

URBAN GOODS MOVEMENTS IN CANADA: INFORMATION SOURCES AND REQUIREMENTS

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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.

^aNot 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:

<u>Costs</u>	<u>Per Person Per Year</u>
Goods trucking	\$280
Person transport, with no value on unpaid time	<u>250</u>
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.

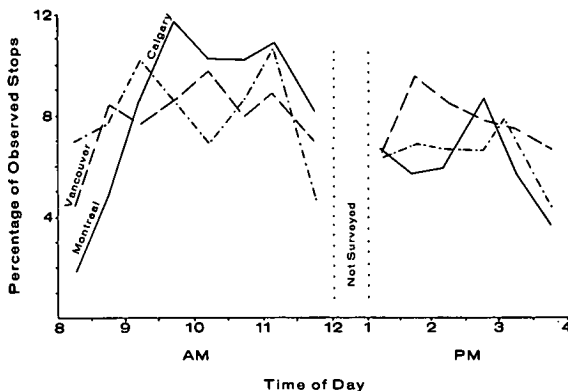


Figure 1. Timing of truck activity in test cities (3).

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 practicality 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.