SIZE

The underlying purpose for the pilot study is to test techniques for increasing the response rate of a mail survey to collect data on commodity movements via highway and to compare questionnaire effectiveness. If the test indicates that at least one of the procedures is feasible, a large-scale or national sample can be designed. The problem then is how large should that sample be.

The primary statistic measuring highway use for movement of commodities is total ton-miles. Combining acceptable responses (including no travel responses) on forms C-3 and C-4 yields a total sample of 590 vehicles. The estimated squared coefficient of variation of the population of ton-miles per 24-hour day is 19. If it is desired to estimate total ton-miles with a relative error of 10 percent at the 95 percent confidence level, the sample, n, of acceptable responses is given by

$$n = \frac{K^2(CV)^2}{D^2} = \frac{4(19)}{(0.10)^2} = 7{,}600$$

If an 80 percent response rate is assumed for a questionnaire of the complexity of form C-4, a total sample of $(7{,}600)^5/_4$ or 9,500 is required. This may be rounded to 10,000. If equally reliable estimates are wanted for regions or divisions or other sub-national levels, samples of approximately the same size must be selected for each level.

The possibility must be considered that the sample should be designed to yield estimates of a given precision for commodity groups, such as commodities that contribute about 10 percent to the total ton-miles of highway shipment. However, the distribution of ton-mile movements for a given commodity or for a given group of commodities is not necessarily the same as the distribution for some other commodity. It is unlikely that any of the distributions approach the normal.

Assignment of the presently available observations to each commodity category would provide too few cases to estimate variability with acceptable precision. A rough measure of the variability of subgroups were obtained by combining data for commodity categories into the groups given in Table 14 and by calculating the squared coefficients of variation for each. Of the 7 groups listed, groups 1, 2, 4, 6, and 7 each contributed about 10 percent to total ton-miles. The third group contributed about 30 percent and the fifth group about 20 percent to total ton-miles. The squared coefficients of variation for the 10 percent groups ranged from about 4 to 7 times that of the estimate for the total. The squared coefficient of variation for the single 30 percent group was about 5 times that for the total and that for the single 20 percent group was about 3 times that for the total.

Although the groupings combine quite different commodity categories, it is believed that the distribution of variances shown for the 10 percent groupings should be a fair

TABLE 14

GROUPS INTO WHICH COMMODITY CATEGORIES WERE COMBINED

Group	Commodity	
	2-Digit Code	Category
1	01	Farm products
2	11, 13, 14	Coal; crude petroleum, natural gas, and gasoline; nonmetallic minerals except fuel
3	20	Food and kindred products
4	22, 23, 24, 25	Basic textiles; apparel and other finished textile products; lumber and wood products; furniture and fixtures
5	26, 27, 28, 29, 30, 31	Pulp, paper, and allied products; printed matter; chemical and allied products; petroleum or coal products; rubber and miscellaneous plastic products; leather and leather products
6	32, 33	Stone, clay, and glass products; primary metal products
7	34, 35, 36, 37, 39, 40, 41, 42	Fabricated metal products; machinery except electrical; electrical machinery, equipment, and supplies; transportation equipment; miscellaneous products of manufacturing; waste and scrap material; miscellaneous freight shipments; shipping containers returned empty

approximation to the distribution of variances for individual categories or even subcategories. The ton-miles values obtained in the study for single movements range from a low of 1 to a high of 6,804. The latter value fell in the food and kindred products category, 2-digit code 20. In all the 7 groups, relatively few high values of ton-miles provided the major contribution to the sizes of the coefficients of variation.

Six times the value for the total should be a conservative estimate of the squared coefficient variation for a commodity category contributing about 10 percent to total ton-miles. If it is desired to estimate the ton-miles for such a category with a relative error of 10 percent at the 67 percent confidence level, the sample, n, of acceptable responses is given by

$$n = \frac{K^2(CV^2)}{D^2} = \frac{1[6(19)]}{(0.10)^2} = 11{,}400$$

If an 80 percent response rate is assumed as before, a total sample of $(11{,}400)^5/_4$ or 14,250 is required. Based on 17,885,836 registered trucks in 1969, this would require a national sample of 0.08 percent of registered trucks.

ADDITIONAL COMMENTS

The major complexity on form C-1 is the requirement for the respondent to provide an estimate of the average distance a commodity was transported if there were 2 or more movements with that commodity. In a few cases, respondents supplied total distance rather than average distance.

