Canada's National Capital Region Goods Movement Study

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The economic viability of an urban area is closely related to the availability of an adequate transportation system. The ability to transport goods efficiently to, from, and within the urban area is a critical element in the promotion of continued economic development. Therefore, the planning of transportation facilities must be cognizant of the needs and requirements of all users, including those of the goods movement industry. This requires a clear understanding of goods movement operations and characteristics. A high priority had been placed by the various levels of government on the development of a goods movement data base and a review of a number of issues and policy considerations facing the local trucking industry in Canada's National Capital Region (NCR). Consequently, in 1989, a study of the characteristics of and issues surrounding goods movement in the NCR was undertaken. The study provides a sound data base for urban goods movement planning in the NCR. It also provides insight into data collection and policy issues of interest to planners in other cities. The findings of that study are reported.

Historically, issues related to urban freight transportation have received less attention than issues related to urban passenger transportation. In recent years there has been renewed interest in undertaking goods movement studies to better define its economic importance, outline its nature and role, ascertain its traffic impact and the impact of traffic on its operations, develop policies and regulations, and implement strategies.

In 1987 a study of urban goods movement operations was completed for metropolitan Toronto, Canada's largest municipality. Its findings created considerable interest in the subject area. The need to undertake studies for other communities to evaluate whether conditions, problems, solutions, and policies were similar to those found in that analysis was soon made apparent.

A study was initiated in 1989 by the member agencies of TRANS, a joint technical committee on transportation systems planning to investigate the nature of goods movement operations in Canada's National Capital Region (NCR). The NCR encompasses Canada's capital: Ottawa, the neighboring city of Hull, and the surrounding suburban and rural communities. Its boundaries closely approximate the Regional Municipality of Ottawa-Carleton (RMOC) in Ontario and the former Communauté régionale de l'Outaouis (CRO) in Québec (Figure 1). The urban area is bisected by the Ottawa River, which also defines the provincial boundary between Ontario and Québec.

A steering committee composed of representatives of municipal, regional, provincial, and federal governments guided the project, which was undertaken by a consultant. Throughout the duration of the study, trucking industry associations and trucking operators, law enforcement and emergency response agencies, and other government offices were consulted.

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CONTEXT

The NCR had a 1990 population of 922,000, making it the fourth largest urban area in Canada. The region's economy, however, is principally based on government functions—about 60 percent of all employment is in services and public administration. Consequently, it does not have the firms that traditionally generate or attract much truck traffic, such as intermodal transfer, manufacturing, and wholesaling. One indication of this is that Ottawa-Hull ranks only 11th among major Canadian urban areas in terms of for-hire trucking revenues by origin, and 7th by destination (*1*).

The NCR has several other unique attributes that figure prominently in goods movement:

- Because the urban area is spread over two provinces, truckers operating in both parts must conform to several sets of regulations. These are directed primarily at serving intercity goods movement. Multiple urban jurisdictions are common in the United States but rare in Canada.
- Most roads and highways in the NCR are under municipal, regional, or provincial jurisdiction. The federal government operates scenic parkways in the NCR from which commercial vehicles are prohibited.
- The federal government is responsible for the five interprovincial bridges across the Ottawa River. Only three are open to commercial vehicles. The proximity of these bridges to the central areas (central business districts) of Ottawa and Hull necessitates the routing of truck traffic through or near the core, regardless of origin and destination.
- Problems of access to the central areas and the interprovincial bridges are further complicated by the lack of a direct, high-capacity link between the bridges and the freeway network on the Ontario side. The significance is that both sides of the Ottawa River tend to be served by depots located on the Ontario side; this is evidenced by the proportion of development in Ontario (i.e., in the RMOC): 83 percent of employment and 77 percent of population.

