

**RESEARCH & DEVELOPMENT OPPORTUNITIES
FOR ADVANCING
HIGHWAY FREIGHT TRANSPORT TECHNOLOGIES**

by

Sesto Vespa

TRANSPORTATION DEVELOPMENT CENTRE
Research and Development Directorate
Policy and Coordination Group
Transport Canada

June 1989

ABSTRACT

Current technological issues in highway freight transport are examined with reference to the current state of the industry. Research areas are identified that cover the range of technologies spanning vehicle, driver, infrastructure, operations, compliance with regulations, and collection of exposure and accident data. Technology assessment and diffusion are discussed with a view to the needs of government and industry.

Research and development in highway freight transport technologies is also presented in the context of federal government and Transport Canada objectives, priorities and responsibilities. From this perspective, objectives and sub-objectives for an R&D program to be conducted by the Transportation Development Centre are proposed that respond to the federal government mandate and to industry needs.

Information was gathered through a literature survey and from interviews with, and written comments from, representatives of several federal departments and six provincial governments, various manufacturers, operators and industry associations, and researchers in federal, provincial and university laboratories.

One purpose of the study was to provide a précis of current thinking on R&D areas of opportunity, to help promote expansion of related activities and to encourage cooperation among Canadian researchers within, and between, the public and private sectors.

ACKNOWLEDGEMENTS

The author wishes to thank the management and staff of the Transport Canada Research and Development Directorate of the Policy and Coordination Group for having provided the opportunity and necessary support for undertaking this study.

The author gratefully acknowledges the cooperation extended by other federal departments, provincial governments, and numerous representatives of the Canadian research establishment and industry.

INTRODUCTION

There is no single agency responsible for all facets of highway freight transportation in Canada. As a result, it is difficult to consider highway transportation from a system perspective, an approach essential for optimizing service design and operation. In order to make fundamental progress, it will be necessary for all levels of government and industry to adopt a cooperative approach. This is especially true in 1989, when we stand on the threshold of a revolution in highway transportation. In the not-too-distant future, computers, communications and other electronic systems may generate an "electronic highway" that inseparably links driver, vehicle and roadway through a vastly distributed network that provides selectable control, guidance and advisory functions. Isolated and uncoordinated approaches to research and to implementing its results will become increasingly less fruitful as the responsibilities of the various governments and industry become increasingly linked.

Highway freight transport technology is an area slated for increased research and development (R&D) activity by Transport Canada's Transportation Development Centre. Highway freight transport has a major influence on consumer costs and on the competitiveness of the nation's exported products. Government and industry must address the increasing social concerns about the safety impacts of larger and heavier vehicles occupying even more of the nation's road infrastructure and transporting an increasing proportion of the nation's dangerous goods. There is also increasing recognition of the large potential that highway freight transport has for providing new technological products and services as well as for creating additional jobs.

This paper presents a compendium of potential R&D activity areas and projects for advancing highway freight transport technologies. It provides a précis of current thinking on R&D areas of opportunity to help promote expansion of related activities and to encourage cooperation among Canadian researchers.

Economic regulatory reform has created an environment that fosters and rewards competitive advantage now more than ever before. Innovation, fundamental to maintaining long-term advantage, requires a sustained long-term commitment to research and development. Transport Canada has decided to make this commitment and invites the transportation community at large to do likewise, both by giving a higher priority to research and development and by making additional funds available to support it.

BACKGROUND

OBJECTIVES

This paper presents the results of a study, which TDC decided to undertake in April 1988, having the following objectives:

1. To provide a précis of current thinking on R&D areas of opportunity, to help promote expansion of related activities and to encourage cooperation among Canadian researchers within, and between, the public and private sectors.
2. To provide the private sector and all levels of government with an understanding of the R&D objectives of Transport Canada, and the associated context within which Transport Canada's central R&D activities are developed and conducted.
3. To assist TDC plan and execute focused R&D activities relating to highway freight transport technology.
4. To serve as a background document which will facilitate coordination of TDC's R&D program with that of other organizations involved with highway freight transport R&D and that wish to participate in and support TDC's program.

