Transportation Development Centre

TDC

ANNUAL Review

1999 2000

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Transport Canada Transports Canada

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MESSAGE FROM THE Executive Director

Working for Innovation in Transportation

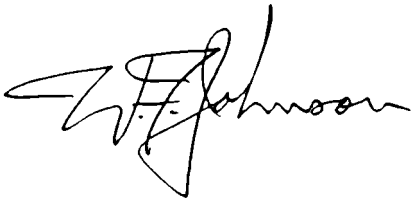
I am pleased to present the *TDC Annual Review 1999-2000*, summarizing the activities and accomplishments of Transport Canada's Transportation Development Centre (TDC) for the fiscal year ended 31 March 2000.

This year, the beginning of a new millennium, was one of solid achievement for TDC. We saw many of our pioneering efforts bear fruit, particularly in the area of intelligent transportation systems (ITS), as Transport Canada developed a federal policy for fostering ITS in Canada and co-sponsored the Sixth World Congress on ITS. In addition, TDC research into marine risk analysis led to the establishment of minimum safe practice standards for navigation in the St. Lawrence Seaway.

As we moved into the 21st century, many of our long-term programs expanded. European partnerships in the international runway friction program grew substantially, the ground de/anti-icing program was extended to include studies of airborne icing, and our grade-crossing safety studies became part of a major cooperative research program, with TDC as program manager.

Our innovative research in all transportation modes also led to invitations for our professional staff to speak at conferences around the globe – in Chile, Australia, and Singapore, to name but a few. TDC's expertise was sought on topics as diverse as management of operator fatigue and electronic data interchange for intermodal operations.

None of these accomplishments would be possible without the dynamism and commitment of TDC staff and the continuing support of our sponsors, research clients, and partners. I thank them all for helping to make 1999-2000 such a successful year.



WILLIAM F. JOHNSON
Executive Director
Research and Development

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TDC Profile

TDC, Transport Canada's centre of excellence for research and development, manages a multimodal R&D program aimed at improving the safety, security, energy efficiency, and accessibility of the Canadian transportation system, while protecting the environment. The Montreal-based centre is one component of the department's Research and Development organization, under the Safety and Security Group. The other, based in Ottawa, is responsible for departmental coordination, interdepartmental programs, and strategic planning.

TDC's mandate is to enhance the department's technological capability, to address the department's strategic objectives and federal government priorities, and to promote innovation in transportation.

TDC is headed by the Executive Director, Research and Development, and staffed by a multidisciplinary team of engineers, planners, economists, and ergonomists, who plan and formulate projects in collaboration with departmental clients. A research library and a communications unit document and disseminate information. Financial, administrative, and informatics services provide corporate support.

R&D Program

TDC's R&D program includes activities in all transportation modes and all stages of the innovation cycle – from concept definition to demonstration and deployment. The projects are contracted out to the agencies best qualified to do the work. Contractors range from consultants, manufacturers, and operators to research groups and universities.

CANADIAN NATIONAL RAILWAYS

PHOTO BY BRIAN LOSITO

Working closely with these contractors and with Transport Canada clients, TDC's professional staff plan and organize activities throughout a project and facilitate application of the end products in Canada's transportation network. They also provide a range of technology intelligence services for Transport Canada and other Canadian stakeholders.

The greater part of the program addresses the specific concerns of the Safety and Security Group. Many projects are part of long-term initiatives

with broad objectives, such as improving school bus safety through studies of current and proposed safety measures; others include cooperative ventures with various government departments, the provinces, and industry.

Internationally, TDC cooperates with research groups in the United States, Mexico, South America, Europe, and Pacific Rim countries, as well as with regional economic associations such as NAFTA, APEC, and the European Union. It participates in major cooperative ventures through memoranda of understanding, intergovernmental agreements, and scientific exchanges.

In addition to developing new technology, TDC supports decision-making through its intelligence-gathering activities, providing clients with information and expert advice related to the impacts of technology on critical transportation issues. This year, for example, TDC published a report explaining how new U.S. Environmental Protection Agency regulations will affect the Canadian railway industry.

Program Priorities and Funding

R&D expenditures are administered by an R&D Management Board responsible for monitoring all Transport Canada R&D and for establishing the allocation of the central R&D funds. A Technical Advisory Committee provides the Board with specialist and technical input on research priorities. The R&D Office in Ottawa leads this committee and TDC is a member.

Special programs augment departmental funding. In 1999-2000 they included:

- the federal Program of Energy Research and Development, administered by the interdepartmental Panel on Energy Research and Development and chaired by Natural Resources Canada
- the New Initiatives Fund of the National Search and Rescue Secretariat, administered by the Department of National Defence

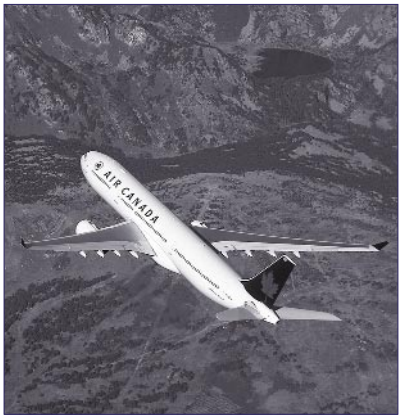


PHOTO BY BRIAN LOSITO

- the U.S.-Canadian Bilateral Agreement on Cooperative R&D concerning Counter-Terrorism

Joint and cost-shared initiatives with other departmental and federal organizations, provinces, municipalities, and industry provide another source of funding. In addition, in 1999-2000, financial support came from NASA, the Federal Highway Administration, and the Federal Aviation Administration for specific activities under joint programs with the U.S.