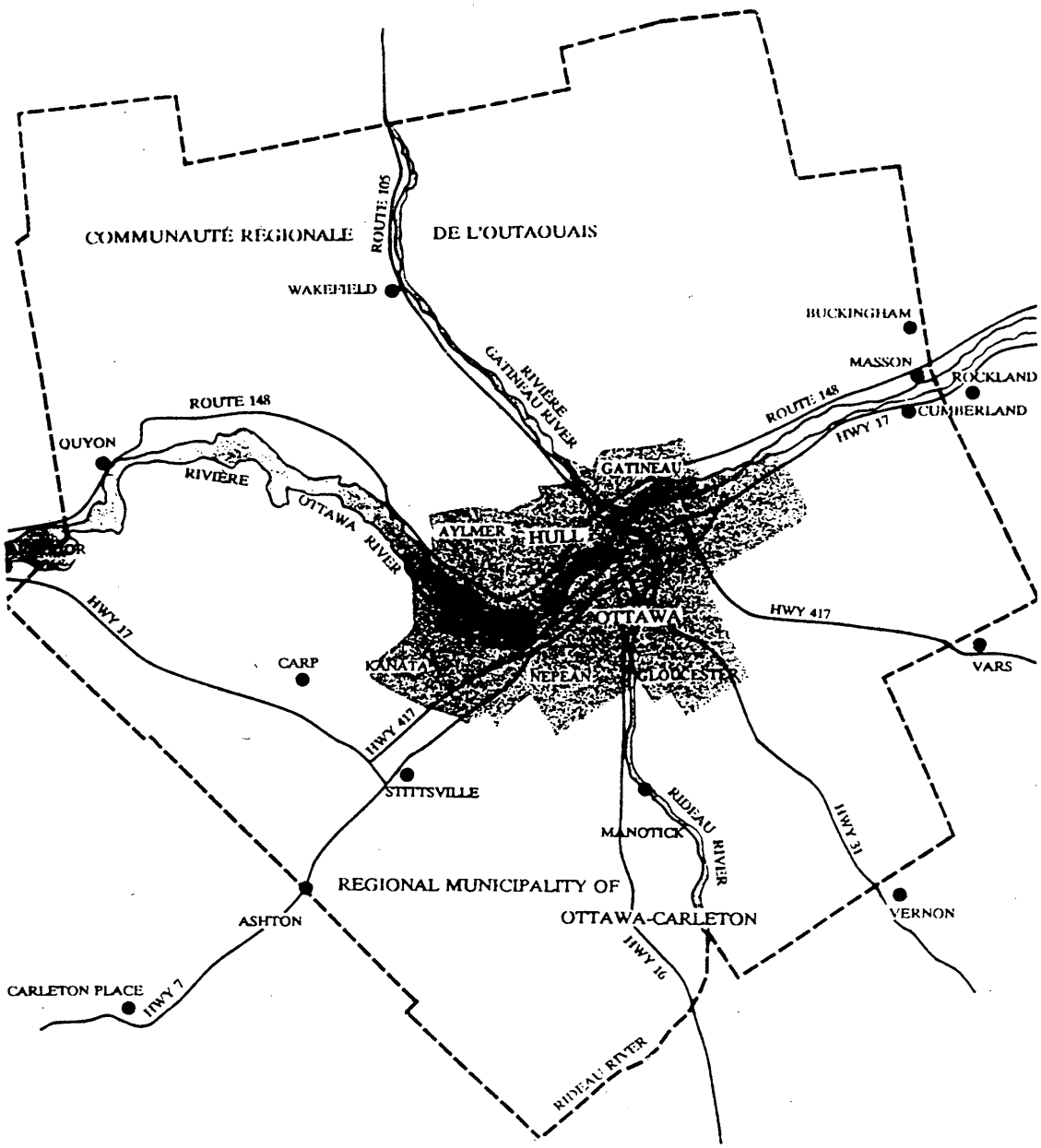

FIGURE 1 NCR study area.

STUDY OBJECTIVES

The four principal objectives of the study were to

- Collect information on the travel patterns and costs of goods movement operations in the NCR,
- Evaluate the effectiveness and effects of goods movement on the existing transportation network,
- Evaluate the implications of possible changes to the existing transportation network with regard to current and future goods movement operations, and
- Review the policies and restrictions governing the movement of goods in the NCR.