SCOPE

This study addressed highway freight transport that generally covers commercial vehicles operated by private, for-hire, and household-goods movers, normally operated at gross vehicle weights in excess of 5 500 kg.

METHODOLOGY

The study was undertaken in-house from information gathered through a literature survey and from interviews with, and written comments solicited from, experts covering a wide spectrum of the industry. These included representatives of several federal departments, six provincial governments and various manufacturers, operators, industry associations and researchers in federal, provincial and university laboratories.

RESEARCH AND DEVELOPMENT IN THE FEDERAL GOVERNMENT

Transport Canada's central R&D activities are administered by the Research and Development Directorate. This directorate has appointed TDC as the program delivery organization. TDC's program is wide in scope and covers all modes. It is intended to complement and extend beyond, but not

replace, R&D initiatives being undertaken by Transport Canada's operating groups and required to support their operational, regulatory and procurement needs. The department responsible for road safety and motor vehicle regulation, for example, conducts its own R&D program to address specific regulatory and road safety initiatives. TDC's program is almost entirely contracted out to the private sector.

TDC's R&D program must respond to federal government objectives and priorities, as well as to those set by various Transport Canada components. For the purpose of this study, these are summarized in Table 1 based on consideration of 1988 Corporate Priorities (1)*. These are presently being updated but current concerns, from an overall perspective, continue to deal with safety and efficiency, security, transport of dangerous goods, environment, and regional development.

TABLE 1
FEDERAL GOVERNMENT AND TRANSPORT CANADA DEPARTMENTAL
OBJECTIVES AND PRIORITIES

-
1. Improve transportation safety and security including for transportation of dangerous goods.
 2. Stimulate and support national and regional economic development.
 3. Promote improved efficiency and productivity.
 4. Reduce energy requirements and promote efficient utilization of national resources.
 5. Undertake and stimulate effective R&D.
 6. Stimulate international trade.
 7. Develop alternative investment strategies.
 8. Preserve useful national infrastructure investment.
-

TDC's R&D activities fall into the following three categories: exploratory, long-term or sector-directed. The purpose of exploratory R&D is to produce knowledge through wide-ranging, systematic assessments of new developments; long-term, to support departmental or previously defined group objectives; and sector-directed, to support innovation in the transport sector and hence further departmental objectives and priorities.

TRANSPORT INDUSTRY STATISTICS

In 1986, the Canadian trucking industry (2) incurred operating expenses of \$12.3 billion. In comparison, the gross operating expenses for all railways, including VIA Rail, were \$6.95 billion (1984) and those of the domestic airlines were \$5.4 billion (1985). In the public sector, the federal, provincial, and municipal governments spent a combined \$4.7 billion (1986) on highway construction and maintenance. In regards to trade with the United States, the primary method of transport is by truck, accounting for 59% of exported goods and 72% of imports. Using operating expenses to measure truck transport activity, for-hire and private carriers (with some differences) domiciled in Ontario accounted for 40% of total Canadian expenses, Quebec for 18%, Alberta for 13%, British Columbia for 11%, Manitoba and Saskatchewan for 12%, and the Atlantic provinces for 6%.

* The numbers appearing within brackets refer to references.

The majority of private trucking firms are local carriers, with more than 89% of their power-unit fleets made up of straight trucks. For-hire carriers are mainly involved in intercity transport, and more than 65% of their power fleet is made up of road tractors. Provincial registration fleet statistics show that in 1986, British Columbia had the oldest fleet, with 75% of its trucks being 6 years old or more. Ontario and Quebec have the heaviest fleets, with 20% of vehicles having a gross vehicle weight designation of 45 360 kg (100 000 lb) or more.

HIGHWAY FREIGHT TRANSPORTATION RESEARCH AND DEVELOPMENT

In order to develop an effective R&D program for the area of highway freight transportation, the shared roles of the federal and provincial governments in this area must be understood.

THE FEDERAL GOVERNMENT'S ROLE

Table 2 details federal government legislation dealing with highway transportation. These acts define limits of authority, standards of performance and requirements to be met for commercial activity, technological products and operations. Table 3 lists the main responsibilities the federal government has acquired in this area.