The *Financial Overview* on page 17 provides a detailed breakdown of TDC's funding and funding sources for 1999-2000.

R&D Highlights

Intelligent Transportation Systems (ITS)

Technological innovation is key to enhancing the efficiency of all our transportation practices.

David M. Collenette, Minister of Transport

A TDC study identifying key issues has helped Transport Canada to determine its role in the development and implementation of an effective **Canadian ITS architecture**. This architecture will provide a unified framework for coordinating the deployment of ITS programs by public and private agencies.

The study report outlines Canadian institutional responsibilities, industrial capabilities, system deployment, and standards development related to ITS. It also discusses the U.S. ITS National Architecture from a Canadian perspective.

The recommendations call for consistency with international programs to ensure cross-border compatibility and to maximize our competitiveness in the international marketplace. The report stresses that Canada's special characteristics, such as population dispersion, language requirements, and environmental extremes, must also be taken into account.

An in-service evaluation of a **freeway traffic management system** was launched this year. The "light infrastructure" system uses transponder-equipped vehicles and dedicated short range communications to monitor traffic flow and manage congestion. By reducing equipment, installation, and maintenance costs, the new system promises to provide an economical solution to traffic management.

The pilot project, undertaken by the Ministry of Transportation of Ontario with TDC support, covers the triangle formed by highways 401, 409, and 425. It is part of a broader program supported by ENTERPRISE, an international ITS association that includes the U.S. Federal Highway Administration, the Dutch Ministry of Transport, and several U.S. states.

Air Transportation

The **Joint Winter Runway Friction Measurement Program** (JWRFMP), initiated in 1996 and slated to end in March 2000, has been extended for another five years. In addition, participation increased this year, with several European carriers taking part in a week of tests at Munich International Airport.

The program's main aim is to develop reliable guidelines for pilots and airport operators on safe landing distances in winter conditions. The extension will enable researchers to launch a series of tests on improved ground friction measurement vehicles, wide-bodied aircraft, and a broader range of runway conditions.

Canadian JWRFMP participants are TDC (the program manager), other Transport Canada groups, the National Research Council Canada, and the Canadian Department of National

NASA LANGLEY

Defence. International members include the U.S. Federal Aviation Administration; NASA; the U.S. Air Force; the International Civil Aviation Organization; the European Joint Aviation Authorities; U.K., French, Norwegian, Swedish, and German civil aviation authorities; Munich and North Bay airport administrations; airlines; and aircraft and aviation equipment manufacturers.

TDC and Transport Canada's Civil Aviation Directorate became partners in the $1.7 million **Canada-U.S. Aircraft Icing Research Alliance** in December 1999. Other members are the National Research Council Canada, Environment Canada, NASA, and the U.S. Federal Aviation Administration. The alliance will prepare and implement a long-term plan for research into airborne icing, exchange technical and scientific information, and develop technologies to improve safety in icing conditions.

In the first research project, a study team evaluated remote sensing equipment for determining aircraft icing conditions aloft, and characterized the airborne icing environment. The data acquired will help to establish a new generation of aircraft icing forecast models.

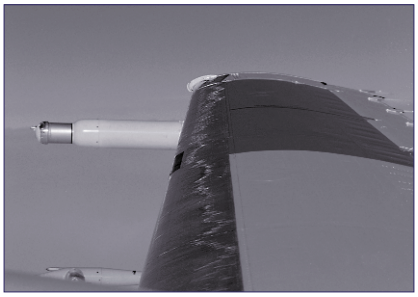
A prototype **aviation safety sharing system** being developed under TDC's flight data monitoring program was presented at the Global Aviation Information Network (GAIN) meetings in March 2000. Created by xwave solutions, the system allows aviation personnel with a safety concern to find out whether others have experienced a similar difficulty and, if so, how it was handled. The innovative

PHOTO BY BRIAN LOSITO

concept takes advantage of the Internet to ensure that air carriers can control access to information and can provide that information to users in real time.

Canada 3000 has committed to participating in a trial of the system and other carriers have shown an interest.

Ice on a Convair's cockpit windows



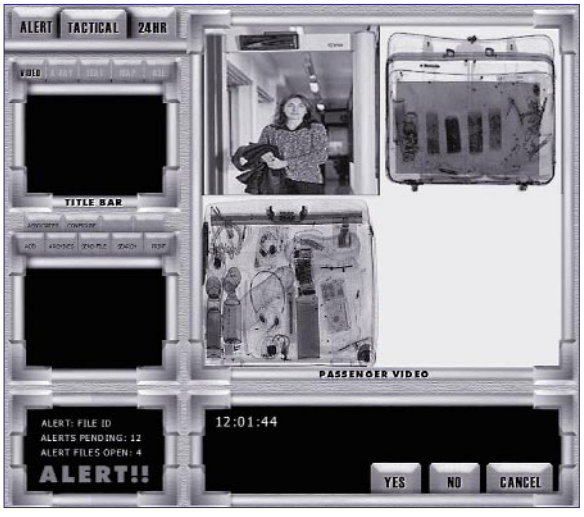
Runback ice on a Convair wing

R&D Highlights

Security

An in-depth study of **airport security system integration and data fusion** has confirmed that, although no universal interfaces currently exist, most systems could be linked to a central security database without excessive costs or labour. The study team developed a concept for system integration and recommended a limited trial implementation at check-in counters, screening points, and boarding gates. The concept calls for a common interface for data and image input/output, and video imaging at several points in the boarding process.