Forms C-2 and C-3 provided space for 5 stops and requested the respondent to provide data for any additional stops on an extra sheet of paper. A few returns contained evidence that more than 5 truck stops had occurred on the travel day but the respondent did not furnish the supplementary sheet of paper with the additional data.

All questionnaires provided spaces for the state personnel to identify the vehicle as to make, year, model, and registered weight on the basis of information on the registration application. This should be eliminated from questionnaires in future studies, but the information should be available at the office. In some states, a registration number is assigned for a number of years to a vehicle owner. He may have sold the vehicle shown in the application and put the tag on a replacement vehicle. Sometimes the registration file has not been updated at the time of sampling. The owner may return the questionnaire with the remark that he no longer has the vehicle in question. He is correct. However, the sample is based on registration numbers not vehicles. Data should have been supplied for any vehicle assigned the selected registration number. Any future form letters requesting cooperation should make that point very clear to the potential respondent.

A check box to indicate "empty" should be added to the various parts of sections B and C of forms C-4. This will clarify the status of return trips and trips for other purposes than to pickup or deliver.

Because form C-4 requests information on the first 5 stops and the last 5 stops for trucks making more than 10 stops during the day, estimation of total ton-miles is based on incomplete data. The weight of the carried load at the end of the last trips should be requested in the last box of section C of form C-4. This would be item g and might be worded, "If any load was left, what was the weight of the load left in the truck?" This will provide a check on the accuracy of the assumption of stop-to-stop similarity of operations for this vehicle class.

Some trucks operated by farmers are driven on private property for at least part of the time. The covering letter should make it clear that only data on highway use are desired. Some respondents did not report delivery or pickup of commodities because they were not operating on a for-hire basis. Any future study should make it clear that information is wanted for vehicles not operated for hire. Some fleet operators do not organize their records by registration number. Other identification should be supplied, if possible. This point requires investigation. It may not be possible to solve the problem of collecting data on rental truck usage for a specified day. However, data should be obtainable on usage of leased trucks. The owner of a leased truck can be requested to supply the name of the lessor or to forward the questionnaire to the lessor.

CONCLUSIONS

1. A mail survey using a mail or phone reminder procedure plus follow-up will yield sufficiently high response rate for valid estimates.
2. A complex questionnaire yielding fairly detailed data will reduce the response rate when compared with less detailed questionnaires, but the reduction is not excessive. The quality of the response as to weight and distance may be improved, and additional detail will be obtained.
3. A sample of about 10,000 registrations should yield an estimate of total ton-miles with a relative error of 10 percent at the 95 percent confidence level. For a commodity class contributing about 10 percent to total ton-miles, a sample of about 15,000 registrations should yield an estimate with a relative error of 10 percent at the 67 percent confidence level. A sample averaging 20 registrations per state mailed each week with a total seasonal mailing to 13,000 registrants will yield acceptable seasonal estimates and quite reliable national and regional annual estimates. A sample of 100 registrations per state mailed one week each month will also yield acceptable seasonal estimates and quite reliable national and regional annual estimates. The effort does not seem excessive in light of the need for the data.

REFERENCE

1. Highway Planning Tech. Rept. 10, April 1969.

OUTLINE FOR STUDY OF URBAN GOODS

The following is an outline of a report on urban goods movement that was prepared by the staffs of the U. S. Department of Transportation, the Canadian Ministry of Transport, and the Highway Research Board as part of the preliminary planning for this conference. It is an analysis of the topics to be covered and information to be gathered for making a comprehensive analysis of urban goods movement. It is included in this Special Report as a potential skeleton on which to build a report on the state of current knowledge and the future research programs needed.