TABLE 2
**FEDERAL GOVERNMENT LEGISLATION DEALING WITH
HIGHWAY TRANSPORTATION**

-
1. Department of Transport Act.
 2. National Transportation Act.
 3. Motor Vehicle Transport Act.
 4. Motor Vehicle Safety Act.
 5. Motor Vehicle Tire Safety Act.
 6. Transportation of Dangerous Goods Act.
 7. Motor Vehicle Fuel Consumption Standards Act.
-

The federal government's direct effects on highway transportation are a result of legislation specifically addressing this area of transportation (from Table 2), other legislation that has a direct impact on highway transportation (e.g., the Railway Safety Act for railway level crossings) and federal-provincial agreements for assistance to specific transportation projects.

The federal government indirectly affects highway transportation when highway transportation plays an important role in determining the success of federal policies and initiatives in other unrelated areas. For example, highway transportation is vital for trade and tourism and will play a pivotal role in the success of Canadian industry under free trade. Strategic planning and use of the highway system are critical to successful military operations as well as for emergency planning and response.

Highway transportation is also affected indirectly by the federal government through administrative decisions, such as participation in cooperative arrangements with the provinces to promote national

highway transportation objectives. Two such examples are federal participation in the Council of Ministers of Transportation and Highway Safety and the Canadian Council of Motor Transport Administrators.

TABLE 3
THE FEDERAL GOVERNMENT'S ROLE IN HIGHWAY TRANSPORTATION

DIRECT

1. Vehicle safety regulation.
 - a. Regulation of new vehicles and tire design and manufacture.
 - b. Corrective requirements for safety defects.
2. Regulation of dangerous goods transportation.
3. Regulation of extraprovincial motor carrier transport.
4. R&D in support of Transport Canada's mandate in highway transportation.
5. Highway/railway safety and level crossing protection program.
6. Highway safety educational programs.
7. Construction and maintenance of roads of federal property.
8. Federal support to provinces for specific road construction projects.
9. Federal support for road safety projects.
10. Bridges over navigable waters.
11. Highway motor vehicle and criminal code enforcement in several provinces.

INDIRECT

1. Free trade and international use of highway system.
 2. Department of defense and strategic use of highway system.
 3. Membership: Council of Ministers of Transportation and Highway Safety.
 4. Membership: Canadian Council of Motor Transport Administrators.
-

PROBLEM AREAS AND POTENTIAL OPPORTUNITIES

In order to maximize the effectiveness of an R&D program addressing highway freight transportation technology, associated problem areas and potential opportunities must also be examined.

Accident Data

According to statistics gathered by Transport Canada's road safety branch, 400 to 460 deaths occurred each year between 1984 and 1986 as a result of accidents involving heavy commercial vehicles. An additional 9 000 to 9 700 personal injuries are also attributed to accidents involving heavy trucks between 1984 and 1986.

The fundamental problem faced when trying to improve upon these statistics is deciding where limited resources could be best allocated to achieve the best results. This is very difficult since accidents are generally the result of many contributing and interrelated factors. A comprehensive and consistent data base detailing accident and exposure data is vital to identification and assessment of countermeasures.

All Canadian jurisdictions require that vehicular accidents involving injury or death be reported, as well as those involving property damage above specified monetary levels. They do, however, differ on the following three salient points: the time frame following an accident during which a death may be attributed to the accident, the definitions, and the level of property damage required for reporting.

In addition to the above differences, there are also jurisdictional differences in the requirement to record accident data. Although specific jurisdiction guidelines are provided detailing which accidents must be reported, guidelines regarding the completion of an accident report by a police officer are not clear and frequently vary within a jurisdiction due to the presence of different enforcement agencies (e.g. municipal, provincial and federal). In some cases, the accident form is completed by a person other than the attending police officer.

The accident report form has been designed to deal with passenger-car accidents, and typically includes data concerning vehicle identification, the vehicle occupants and their injuries, the location and time of the accident, the weather conditions and vehicle movement immediately prior to the accident. For commercial vehicle accidents, information relating to the vehicle configuration, its load and the driver's experience are not included. A combination vehicle, such as a tractor-semitrailer or a B-train, will frequently be identified solely by reference to the number plate or registration or licence of the power unit. Accident reports frequently do not identify trailers unless there is a specific reason to do so.