Other work in this long-term cooperative effort with U.S. security authorities focussed on the development of advanced technologies to provide reliable, effective explosives detection systems for carry-on and checked baggage.



Graphical user interface for airport security data fusion (under development)

Marine Transportation

LAURENTIAN PILOTAGE AUTHORITY CANADA

A **training program for marine pilotage certification candidates** released this year takes into account the advanced navigation technologies now in use, the particular working environment, and the candidates' experience. While specifically applicable to the Canadian Coast Guard's Laurentian Region District 2, it could be adapted for use in other areas.

Developed by the Institut maritime du Québec and Educ Action of Quebec City, the program is documented in three volumes: the training manual; a guide for candidates; and an evaluation guide for the use of certification authorities only.

The Laurentian Pilotage Authority, the Canadian and St. Lawrence ship owners' associations, licensed pilots, ship's officers with pilotage certificates, and officers with in-depth knowledge of the pilotage area helped to analyse the training needs and to validate the program.

In cooperation with Environment Canada and the British Columbia Ferry Corporation (BCFC), TDC investigated the effects of commercially available **emission control technology**, including a continuous water injection (CWI) system, on main diesel engine performance.

BRITISH COLUMBIA FERRY CORPORATION

The CWI system trials took place on the *Queen of New Westminster*, a BCFC vessel. The research team installed a firing pressure remote transmitter, consisting of pressure sensors, an engine fuel rack, and an engine timing sensor, to monitor engine combustion performance. They also sampled and analysed exhaust gas emissions and manually recorded data on other variables.

The results indicated that the CWI system reduced NOx emissions by more than 20 percent, without entailing any fuel penalty.

The first phase of a project to improve **evacuation systems for offshore oil rigs** involved modelling tests and computer simulations to examine proposed and existing systems. A parallel study determined the human factors involved. The results served as a basis for the development of criteria for rating evacuation systems.

The next phase will include development of risk profiles and evaluation tools, as well as guidelines for system implementation. The ultimate aim is to develop design standards and regulations for such systems.

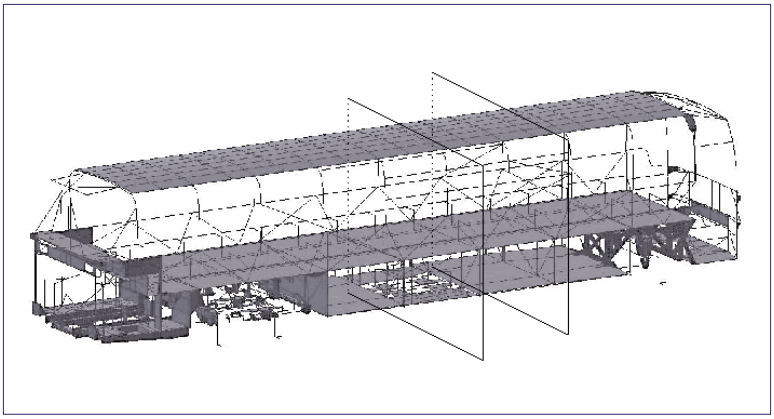
Road Transportation

Montreal 2000, an electric-vehicle (EV) demonstration supported by the federal and Quebec governments, Hydro Quebec, and industry, is evaluating the performance of 20 EVs that have been introduced into commercial and institutional fleets in the Montreal area. Each vehicle is equipped to monitor parameters such as the amount of current used, range, ambient temperature, and frequency of recharging. TDC is conducting control performance tests of two EVs in parallel with the in-service demonstration.

The year-long project will allow for extensive data collection and for evaluation of the reliability, efficiency, and cost-effectiveness of the vehicles in typical Canadian operating conditions. Surveys will determine user satisfaction with their comfort and convenience. The overall aim is to document the benefits of using EVs in urban commercial and institutional fleets.

HIBERNIA MANAGEMENT AND DEVELOPMENT COMPANY LTD.

The **Canadian Strategic Highway Research Program** (C-SHRP) has been extended to March 2004 for a second five-year phase of technology transfer. The program runs hand in hand with the U.S. Strategic Highway Research Program, sharing the results of highway research and supporting long-term pavement performance (LTPP) studies. The Transportation Association of Canada administers



Finite element model of an intercity bus

C-SHRP, with guidance from the funding partners – the federal and provincial departments of transport.

To date, research products from the programs have saved provincial transportation departments an estimated $40 million. The LTPP work has led to improvements in road surfacing materials and to publication of guidelines for best practices.