Urban goods movement issues can be generally grouped into four broad categories: transportation planning, traffic engineering and design, safety, and its economic relationship. The objectives of the study were somewhat shaped by the issues at hand. Specific to the NCR was the need to address the following:

- The adequacy of current building bylaws and, in particular, on-street parking and loading regulations in the two central areas;
- The characteristics of interprovincial goods traffic as they pertained to the bridges and to through movements in the central areas;
- The adequacy of the NCR truck route networks and the need to institute a dangerous goods truck route system as well;
- The costs of goods movement operations in the NCR and the effects of congestion on these costs; and

• The means of incorporating urban goods movement considerations into the urban transportation planning process, particularly in light of the influence of land use plans and policies.

METHODOLOGY

Three data collection methods were used to collect quantitative and qualitative information on goods movement activities. Survey 1 consisted of three truck origin-destination surveys. Survey 2 represented three follow-up telephone surveys. Survey 3 consisted of several "focus group" sessions (Figure 2).

A major component of the data collection program was the bilingual origin-destination mail-back surveys (Survey 1). This survey had three components: A, the principal sampling of overall goods movement activities, and two special-purpose surveys—B, which constituted a survey of "external" vehicles, and C, a documentation of vehicles that crossed the interprovincial bridges.

The sampling frame established for the survey was the provincial (state) commercial vehicle registrations in the subject area, consistent with previous studies in Toronto, Vancouver, and Chicago. However, unlike those studies, multiple registries were used (i.e., those of both Ontario and Québec). Since major differences existed in the two provincial classification systems, a common means of classifying vehicles was developed on the basis of vehicle weight. Vehicles were categorized by weight class and body type into three groups, labeled light, medium, and heavy for convenience.

There were approximately 59,600 trucks registered locally in the NCR on the basis of provincial records, although the actual truck population in the NCR was estimated to be about 24,000. The difference is explained partly by seasonal variations (the surveys were conducted in late autumn), a variation in vehicle registrations between the provinces, and an activity rate affected by the beginning of the economic downturn.

For Survey 1A, 3,650 trucks were sampled (6.2 percent), but only 2,520 were active in goods movement. (The sample was weighted to get greater representation of heavier vehicles.) Completed responses were obtained from 710, whereas 250 trucks, or approximately 1 percent of the actual NCR truck population, recorded trips on the day of the survey in the NCR.

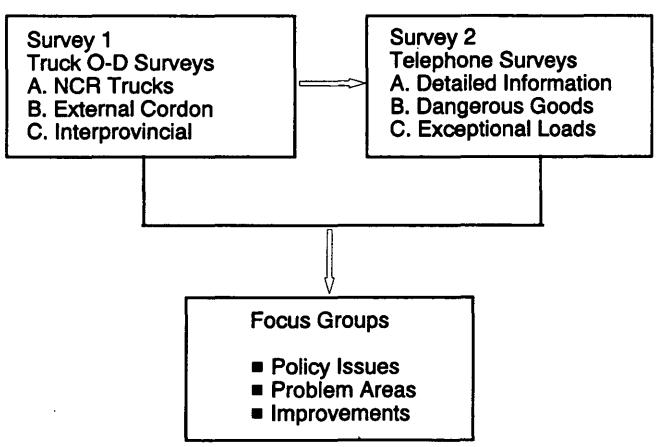

FIGURE 2 Data collection.

It was recognized that externally based vehicles were also active in the study area, making pickups and deliveries, and subject to the same conditions as locally based vehicles. Accordingly, a sample of externally based vehicles (i.e., vehicles registered outside the NCR) was selected from data collected at a cordon drawn across highways near the NCR boundaries. A sample of 700 trucks was drawn from the observed population of 2,870 trucks from which registry data were available; completed responses were obtained from 130 trucks for Survey 1B.

One of the principal issues in the NCR was the need for additional interprovincial bridge capacity. A separate survey, 1C, focused on all commercial vehicles crossing the existing bridges linking the provinces of Ontario with Québec. A similar sample of 700 trucks was drawn from an observed population of 2,866 trucks; 96 completed responses were obtained.

Each survey targeted vehicle trips made over a 24-hr period—Tuesday, December 12, 1989, for Survey 1A, and Tuesday, October 24, 1989, for Surveys 1B and 1C. The first part of the survey requested information on the respondent's firm, fleet size, and type of business.