I. A look at the urban freight transport industry

A. Freight flows as a system: an overview of freight movement and identification of major problem areas

1. Graphic picture of freight flows, from raw materials to household, using hypothetical or actual examples
2. Possible combinations and permutations in the basic process
   a. Less-than-truckload (LTL) shipment from manufacturers to retailer and to consumer
   b. Air freight sent by urban manufacturer to overseas destination
   c. Rail shipment of bulk goods through a freight yard to a manufacturer in an urban area
   d. Truck shipment from manufacturer to consolidation point where cargo is sealed in a container and sent by truck, which in turn may travel part of the route on a flat car, to wholesaler or to retailer and to household in a delivery truck
   e. Container unloaded off a ship and sent by rail to retailer or wholesaler
   f. Other possibilities
3. Points where inefficiency may result because of LTL shipments, regulations, crisscrossing of paths, congestion, empty backhaul, design and location of terminals, and labor practices
4. Points where adverse impacts ("external costs") occur on community such as delays imposed on passenger travel, smog, noise, and vibration
5. Freight movements relatively insensitive to price such as refuse and mail

B. Structure and economics of freight industry

1. Statistics of freight movement by mode, both intercity and intracity
2. Characteristics of industry by mode
   a. Ease of entry and exit, barriers to entry, and degree of competition
   b. Services performed

c. Rates, costs, nonuser sources of funds, and profits

d. Comparison of common carriers, private carriers, and contract carriers

C. Urban freight terminals

1. Current trends in terminal locations for each mode
2. Problems and advantages of multimodal terminals
3. Container and piggyback terminals
4. Public and multiple-carrier terminal parks versus individual private terminals
5. Size and location
6. Costs of development and operation
7. Problems of safety and security
8. Freight forwarder
9. Trends toward more shipments or higher inventories

D. Documentation of freight movements

1. Current practices and problems in documentation of freight by different modes
2. Problem of intermodal transfers and shipments
3. Coordination of the flow of paper work with the flow of freight
4. Different governmental agency requirements for documentation
5. Availability of data for research and public planning purposes

II. Key factors influencing patterns of urban freight transportation (examination of certain factors that have significant effects on the transport of goods within urban areas and that, to a large degree, are independent of short-run market forces by describing and analyzing a key determinant in terms of its influence on urban goods movements, consequences of these influences, with particular attention to the costs of transporting freight in urban areas, and measures that might increase efficiency and reduce transport costs)

A. Regulation and control of freight flow by federal, state, and local governments for all modes

1. Control of competition through route structure, schedules, number of competing firms, and rate fixing within and among modes
2. Prevention of intermodal or vertical integration of freight companies, including multipurpose conglomerates
3. Prospects for modal and intermodal mergers or nationalization
4. Effects of multiple federal agency regulations of freight movement
5. Control over the public carrier versus the private carriers
6. Size and weight restrictions by federal, state, and local governments
7. Measures to reduce external costs, particularly congestion, noise, and air pollution
8. Safety to transportation users and to the urban environment
9. Effects of terminal zones

B. Role of government in financing the freight industry
   1. Capitalization and financing by the various modes
   2. Criteria for rate-making and concept of cost-plus bases of pricing
   3. Sharing of through routes and joint rates
   4. Capital and operating cost comparisons for different modes and their sources of funding
   5. Present forms of direct federal, state, and local subsidies for all modes
   6. Indirect forms of subsidies such as subsidies to airways and airports, Urban Mass Transportation Administration grants for demonstration projects, capital write-offs, cost allocations for highways, land grants, and profitable route structures
   7. Passenger deficit on commuter railroads and freight railroads
   8. Waterway construction with public funds

C. Labor policies and practices that affect urban goods movements
   1. Current labor policies and practices by mode
   2. Effects of industry-wide bargaining
   3. Effects of labor union jurisdictions
   4. Labor problems and the intermodal shipment of goods
   5. Effect of labor costs and practices on mode of shipment and transfer points
   6. The small carrier and labor and the private carrier and labor
   7. Labor cost comparisons of modes
   8. Effects of containerization and other technological innovations on the demand for labor

D. Technology and potential innovations in the urban movement of freight
   1. The container, its benefits and its problems
   2. The container port and its effects on the total port and concentration of shipbound freight
   3. The land bridge
   4. Piggybacking
   5. Commodity pipelines
   6. Freight regulation to force consolidation of local deliveries
   7. One-way nonreusable packaging
   8. Functional large-scale intermodal terminals
   9. Double and triple bottoms
   10. Size and weight increases
   11. Impact of the jumbo jet

III. Critical impacts of freight movements on urban areas (examination of short-term and long-term effects of certain critical by-products of the movement of freight within urban areas by an analysis of the by-products such as congestion associated with the movement and unloading of trucks in urban core areas; the consequences such as higher operating, time, and risk costs for all surface transport in the area; and measures that might be employed to reduce the costs such as more off-street unloading docks and more imagination in the design of trucks)