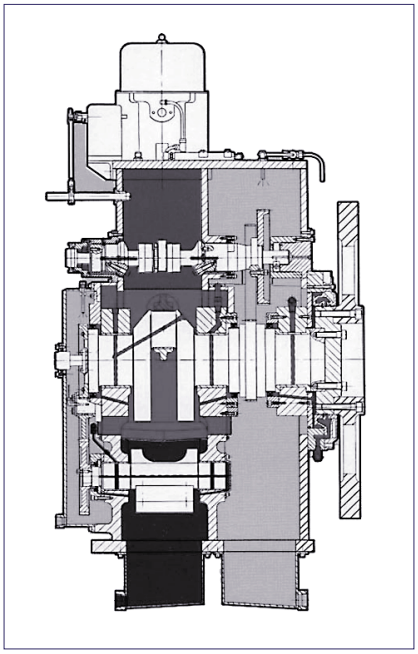
A research team has developed recommendations for **reducing the weight of intercity buses**, in an effort to decrease fuel and infrastructure costs. The team used finite element analysis and optimization techniques to determine which components offered the greatest potential for weight reduction. After selecting the roof, floor, and side trusses (all parts of the bus structure, which contributes 17 percent of the bus weight), they developed new design concepts for each of these structural components.

All the concepts offered an estimated 50 percent weight reduction compared to the traditional stainless steel structure. This would yield a 9 percent decrease in overall bus weight, without appreciably increasing the cost of the vehicle. A cost analysis indicated that this decrease would result in significant savings over the 15-year life cycle of Canadian bus fleets.

Rail Transportation

A four-year research program is taking a fresh approach to increasing the **safety of rail-highway grade crossings**. TDC and Transport Canada's Road Safety Directorate are working together to study the technological, operational, and human factors aspects of the problem and to develop effective solutions. The major Canadian railways and several provinces are also supporting the program. The research is a component of *Direction 2006*, a federal initiative aiming to halve the number of grade crossing accidents by 2006.

For the first year, the primary concern is program planning and implementation of projects to improve the understanding of specific problem areas. The kick-off workshop was held in November 1999 (see page 15).



Cut-away side view of the single cylinder engine used for the simplified test

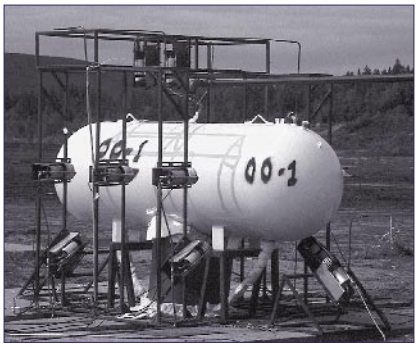
Validation of a **simplified test for diesel fuel and lubricating oil additives** began with trials of the methodology and procedures developed in earlier phases of the project. The test will provide a relatively economical alternative to the method now in use. Another advantage is its ability to verify compliance with recent U.S. Environmental Protection Agency emissions regulations.

To date, the expense and complexity of acceptance testing has discouraged the development of additives that could reduce fuel consumption and harmful emissions. The simplified test is intended to overcome this problem.

Transportation of Dangerous Goods

The **study of pressure relief valves (PRVs)** entered a new phase this year, with tests on the valves in three different operating modes. The research team exposed three 500 U.S. gallon propane tanks fitted with PRVs to fire engulfment and recorded the results.

A PRV operated by a computer-controlled solenoid was used to obtain the required operating characteristics of the three test modes and specially designed propane burners provided controlled fire conditions for each test. In all cases the tanks ruptured, but no catastrophic failures occurred.



Test set-up for PRV trials

The researchers will analyse the results and develop recommendations for safe PRV operating modes to be specified in the standards for vessels transporting dangerous goods.

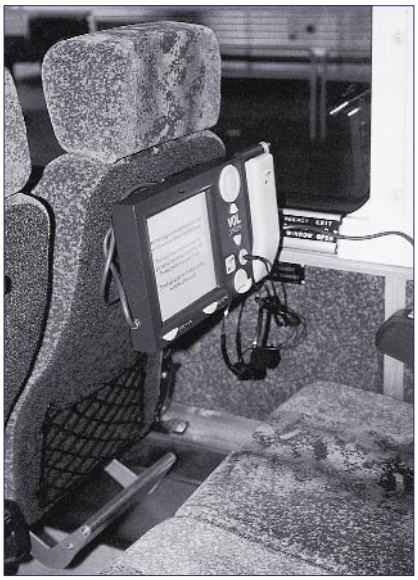
Transportation Accessibility

TDC, Transport Canada's Road Safety Directorate, and members of the National Mobility Equipment Dealers Association (NMEDA) are cooperating on **generic testing of vehicles** modified for drivers with disabilities. GM, Ford, and Chrysler are providing the vehicles, so that the most commonly used models and conversion features can be tested for compliance with Canada Motor Vehicle Safety Standards (CMVSS) regulations.

Tests completed this year involved a Ford E150 with a raised roof, raised door, and sofa bed; a Ford E250 with a lowered floor and quick-release seats; six-way power-transfer seat bases; and power door openers.

The guidelines and certification specifications resulting from the tests become industry standards, available to all NMEDA members. This enables them to produce safe converted vehicles that meet both CMVSS requirements and the needs of persons with disabilities, without the prohibitive expense of individual testing.