The second part requested information on the vehicle's characteristics, load/commodity, trip origin, destination, timing, and routing information over that 24-hr period. The results from these surveys were edited, validated, weighed, and expanded. A combined origin-destination trip matrix was then calibrated according to observed values collected along major regional screenlines.

Telephone surveys were undertaken to collect detailed information from trucking managers and dispatchers on their organizations, general characteristics, perceptions and problems, and operating costs. The sample was stratified according to factors such as economic sector, fleet size, and composition. The first survey sampled 100 firms, from which 71 valid interviews were collected. The other surveys focused on dangerous goods carriers (22 interviews of 30 sampled firms) and exceptional load carriers (28 interviews of 30 sampled firms).

Four focus group discussion sessions were held in English and French with representatives of interested parties to further explore the traits and conditions identified in the previous surveys. The sessions included trucking operators, police forces, and industry associations.

PRINCIPAL FINDINGS

It was estimated that there were approximately 153,100 goods movement trips made daily in the NCR in 1989. Goods movement trips accounted for about 11 percent of all vehicular trips. Eighty-five percent of all trips involved an RMOC origin or destination, compared with 9 percent for CRO points and 6 percent for external locations. Areas with high concentrations of industrial activity and transportation and communications industries generated the largest numbers of goods movement trips.

Only 8 percent of all trips had an origin or destination in the central area of Ottawa-Hull. About 96 percent of goods movement trips from the RMOC were contained within the RMOC, whereas 74 percent of goods movement trips from the CRO were contained within the CRO. Only 2 percent of the trips involved crossing the provincial border between the RMOC and the CRO.

Goods movement activities were found to be greater on the Ontario side of the NCR (Table 1). However, the combined NCR trip generation rate of 0.16 trips per person was comparable with that observed in the 1987 metropolitan Toronto study.

Interprovincial trips (Survey 1C sample) constituted about 5 percent of all NCR goods movement trips, with slightly greater involvement of Ontario-based vehicles. In addition, some 53 percent of external trips were identified as being through trips and did not involve either an NCR origin or destination. Close to one-half of trips in the central areas were through trips as well.

Goods movement trips originating in and destined to the same zone accounted for over half (57 percent) the unlinked trips. It is recognized that this rate is somewhat dependent on zone boundaries, but a significant proportion (37 percent) of linked trips were also intrazonal. Unlinked trips represented the true origin/destination sequence of movements, whereas linked trips were desire line patterns of stops served from the vehicle's base of operations.

The overall average daily trip rate was 8.7 trips per vehicle, comparable with the rates observed in Toronto (9.7) and Vancouver (7.7) (*2*; summary of 1988 Vancouver truck survey). Medium-sized trucks tended to have the most stops per vehicle, whereas the heaviest group of trucks had, predictably, the highest trip times and trip lengths (Table 2). They also tended to have a greater proportion of external versus local trip origins/destinations than did the smaller trucks.

Because all interprovincial trips pass through or near the urban core, it was found that compared with all other internal trips, these were longer, on the average, and had lower average speeds (Figure 3).

An indication of the differences between intraurban and interurban travel was found by examining the trips per vehicle in Surveys 1a and 1b. The average of 12.0 trips per vehicle

TABLE 1 Population, Employment, and Trip Generation

Area	RMOC (Ontario)	CRO (Québec)	NCR (Combined)
Population	706,400 (77%)	215,800 (23%)	922,200
Employment	381,100 (83%)	77,000 (17%)	458,100
Per capita employment	0.54	0.36	0.50
Trips generated:			
- per capita	0.18	0.07	0.16
- per job	0.34	0.20	0.32

TABLE 2 Overall Average Trip Characteristics

Province Of Registration	Class Of Truck	Trips Per Vehicle	Trip Length (km)	Trip Time (min)	Stop Time (min)
Ontario	Light	9.7	12	17	31
	Medium	10.3	14	21	29
	Heavy	5.4	75	72	54
	All	9.1	19	23	33
Québec	Light	4.2	21	**	**
	Medium	7.4	22	32	44
	Heavy	6.0	41	43	27
	All	5.9	34	40	32
Ontario & Québec	All	8.7	20	25	32