A. Impacts of freight movements on the urban transportation system for an actual or hypothetical urban area
   1. Present situation
      a. Interurban versus intraurban freight movements by mode
      b. Parking and double-parking of trucks on city streets
      c. Congestion and time costs to automobiles and wage and capital costs to truckers
      d. Compatibility of passengers and freight at airports, e.g., local distribution of cargo carried by jumbo jets and urban railways
   2. Present trends and their consequences over a 10- or 20-year period assuming that present patterns continue and technology does not change significantly
   3. Other considerations

B. Impact of freight movement on urban structure and planning
   1. Effects of changes in freight transport technology on location and structure of cities
      a. Sailing ships, particularly the clipper ship
      b. Railroads
      c. Motor truck
      d. Pipeline
      e. Air cargo
      f. Other such as combinations of those listed including piggybacking, containers, unit train, and jumbo jet
   2. Changes in urban areas
      a. Changes in size of urban areas, dispersal of consumers, suburban shopping centers, and changes in residential density
      b. Changing character and distribution of manufacturing and service industries
   3. Impacts on urban planning

C. Problems of waste disposal
   1. Statistics on waste removal
   2. Forecast of growth of waste based on current trends
   3. Type of waste being produced including old cars, manufacturing by-products, trash, and sewage
   4. Effect of nonreusable packaging
   5. New processes and costs of waste removal
   6. Impact of waste removal on urban congestion and pollution

D. Impacts of urban freight movement on urban environment and ecology
   1. Air pollution
   2. Noise
   3. Vibration
   4. Accidents

5. Visual impacts
6. Land uses including terminal size and location

IV. Evaluation of current knowledge, analytical tools, and planning practices regarding urban freight movements

A. Current research in progress and recently completed on the movement of goods in urban areas

1. Urban and regional transportation planning studies of freight movement such as those by the Tri-State Transportation Commission and the Baltimore Regional Planning Council
2. Studies being sponsored by the U.S. Department of Transportation, the U.S. Department of Housing and Urban Development, the Interstate Commerce Commission, and other governmental agencies
3. International studies of urban freight movement and including those in Canada, United Kingdom, France, Germany, Japan, and Australia
4. Freight movement studies conducted by or reported to the United Nations, the Organization for Economic Co-operation and Development, the Agency for International Development, and the World Bank
5. Freight studies conducted by contract research agencies

B. Modeling and demand forecasting (analytical frameworks or "models" that give explicit treatment to the relations among the number of units of a particular transportation service that would be consumed per time period and key variables such as rates, travel time, costs including wage, capital, and operating costs, service characteristics, and other factors)

1. Potential uses of models
   a. Explain basic relationships such as those between land uses and the demand for goods movements
   b. Predict effects of changes in values of key variables such as travel time
   c. Forecast demands for future services
   d. Evaluate alternatives
2. Present state-of-the-art of modeling urban goods movements
3. Modeling the demand for goods transport versus modeling the demand for passenger travel
   a. Similarities
   b. Differences
   c. Mutual compatability
4. Types of information and models needed
   a. Local transportation demand forecasting and land use planning
   b. State and federal aggregate demand analysis, evaluation of alternatives, and development of transportation policy

C. Transportation planning and urban goods movements

1. Evolution of treatment of goods movements in transportation planning
2. Present practice

3. Impact of Section 134 of 1962 Federal-Aid Highway Act: After July 1, 1965, the Secretary shall not approve. . . any program for projects in any urban area of more than fifty-thousand population unless he finds that such projects are based on a continuing comprehensive transportation planning process carried on cooperatively by States and local communities in conformance with the objectives stated in this section.

D. Data concerning urban goods movements

1. Summary of data currently available or being collected

a. Required by Section 134, 1962 Federal-Aid Highway Act

b. Collected by major urban studies and authorities

2. Data deficiencies and costs of collecting data necessary to meet stated planning goals and modeling specifications

V. Priorities for the future (identification of alternatives that show the greatest promise of improving the efficiency of transporting goods in urban areas and the areas in greatest need of additional work)

A. Institutional innovations

B. Technological innovations

1. Innovations in existing technology

2. New technology

C. Changes in federal policy

D. Changes in state and city policy

E. Research and data

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