Persons with disabilities, mobility training specialists, and bus industry personnel gathered in Toronto to evaluate technologies for improving **intercity bus accessibility for persons with sensory disabilities**. They tried out fourteen high- and low-tech aids and provided feedback in structured interviews following the trials.



Design concept for a passenger communications centre

All of the aids, ranging from raised and Braille seat numbers to an infrared broadcast system, proved helpful. Among the most successful were an interactive pager and talking signs that guide passengers with visual impairments to the loading bay and bus entrance.

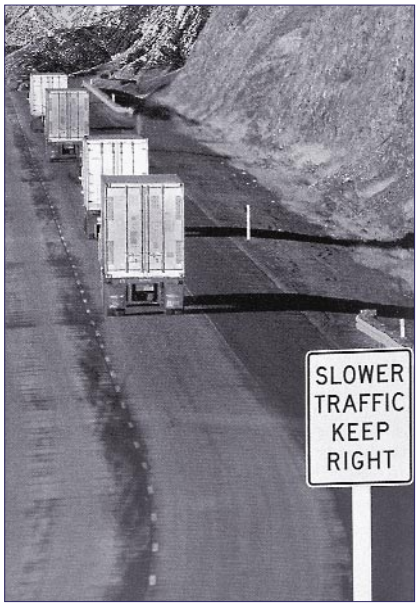
Human Factors

This year a research team reviewed **fitness-for-duty and readiness-to-perform tests** to assess their applicability to the transportation industry. In addition to offering an alternative to biochemical drug screening, these tests can detect many other causes for poor performance and are more readily accepted by employees.

The evaluation criteria included the resources and time needed for testing, the time needed to determine the results, and the validity of the test in a transportation environment. Of the twenty-six tests, nine were selected for further study.

TDC and Transport Canada's Road Safety Directorate are working with Alberta government and industry organizations to develop **recommended practices for fatigue management programs** (FMPs) in the trucking industry.

Driver groups with parallel characteristics, such as driving experience and age range, are taking part in the program. One group is maintaining the status quo, another is taking an educational program with follow-up support, and a third is benefiting from fatigue-reducing improvements to work and scheduling practices, in addition to the educational program.



Researchers will assess the success of each approach from both objective and subjective points of view. The results will enable them to develop a comprehensive awareness and training program on FMPs for the trucking industry.

Outcomes

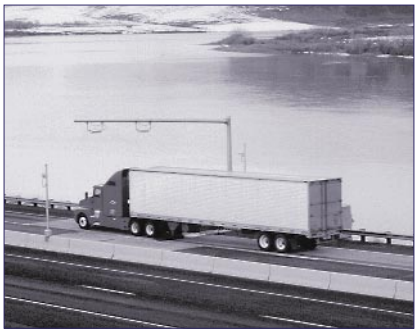
Technological knowledge is the main source of economic growth and improvement in the quality of life.

Organization for Economic Cooperation and Development

TDC's pioneering work in intelligent transportation systems (ITS) provided a solid foundation for the ITS plan announced by the Minister of Transportation at the Sixth World Congress on Intelligent Transport Systems in November 1999. For the past two decades TDC has fostered research, development, and demonstration of ITS. It has always recommended a structured approach to the implementation of ITS in Canada.

The new plan underlines Transport Canada's commitment to stimulating **ITS development and deployment**. As outlined in *An Intelligent Transportation Systems Plan for Canada: En Route to Intelligent Mobility*, the plan has five main components: developing partnerships for knowledge; establishing a Canadian ITS architecture; fostering research and development; ensuring ITS deployment and integration; and strengthening the ITS industry.

In a very tangible success, International Road Dynamics (IRD) of Saskatoon, Saskatchewan, won an



One of the trucks in the Green Light Project passing under the transponder readers that allow in-transit weighing and preclearance

ITS America *Best of ITS* award this year for its implementation of the Oregon Green Light Project. The project is based on **weigh-in-motion and automatic vehicle identification technology** originally developed by IRD in TDC-sponsored work. It allows trucks that comply with regulations to be weighed and precleared at highway speed. Over 12,600 trucks are enrolled in the project, and the savings over one year are estimated at almost $2 million.

IRD has become a world leader in the market for "smart" highway equipment.

The prestigious Octas Innovation Award for 1999 went to Telecite of Montreal, Quebec, for its **Visual Communication Network**™ (VCN), a multimodal, multimedia, passenger information system originally developed under TDC's accessibility R&D program. The Quebec Federation of Computer Science confers the award for outstanding achievements of Quebec businesses in the fields of information sciences, multimedia technologies, and computer applications.

The VCN uses high-definition, colour LED technology to deliver easy-to-read, real-time messages in public transit systems (in-vehicle and platform applications are available). A complementary speech module provides emergency announcements. The system makes travel safer and more accessible not only for those with hearing or visual impairments, but for all.

Outcomes

The VCN is now an international success. Various applications are in use in subways, as well as rail and bus transit networks, in Montreal, New York, Hong Kong, Paris, and Mexico City.