Because of the problems in assembling reliable accident data, Transport Canada has initiated a Traffic Accident Information Data (TRAID) system. It has also established 10 Multidisciplinary Accident Investigation (MDAI) teams at several universities across Canada. This accident data base should now be refined and expanded to provide for complete compatibility between provinces in order to serve in a national capacity.

Exposure

In order to evaluate exposure correctly and accurately, it is necessary to be thorough and consistent in detailing the parameters that are to serve as measures of travel. This information is then linked to the accident counts for a given period. Vehicle configurations must be identified to obtain meaningful results that permit useful analysis and decision making. To this end, it is important to have classification equipment that is reliable, provides the minimum required data in a convenient format for easy handling and is low cost. Once this data is compiled, it must be effectively stored and analysed.

The basic requirements for setting up a "national sampling system" can be identified as follows:

1. A system of permanent counting stations (PCS) working 24 hours per day. The number and locations of PCS would be selected through analysis of the national road network. A representative cross-section of this network would be monitored as required by the data accuracy specification.
2. A proper sampling framework, established to permit the congruous operation of portable and permanent counting/ classification systems and to address impacts of seasonal changes, weather, changes in vehicle mix, etc. The portable units would permit adjustments to weighting factors used with the PCS, thereby leading to more accurate short-term results and following long-term trends more effectively.

A minimum of one or two provinces should be involved in setting up the national sampling system. The other provinces should then be incorporated as required.

In terms of exposure data, there are opportunities to be innovative in Canada. There has been rapid progress in data collection capabilities as a result of technological change. Many provinces (such as Quebec, Ontario and Saskatchewan) are looking at the possibility of expanding and updating their weigh station and traffic data systems. It is important that there be effective coordination of all efforts to facilitate further cooperation in the future and the implementation of a national sampling system. This system should reflect the country's present data-collection capabilities and the provinces' future plans. Its implementation will also likely involve negotiation with the provinces for specific requirements that go beyond provincial concerns.

Highway design and condition are two important factors that may contribute to accidents. To support the accident and exposure data-collection requirements, it is also essential to develop a national system aimed at identifying a position on the national highway system. The required precision would be prescribed by accident and exposure data needs.

Technology Assessment and Diffusion

Canadian research into highway freight transport technologies is fragmented and often lacks international scope. Researchers have also had difficulty disseminating their findings to companies seeking solutions to existing and potential problems.

Nonetheless, Canadian researchers have made significant contributions to highway freight transport technologies. A means must be found to promote the work done by Canadian agencies within the global research community.

In order to be competitive, Canadian highway freight industries must incorporate the latest research technology in the most efficient and effective manner possible. Since a large proportion of highway technological advancements occur offshore, the identification and integration of valuable foreign technology is essential.

Technology transfer requires the adoption of a planned and structured approach by both industry and government. Government should promote a long-term view in industry by assessing national and international trends that have the potential for making significant impacts on the national economy and the international competitiveness of its industries.

Government and industry should promote cooperation of Canadian research and international technology exchange in areas that will have potentially beneficial results for the Canadian economy. In terms of emerging technologies, for example, it is important that robotics, computer and communications technologies be carefully examined from an international perspective for potentially important applications to traffic management (street control, freeway management, enforcement), vehicle monitoring and control, as well as for potential development toward the "electronic highway" that will ultimately link vehicle, driver and roadway.

These technologies have the potential to make revolutionary changes in technical capabilities and cost factors, thereby playing a key role in determining what transportation services are provided and how. Important efforts to provide high-technology products as a result of R&D advancements are now underway in Europe, the United States and Japan. Once they are established, these high-technology products will be sold worldwide. Canada must find its own way into these fields based on the transportation needs and technical capabilities of the national economy as well as through the manufacture of products for the local and export markets.

Vehicle Technology

The transportation gross domestic product (GDP) for all transportation modes currently comprises 4.8% of the total Canadian GDP (3). This marks a significant improvement since 1961, when transportation GDP was 7% of the total; however, it is still almost 50% higher than the comparable figure for the United States. To remain competitive with American industries and to increase Canadian penetration of north-south freight traffic, further improvements in road transport productivity must be

achieved. The two areas in which improvements can be foreseen is in regulatory uniformity and transportation electronics.