** insufficient data

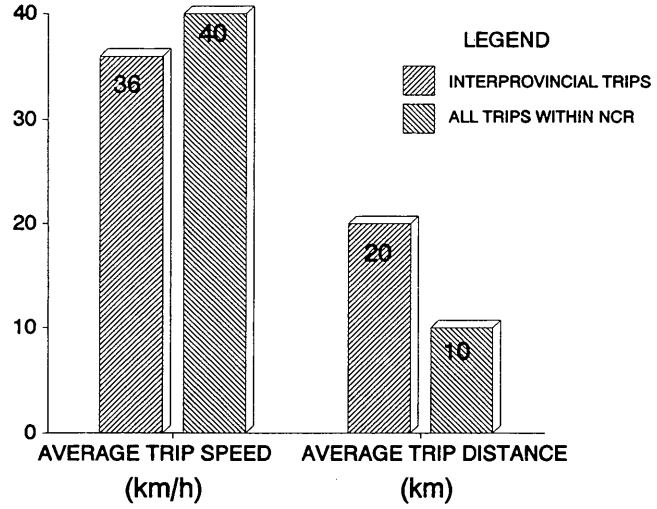

FIGURE 3 Interprovincial goods movement characteristics.

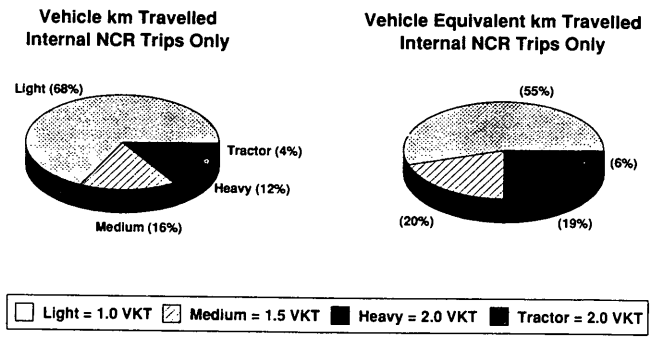

FIGURE 4 Trip characteristics.

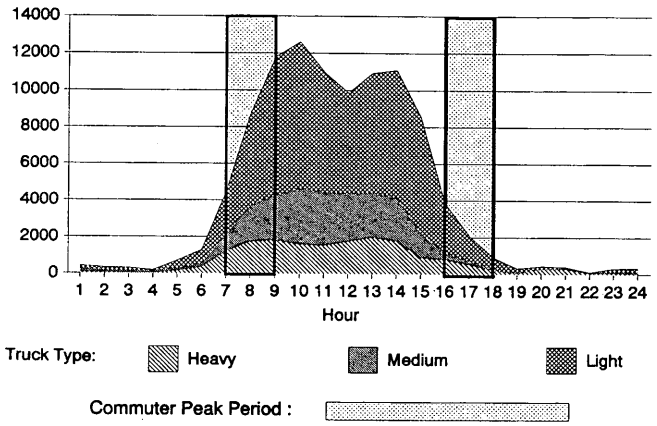

FIGURE 5 Hourly trip distribution.

for trips completely internal to the NCR and 3.5 trips per vehicle at the external screenlines is consistent with the differing forms of operation (Table 3).

The external trip data also showed that vehicles engaged in intercity travel were making multiple stops in the urban area (although information on the ultimate origin or destination of transshipped goods was not collected).

Whereas the heavy truck population is small compared with that of lighter trucks, the impact on the transportation network was disproportionately higher, based on heavy trucks' passenger car equivalents. In terms of actual distance traveled, light trucks dominate, but heavy vehicles (including tractors) have a much greater effect on capacity—60 percent greater than actual distance traveled (Figure 4).

Goods movement trip generation largely coincided with the normal business day. Ninety-five percent of firms surveyed indicated that they were in operation between 8:00 a.m. and 4:00 p.m., in part governed by customer demand. Peak-period congestion tended not to be a factor in determining the hours of operation. Only 18 percent of truck trips were generated during the two commuter peak periods (Figure 5).