This year the Canadian Coast Guard established a methodology for setting **minimum safe practice levels for aids-to-navigation in the St. Lawrence Seaway**. The standards are the culmination of long-term TDC research to increase the safety of navigation in difficult waterways. The marine navigation safety system developed under the program uses a minimum safe design preprocessor to establish the risks associated with differing configurations of fixed and floating aids. The system processes data from operators, field experts, and historical records, and takes into account variables such as vessel and channel characteristics, traffic density, and weather conditions.

The results provide an objective basis for determining the aids required for specific waterways.

A Guide to Light Bulb Analysis, originally published by TDC in 1985, is still the reference of choice for the Transportation Safety Board of Canada and other investigation authorities worldwide. The guide provides clear illustrations of damaged bulb filaments, an information sheet, and a checklist.

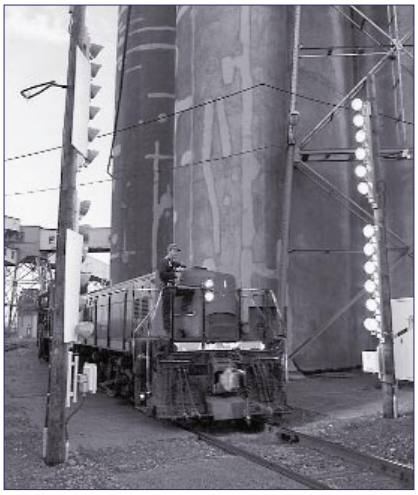
Analysis of damaged light bulbs helps investigators to determine the operational status of various aircraft systems at the moment of impact. This can provide invaluable clues as to where to focus an accident investigation.

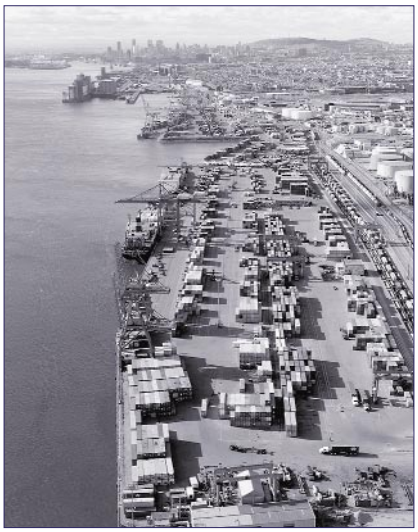
TECHNOLOGY Transfer

Technology is altering every aspect of our lives … and collaboration is becoming more essential.

Speech from the Throne, October 1999

The acquisition and dissemination of technology intelligence are high priorities for TDC. Professional staff monitor developments of potential interest to the department; host international delegations; initiate and participate in seminars, workshops, and conferences; and serve on national and international committees. Some highlights from 1999-2000 follow. Listings of committee and association memberships, presentations, and papers begin on page 22.





TDC was on the Canadian team attending **Electronic Commerce 2010**, an Asia Pacific Economic Cooperation (APEC) seminar held in Santiago, Chile, in April 1999. The seminar, aimed at helping APEC countries benefit fully from recent advances in electronic commerce, centred on development of government policy and business initiatives in trade and transportation.

TDC presented two projects designed to improve productivity and efficiency at the Port of Montreal through Web-based electronic data interchange and automated identification and tracking of containers.

These projects were also highlighted in May 1999 at the APEC **Forum on Intermodalism and Satellite-Based Transportation Technologies** in Singapore. They provided excellent examples of intermodal applications of advanced technologies, as the container tracking and data interchange at the port covers shipping, trucking, and rail.

The first **International Symposium on Transportation Recorders** gave TDC an opportunity to promote two innovations – a flight recorder configuration standard and a 3D flight data animation program – developed under its flight data monitoring program. Both are designed to facilitate aircraft accident investigations.

The symposium, sponsored by the U.S. National Transportation Safety Board and the International Transportation Safety Association, took place in Arlington, Virginia, in May 1999. Presentations highlighted state-of-the-art technologies applicable to data recording in every mode.

Sample screen of the 3D flight animator, which develops graphic reconstructions from the information provided by flight data recorders

ENERGY CONVERSIONS INC.

Locomotive fuelled by liquefied natural gas

The **Railways and the Environment Workshop** held in June was organized by Transport Canada, Environment Canada, the Railway Association of Canada, Manitoba Highways and Government Services, Transport 2000, and the University of Calgary. The workshop brought all levels of industry and government together to consider rail's role in a Canada committed to sustainable transportation.

TDC has an active program investigating means of reducing locomotive emissions. A report published under the program, examining how new U.S. Environmental Protection Agency (EPA) regulations will affect the Canadian railway industry, has proved a best seller. This issue was debated at the workshop. A major concern for the railways is the trade-off between reduced emissions and efficiency.

TDC fielded many questions on its accessibility program at the **Fourth Global Conference of the International Federation on Ageing**, a U.N.-sponsored event held September 5-9, 1999, in Montreal. TDC's Senior Ergonomist delivered a paper on a universal framework for accessible transportation, and other staff members were on hand at the Transport Canada booth, distributing publications highlighting our projects. Innovative work on assessment and retraining of elderly and disabled drivers drew particular interest.