Notwithstanding the productivity gains, the area of truck electronics will play a major role in advancing commercial vehicle safety. Based on available registration and accident data, heavy commercial vehicles are involved in about 3.5% of all reportable accidents and 10% of all road fatalities. Not only is the public concerned over the disproportionate involvement of trucks in fatal accidents, but it is also concerned that in those accidents, an occupant of the other vehicle, usually a passenger car, is usually the fatally injured party. Equally alarming to commercial vehicle operators are United States and European studies that rate the trucking industry as having an annual fatality rate of 58 deaths per 100 000 workers, second only to mining and quarrying at 60 deaths per 100 000 workers (4). The average industry experiences 11 deaths per 100 000 workers.

Truck safety electronic systems of the future will monitor and record: driver medical and physical condition, providing a feedback alarm for specified unsafe conditions; vehicle dynamic performance, providing the driver with warnings of potentially unsafe conditions; condition of safety-related components and scheduling of maintenance and repair work. They will control the operation of drivetrain, suspension and brake components to optimize performance, preselect routes based on traffic volumes and monitor loading practices.

Commercial vehicle safety issues fall into a wide range of classifications including vehicle stability, dynamic response, aggressiveness, crashworthiness, braking, ergonomics, visibility, maintenance and reliability. In turn, each of these classifications contain multiple subclassifications.

Opportunities for R&D in vehicle technology, identified in general areas, are as follows.

1. Design features for improved vehicle safety, such as for reduced aggressiveness, improved crashworthiness and occupant protection, maximized braking efficiency and effectiveness, and optimized ergonomics for better driver control and traffic interfacing.
2. Improved combination vehicle dynamics through application of weight and dimension design criteria to trucks and trailers, development of stability and control performance criteria for trailer and semitrailer coupling devices, use of semi-active and active trailer axle steering mechanisms, development of effective anti-jackknife devices, enhancement of engineering tools for analysis of combination vehicle dynamics and improvement of tank design for reduced slosh.
3. Improved suspension dynamics through development of internationally recognized test methodology, understanding the influence of mixed suspension parameters on vehicle control and stability and development and use of high-stability suspension systems.
4. Better understanding of the overall effect of combination vehicles on the roadway-suspension interface.
5. Improved energy and environmental conservation and fuels substitution through technologies for engine and drivetrain tribology, energy efficiency, use of alternative fuels, assessment of fuels and fuel additives, minimized aerodynamic drag and reduced exhaust emissions.
6. Improved on-board electronic systems.
7. Feasibility study of an advanced concept vehicle (with broad participation of Canadian research community) that incorporates, to the greatest extent possible, the latest technology in each design area.
8. Enhanced productivity of special-purpose vehicles (auto carriers, furniture vans and household goods movers, logging industry vehicles, extended vehicle combinations and cargo containers that can be used for more than one transportation mode) through improved vehicle design and operation.

Infrastructure Technology

Current federal expenditures for road infrastructure maintenance and construction amount to \$225 million per year. Under agreements already in place, the federal government will spend \$1.233 billion over the next fifteen years in contributions to the provinces for road construction. This makes the federal government one of the largest sources of highway funds in Canada, exceeding the annual highway budgets of six of the ten provinces. It would therefore be prudent for Transport Canada to establish both safety and maintenance criteria within its procurement and contribution objectives, in order to minimize its long-term contributions, and to ensure that technical innovations in highway construction and maintenance techniques are adopted.

In the area of infrastructure technology, it is essential that research and development be conducted in cooperation with the provinces. The American Strategic Highway Research Program (SHRP) and the Canadian Strategic Highway Research Program (C-SHRP), to which Transport Canada currently contributes, focus on the rehabilitation and maintenance of existing highways. The programs, however, do not address the relationship between design standards and road safety, nor do they focus on the interactions between vehicle vertical dynamics and pavement and bridge damage.

The following potential R&D opportunities have been identified in broad areas that deal with the impacts of vehicle-to-infrastructure, infrastructure-to-vehicle and roadway design.