In examining the destination, size, and composition of loads, it was found that

- Deliveries were more than twice as frequent as pickups;
- Fewer pickups and deliveries to the Ottawa and Hull central areas (70 and 40 percent, respectively) used off-street facilities than was the case for the NCR in general (80 percent);
- Aside from "other" goods, finished or processed products represented the largest category of goods carried;
- One-third of all vehicles were empty, 18 percent were full, and the remainder were carrying partial loads;
- Only 2 percent of commodities transported were dangerous goods; 47 percent of the dangerous goods were flammable liquids and compressed gases; and
- Less than 1 percent of goods transported were oversized or overweight loads requiring special transport permits.

Multiple regression analysis was used to develop truck trip generation rates based on the origin-destination data. The analysis derived generation rates as a function of zonal pop-

TABLE 3 Mean Trip Characteristics (Ontario and Québec)

Category	Survey 1a (internal)	Survey 1b (external)
Trips per vehicle	12.0	3.5
Trip Length (km)	10.5	71.2
Average Trip Time (min)	15.8	72.0
Average Stop Time (min)	27.9	54.9

ulation and employment. It was found that

- Population has a minor influence on truck trip generation,
- Government (public administration and related agencies) is not a large generator of truck trips,
- Equations for both light and medium trucks each have high coefficients of correlation (approximately 0.90), and
- Equations for heavy trucks exhibit small coefficients of correlation (0.362).

The equations are useful in providing order-of-magnitude forecasts of truck trip generation. More precise forecasts might be derived from detailed surveys of major generators at the individual site level or at office or industrial parks. In addition, the randomness inherent in truck pickup and delivery itineraries requires a more elaborate tracing of representative individual vehicles, both to corroborate observations and to gain further insight into daily variations. Finally, the trip generation rates were based on the relative aggregate indicators of population and employment; other indicators—notably measuring construction activity as an indicator of heavy truck activity—are required.

VALUE OF GOODS MOVEMENT AND THE IMPACT OF CONGESTION

The cost of transporting a product or its component parts accounts for a small, yet pivotal, portion of the final price of a product, and ultimately it reflects on the relative competitiveness or economic viability of a community. Under extreme, prolonged conditions, congestion also influences the location of industries that are dependent on truck access (*3*). The operating costs of moving goods in the NCR are affected directly by factors such as congestion, whose costs are passed onto consumers in the form of increased prices.

To obtain a measure of the value of goods movement in the NCR and the impact of congestion, hourly operating cost data were obtained from in-depth operator interviews (Survey 2a). These were confirmed by other operators during the focus group discussions. On the average, hourly operating costs ranged from $30.00 to $47.50 (Canadian dollars) for vehicle and driver, depending on the class of vehicle used.

Though not directly comparable because of the size and economic base served, Toronto costs ranged from $28.15 to $36.00 (1986), and Montréal costs were between $35.15 and $43.40 (1988) (*2*; data provided by Association du Cammionnage du Québec from a 1988 study of its members in the metropolitan Montréal region). The NCR averages were not comparable with the provincial averages for Ontario and Québec. This was expected given the dominance of interurban trucking and related economies of scale in the provincial cost data. However, the average operating costs generally were the same across the NCR (whereas the two provincial averages differ). This suggests that the location of a firm and its source of labor are not dependent on the provincial jurisdiction within the NCR.

The NCR costs were applied to average daily vehicle hours of travel based on trip rates, and mean travel and stop times, by vehicle class. Expansion factors were then applied to represent annual levels of travel and cost. The total cost of moving goods in the NCR based on this approach was estimated to be about $500 million annually.

Approximately one-half of the operators interviewed (Survey 2) believed that congestion contributed significantly to their operating costs. However, in examining the most commonly cited areas of congestion, it was found that location influenced the identification of congestion points only to a certain extent (i.e., frequency of use of a facility to the operator's location).

Congestion costs were determined from Survey 1 data by grouping trips by vehicle class by time of day, comparing travel time differentials, and then applying hourly costs. It was found that approximately 15 percent of morning and evening peak-period travel time was directly attributable to congestion, consistent with the experience of operators in Survey 2. The cost of congestion to the goods movement industry during the peak hours was estimated to be between $14 million and $18 million annually.