In November 1999 TDC was the host for IMAPCR '99, the **Second International Meeting on Aircraft Performance on Contaminated Runways**, sponsored by Transport Canada and NASA. The meeting highlighted the progress of the Joint Winter Runway Friction Measurement Program (JWRFMP), a long-term cooperative initiative seeking solutions to the complex problems of takeoff and landing in winter conditions (see page 3 for more on the program).

NASA LANGLEY

Reference ground friction measuring vehicle being used in the development of an international runway friction index

The 140 IMAPCR delegates, all with impressive expertise in the field, agreed on the importance of globally harmonized standards for measuring runway conditions and correlating them with aircraft braking performance. They applauded the decision to continue the JWRFMP, which had been scheduled to wind down after the 1999-2000 winter. The extension should allow researchers to complete the development and validation of international standards.

The **Sixth World Congress on Intelligent Transport Systems** (ITS), held November 8-12, 1999, in Toronto, highlighted the latest international developments in ITS technology. Responding to the theme of the congress – *ITS: smarter, smoother, safer, sooner* – TDC delivered two papers on increasing local and international productivity and efficiency through ITS applications.

Transportation specialists from government, industry, and research organizations attended the event. They exchanged information on the status of current projects, discussed promising new applications, and considered international strategies for the development of effective, user-friendly systems. ITS Canada, ITS America, ERTICO (ITS Europe), and VERTIS (Asia-Pacific) co-sponsored the program.

Also in November, TDC and Transports Québec were the hosts of a **meeting of the International Organization for Standardization Technical Committee (TC) 204.** Over 135 experts from the nineteen participating countries attended.

The committee is responsible for standardizing information, communication, and control systems for urban and rural surface transportation, particularly intelligent transportation systems. TC 204 has 16 working groups on specific aspects ranging from system architecture to wide area communications. TDC is particularly active in the working groups dealing with transport information and control systems, commercial vehicle operations, dedicated short range communications, and driver warning systems.

The Government of Canada exhibit at the ITS World Congress highlighted several TDC projects

As part of its role in the Research Committee of *Direction 2006*, TDC worked with Transport Canada's Rail Safety Directorate and other committee members to organize a **rail-highway grade crossing research workshop** in Ottawa on November 18, 1999. *Direction 2006* is a cooperative federal initiative to halve the number of grade crossing and trespassing accidents by the year 2006.

Over 40 representatives from government, industry, and academia attended the presentations and discussion groups. Topics included current research initiatives in Canada and the U.S., statistics on grade crossing and trespassing accidents in Canada, current technology, and recommendations for future R&D.

At the workshop, the Volpe National Transportation Systems Center and the *Direction 2006* Research Committee agreed to regularly exchange information on research in Canada and the United States. The Volpe Center, a branch of the U.S. Department of Transportation, has a special interest in rail-highway grade crossing safety.

Library and Information Centre

The Library and Information Centre's team of information specialists identifies, evaluates, and delivers pertinent information to project managers and researchers, using authoritative scientific and technical databases, networked library resources, Internet searches, and a core collection of research reports and reference sources. The centre also provides reference and interlibrary loan services to the transportation community.

Communications

The Communications Unit is responsible for all stages of publication production leading to the documentation and dissemination of technical and general information on TDC's research program. It produces reports, technical papers and presentations, exhibits, and conference literature.

The unit is also responsible for TDC's Web site, which is updated monthly, and for handling corporate e-mail. The Web site includes project descriptions, report summaries, TDC news, and a list of publications.

CORPORATE Services

TDC's Financial, Administrative, and Informatics services work in close cooperation with research staff to ensure successful delivery of the R&D program.

Financial Services

This unit provides consulting and advisory services to TDC's research staff, as well as a full range of financial services. The unit ensures compliance with the financial requirements for TDC's contracts through cost controls, auditing, and financial analyses. Financial Services also prepares the monthly reports needed for decision-making and effective financial management.

Administrative Services

Administrative Services manages records and supplies; handles mail and other communication services; procures equipment and supplies; assists project officers with project completion procedures; and distributes TDC publications. This unit also manages a $1 million inventory of supplies and equipment.

Informatics Services

The Informatics unit provides a full range of services, including applications development; computer and network troubleshooting; computer system and network security management; and software and equipment purchasing. It also provides advice and assistance to TDC staff and maintains the daily operations of the computer network.

This year Informatics staff implemented the first two modules of a new project information management system (PIMS): one for publications information management and the other for management of financial data. They also oversaw a smooth transition to Y2K operations.

FINANCIAL Overview

This section provides a review of TDC's expenditures and funding sources for fiscal year 1999-2000, as well as a statistical analysis of its R&D program.

Table 1 lists operating and program expenditures from Transport Canada funding sources. Departmental R&D program funding, totalling $6.6 million in 1999-2000, was used to leverage substantial support from external sources, as seen in Table 2. This support increased the funding of TDC's research program by over $3.1 million, nearly 50 percent of total R&D funding this year. Additional contributions from industry, government, and other sources increased the overall value of the program by another 36 percent, for a total of $13.3 million. These contributions represent shared cost, in-kind, and other R&D expenditures that did not flow through TDC.