1. Understanding the dynamics of vehicle loads and suspensions, and their interaction with the pavement, for improved vehicle design.
2. Development of technology to minimize vehicle contribution to road wear, to minimize government and industry costs.
3. Development of alternative materials for pavements and structures for improved energy efficiency, materials substitution and reduced corrosion and environmental deterioration.
4. Updating of highway geometric and signage standards for compatibility with the dynamic performance of the new generation of Canadian heavy commercial vehicles, and to provide for changeable message signs.
5. Support of C-SHRP and SHRP projects for improved design, construction, maintenance and long-term performance of highway infrastructure.
6. Federal support for the establishment of a national standard for locating accident sites, and support for implementation of the standard through required conformance in federally financed projects.
7. Investigation of pavement surfacing techniques to reduce wheel splash and spray without detriment to other desirable pavement requirements.
8. Updating of roadside furniture standards for compatibility with today's lightweight front-wheel drive passenger vehicles and the new generation of heavy commercial vehicles.
9. Development of a highway safety furniture maintenance handbook to be followed on all highways supported through federal funds.

Compliance Technology

The provincial and territorial governments operate approximately 150 permanent, 150 portable and 50 weigh-in-motion (WIM) weigh scales, with about 900 staff and a combined annual budget approaching \$300 million. Weigh scales staff in the majority of jurisdictions do more than just weigh trucks. Many facilities monitor vehicle licences and registration, vehicle insurance, motor fuel and sales taxes, motor-carrier authority, driver licencing, inspection certificates, mechanical condition, dangerous goods placarding, driver training cards, special operating permits and vehicle dimensions. With the introduction of the National Safety Code, these facilities will also soon be monitoring hours of service.

Most violations of provincial regulations result in civil charges against either the vehicle owner, the operator or the driver. Because many of the charges are challenged through the courts, the weighmaster must be prepared to present sufficient evidence of the violation to a court of law. The specifics determining each offence vary from province to province, depending upon the wording of statutes, thus making a nationally accepted prosecution or defence very difficult. However, there are opportunities to use technology to improve the accuracy and productivity of techniques that monitor compliance with national regulations, as follows.

1. Development of a national standard for static axle scales, on-board weigh scales and weigh-in-motion scales.
2. Development and demonstration of a system for integrating automatic vehicle identification and provincial records, thereby bringing violations to the attention of the weighmaster.
3. Development of improved on-board weigh scales, allowing the vehicle operators to maximize payload while remaining within legal limits.
4. Improvement of weigh-in-motion scale technology to lower costs and to improve accuracy and reliability at higher speeds in order to reduce traffic delays, and expand automation features to reduce staffing costs.

Operational Technology

Operational technology spans a whole range of issues dealing with driver performance as well as vehicle and fleet operations.

Traffic safety experts generally agree that approximately 70 to 80% of vehicle accidents are attributable to driver error. Attempts are now being made worldwide to address the causes in a more systematic manner.

In Canada, the National Safety Code for Motor Carriers specifically addresses commercial vehicle driver licence classifications, training and examination; violation records and interjurisdiction records exchange, and drivers' hours of service. Specific human factors relating to vehicle safety still require further attention.

In terms of vehicle and fleet operations, major advances are foreseen in areas relating to vehicle dispatching and vehicle location identification. Active vehicle location technology has not yet been sufficiently integrated into commercial transport fleets to allow automated route calculation, with instructions conveyed automatically to the driver en route. En-route instruction currently requires a voice communications link between driver and dispatcher in order for the dispatcher to know the location of the vehicle. If a passive link between the vehicle and a dispatch computer could establish the location of each vehicle, an expert system could calculate en-route changes so as to maximize fleet efficiency. Similarly, passive vehicle location technology can be used to trace en-route cargo, which is becoming more necessary with just-in-time manufacturing techniques. Passive vehicle location technology can have other applications, particularly with respect to highway planning, dangerous goods routing, emergency response vehicle security and driver route guidance.

The following potential areas of opportunity for operational technology R&D have been identified.