However, peak truck activity occurs outside the peak periods (i.e., 9:30 a.m. to 3:30 p.m.). Congestion, though reduced significantly in most areas, is also evident and may be attributable to, among other things, less road capacity due to on-street parking. It was determined that 11 percent of travel times for trips beginning between the two peak periods could be attributable to congestion, and the cost was estimated to be between $25 million and $33 million. The overall cost of congestion was between $40 million and $50 million, or approximately 8 to 10 percent of the annual cost of goods movement in the NCR (Figure 6).

ISSUES

A series of issues was identified by the surveys of shippers and operators and by the focus groups:

- The inadequacy of on-street loading facilities,
- Congestion in both central areas,
- Operational and geometric constraints,
- Too many parking/stopping restrictions,
- Inconsistencies in and quantity of regulations among the jurisdictions (municipal as well as provincial),
- The utility of a dangerous goods truck route network,
- The need for more interprovincial bridges,

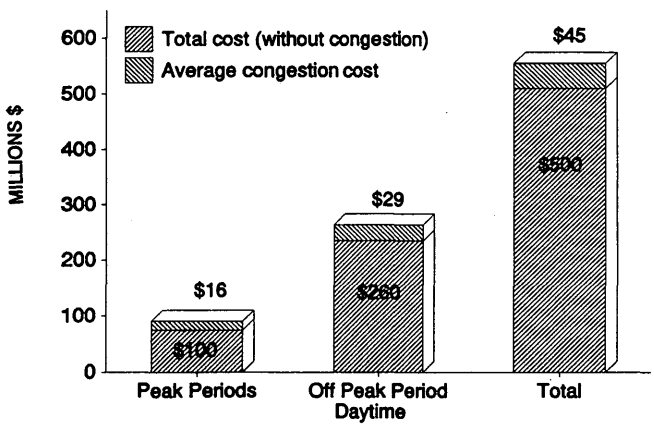

FIGURE 6 Cost of congestion.

- An already inadequate and shrinking truck route network, and
- The need for improved and increased communications among those involved in goods movement in the NCR.

These issues were evaluated in the context of the data collected and the ability to implement a solution. A manifestation of the latter was the opposition by NCR community groups concerning the designation of new truck routes near the Ottawa central area because of concerns about truck noise, vibration, and pollution. The conclusions and recommendations of the study were drafted with a view to responding to the issues at hand.

STUDY RECOMMENDATIONS AND DISCUSSION

There were 14 principal recommendations; they are discussed below. An impact assessment of five possible changes to the road network also was conducted. Two of those changes dealt with the issue of additonal interprovincial bridges. The results will be used in the planning and prioritization of new roads and bridges.

The first recommendation was to provide for new alternate truck routes bypassing the Ottawa central area to reduce through goods movement trips and congestion. The means to do so was left to a further study. The second recommendation was to increase enforcement of the use of on-street loading/unloading facilities to eliminate infringement by unauthorized private vehicles. The largest number of concerns on any issue was recorded with regard to on-street loading/unloading in the central business district.

The third recommendation was to enhance existing curbside management strategies and to introduce new ones through an investigation of new technologies and a better understanding of current policies. RMOC already has a curb space management policy for the Ottawa central area (*4,5*) that gives priority to commercial loading after essential needs (such as clearance for fire hydrants, bus stops, accesses, and intersections) have been addressed.

The principal problem in the NCR is common to the downtowns of most North American cities where several transportation uses are competing for the same limited space (*6*). A common means of increasing street and intersection capacity is to reduce or eliminate on-street parking and loading/unloading areas (*7*).

The intention of the study's recommendation was to seek out a strategy as broad based as possible, taking into account competition among several users for the curbside lane. It was recognized that a more detailed understanding of on-street loading/unloading operations would be required, given, for example, that the space requirements and duration vary according to commodity and land use. One such analysis is now being undertaken in Toronto, as a follow-up report to the 1987 *Metropolitan Toronto Goods Movement Study*.

The fourth recommendation was to review and revise municipal bylaws in the respective central areas to ensure their adequacy and consistency. For example, a review of municipal bylaws indicated that the loading requirements of suburban communities appeared to be stricter than those of the inner cities. It was also recognized that solutions in this area tend to be long term and cannot be retroactively applied unless there are redevelopment opportunities at individual sites. There was also a need to acknowledge, on the basis of the stop time evidence presented in Table 3, the varying parking and loading requirements of goods movement trips based on time and truck size.