1. Understanding driver behaviour and limits of performance, including driver reactions to external perceptions and stimuli, as well as the effects on the driver when distractions such as cellular telephones, video screens and route guidance systems are introduced into the driver area.
2. Improvement of ergonomics and human factors engineering to reduce driver fatigue and increase driver awareness of events occurring around the vehicle.
3. Development of technologies that aid driver training, evaluation and licensing, and that promote uniform minimum qualifications for operators under the National Safety Code.
4. Development of driver monitoring systems for medical and physical conditions, including hours of service, that provide feedback on the driver's condition and are aimed at improving driver decisions.

5. Development of driving aids that improve vehicle control and provide advance warning of potentially hazardous conditions such as a shift in trailer centre of gravity, trailer swing or impending vehicle upset.
6. Enhancement of dangerous goods transportation safety, including non-destructive testing techniques for materials, more effective hazard containment technologies, improved communications systems, more secure product identification and expanded applications of expert systems for rapid emergency response.
7. Examination of communication and computer technologies in support of fleet and traffic management, mobile office and travel advisory functions, and to optimize use of the highway system around principal transportation hubs.

PROPOSED TDC R&D PROGRAM IN HIGHWAY FREIGHT TRANSPORT TECHNOLOGIES

In developing a proposal for TDC's R&D program for highway freight transport technologies, it was necessary to consider the perceived opportunities for R&D in the context of federal government and Transport Canada priorities, as well as the R&D mandate given to TDC. It was also necessary to consider federal responsibilities in highway transportation. From these considerations, and after a great deal of consultation with provincial and federal governments, industry and industry associations, the overall objective of TDC's highway freight transport technologies R&D program was proposed as follows:

"To promote and undertake cooperative research, development and demonstrations relating to the safety and productivity of commercial vehicles, their impacts on the roadways on which they travel and their operations, and including transportation of dangerous goods, energy efficiency and use of alternative fuels."

Concurrent sub-objectives were also proposed for this program, as follows.

1. To develop data-gathering technology and systems to support the corporate need for meaningful heavy truck exposure and accident data.
2. To facilitate the systematic assessment and diffusion of new developments in highway freight transport technology.
3. To advance research into highway freight transport technologies relating to vehicle safety and productivity.
4. To advance research into the effects of infrastructure on highway freight transport and vehicle design.
5. To stimulate applications of technology and enhancement of existing technology to improve the performance and productivity of compliance techniques that support national regulations.
6. To investigate advanced technologies for improved operations in the highway transport sector, and related human factors, to assist Canadian transportation industries in operating more safely and efficiently and in keeping pace with emerging technologies.

CONCLUSION

There are many and varied R&D opportunities available for advancing highway freight transport. These touch upon virtually every facet of the industry and will ultimately determine its economic position vis a vis the competing modes as well as the public's acceptance of an increasing role for the industry on the nation's road network.

With the limited funds available to the Transportation Development Centre to address highway freight transport R&D, its emphasis will be upon those areas that support Transport Canada's mandate in highway transportation. It will be the responsibility of the highway transportation community at large to make the greater vision of a highway transportation system of the future a reality.

REFERENCES

1. *1988 Corporate Priorities*, Transport Canada, TP 6620.
2. *Trucking in Canada (1986)*, Statistics Canada catalogue 53-222.
3. *Freight and Passenger Forecasts 1988*, Macroeconomic and Regional Analysis Branch, Transport Canada, TP 2957E.
4. *Heavy Truck Safety Study*, United States Department of Transport (DOT), DOT HS 807 109, March 1987.

WORKSHOP 3 – TRANSPORT SYSTEM ECONOMICS

Chairman: G. Gera, Ministry of Transportation, Ontario

Presentations

1. **Highway/Rail Compatibility Issues – Intermodal Strategy and Operations in a Changing Environment**
D.P. Smith, A.W. Gibson, CN Rail
2. **Trucking Industry Response to RTAC Weight and Dimension Regulations**
F.P. Nix, Canadian Institute of Guided Ground Transport
A.M. Clayton, University of Manitoba
B.G. Bisson, University of New Brunswick
M. Boucher, Université du Québec
3. **Intermodal Transportation and the Vehicle**
R.H. Foot, T.W. Phillips, CP Rail

OPEN DISCUSSION