Problems concerning interprovincial travel within the NCR related to permits required to operate interprovincially and the use of the three bridges on which trucks are allowed. The fifth and sixth recommendations were drafted with a view to considering the results of this study in the future planning for bridges and ensuring that local operators were aware of, and made available, interprovincial operating requirements. The latter recommendation was directed at the needs of independent operators (which tend not to be part of the interurban carrier industry). Larger operators understood the regulatory requirements for interprovincial operations in the NCR and had few difficulties in meeting them.

The seventh and eighth recommendations dealt with the issue of truck routes, specifically, the "shrinking" truck route system and resultant discontinuities, even in emerging growth areas. A single, coordinated NCR truck route system (or map of one) does not exist. Links have been removed from the system in recent years because of complaints from residents. Nighttime restrictions have been imposed on other residential links. Nighttime deliveries are not prohibited, although the activities tend to be confined to industrial and commercial areas. A night delivery strategy was attempted at a major shopping center but was abandoned as not being cost-effective.

Reinstituting those removed truck route links would be difficult. However, the study recognized and recommended that it is important both to enhance the means used to designate routes in the NCR and to ensure that the entire NCR truck route system is well known to operators.

The 9th and 10th recommendations dealt with the issue of seasonal load restrictions. These were imposed in the spring months to account for structural constraints that occur from spring thaw. The resulting discontinuities in the truck route network were reported to increase travel times and operating costs, especially since some operators had to use a greater number of trucks and movements to transport a given load. However, it was recognized that road reconstruction incurs significant public costs. The conclusion of the report was to attempt to minimize seasonal road discontinuities and to factor roads and bridges that are subject to seasonal load restrictions into the process that determines priorities for facility rehabilitation.

With respect to dangerous goods, it was discovered that there are about 500 dangerous goods incidents each year, most occurring on private property (i.e., at storage terminals or loading/unloading facilities). Municipalities in Ontario and Québec, among them the RMOC, have considered or proposed the limitation of urban dangerous goods movement to specific truck routes. Operators were generally not in favor of the limitations because of perceived cost increases and logistical problems.

The designation of these systems, however, is under provincial jurisdiction. In Ontario, the Ministry of Transportation has not designated dangerous goods truck routes because of concerns about increased accident and spill risks, additional

economic burdens on the trucking industry, and further enforcement required by police forces. It was subsequently recommended (the 11th recommendation) that the current practice of not designating them be maintained until justification, through a risk assessment ascertaining need, is demonstrated.

The issue of oversized loads was also of interest because some 1,120 such permits were issued in the NCR in 1989, the movement of some of these loads required police or other escorts, and there were regulatory and operational differences among municipalities and between the municipality and the province governing their movement on facilities under their respective jurisdictions. A twelfth recommendation was made to establish a committee to address those regulatory differences.

Inherent in all the preceding issues was the need for improved and increased communications among those involved in goods movement in the NCR. The thirteenth recommendation was that the dialogue initiated in this study be maintained. In particular, it was also recommended that trucking operators organize to speak with a single voice. Currently, trucking associations exist by province, region, or industry type—no single association represents the entire NCR.

The fourteenth recommendation was to monitor and refine the characteristics and relationships developed in this study and to establish liaison with other technical committees to evaluate and perhaps apply their strategies.

CONCLUSION

The results of the study have focused attention on the needs and concerns of the goods movement industry. A number of agencies were involved in guiding the study and, consequently, have each gained considerable knowledge of the scope and magnitude of goods movement operations within their communities.

A strong data base now exists and contains comprehensive data on goods movement activities across the NCR. Future studies may evaluate the impact specific proposals will have on goods movement within the NCR.

The study represents the largest goods movement survey ever undertaken locally and provides a clear understanding of local goods movement operations. In short, there is a greater appreciation of the travel patterns, costs, and needs of the industry. This is critical for planners and transportation practitioners, considering the impact of the goods movement industry on the urban economy. Increased costs and delay are important factors in the total cost of moving goods and are ultimately reflected in the selling price of a product or commodity.

A committee consisting of most of the study's municipal and provincial participants has since been formed to develop a process by which the findings of the study can be implemented.

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