Table 1 1999-2000 EXPENDITURES: TRANSPORT CANADA FUNDING SOURCES (Thousands of dollars)

Operating Costs	
Salaries*	1 510
Base Operating Costs	600
	2 110
R&D Program Expenditures	
R&D Management Board	5 070
Other Departmental Sources	1 550
	6 620

Table 2 1999-2000 R&D EXPENDITURES: ALL FUNDING SOURCES (Thousands of dollars)

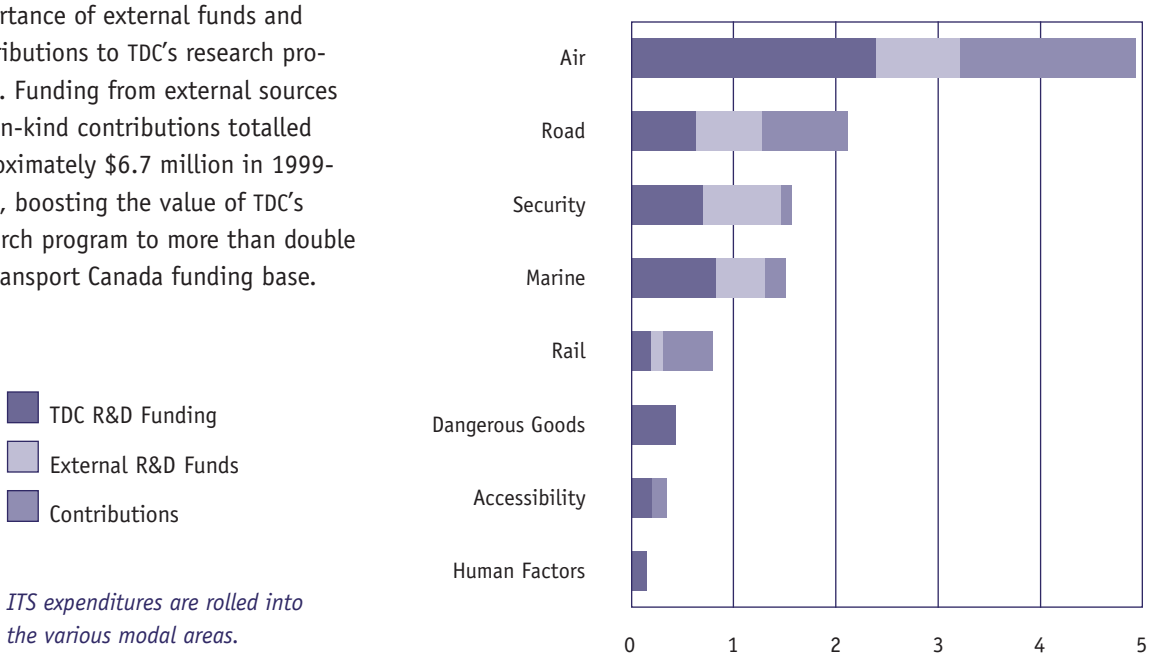
All Transport Canada Sources	**6 620**
External Funding Sources	
Program of Energy R&D – Natural Resources Canada	1 410
New Initiatives Fund – National Search and Rescue Secretariat	150
Canadian Coast Guard	110
U.S.-Canadian Agreement on Cooperative Counter-Terrorism R&D	980
Foreign Sources	500
Other	10
	3 160
Total TDC R&D Expenditures	**9 780**
Additional Contributions (estimated)	
Industry	1 550
Government & Other Sources	1 980
	3 530
Total Value of R&D Program	**13 310**

** Includes funds from the Program of Energy R&D – Natural Resources Canada*

FINANCIAL Overview

The breakdown of R&D expenditures by program area and funding source presented in Figure 1 illustrates the importance of external funds and contributions to TDC's research program. Funding from external sources and in-kind contributions totalled approximately $6.7 million in 1999-2000, boosting the value of TDC's research program to more than double its Transport Canada funding base.

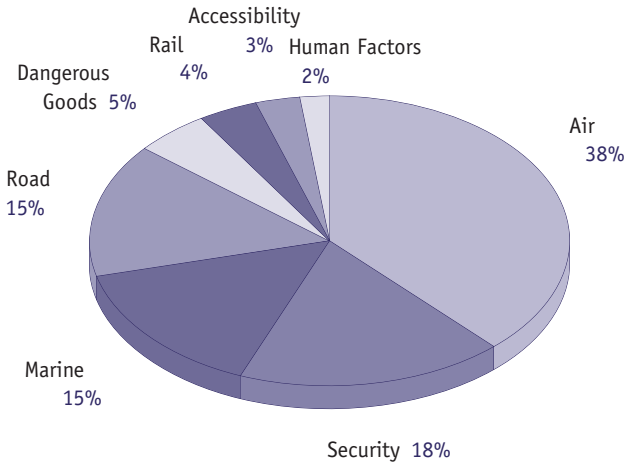
Figure 1 R&D EXPENDITURES BY PROGRAM AREA AND FUNDING SOURCE
(Millions of dollars)



NOTE: ITS expenditures are rolled into the various modal areas.

Figure 2 provides a breakdown of R&D expenditures by program area. Expenditures in the air mode reflect TDC's leading role in international winter aviation research.

Figure 2 R&D EXPENDITURES BY PROGRAM AREA
(Percentage of 1999-2000 expenditures)

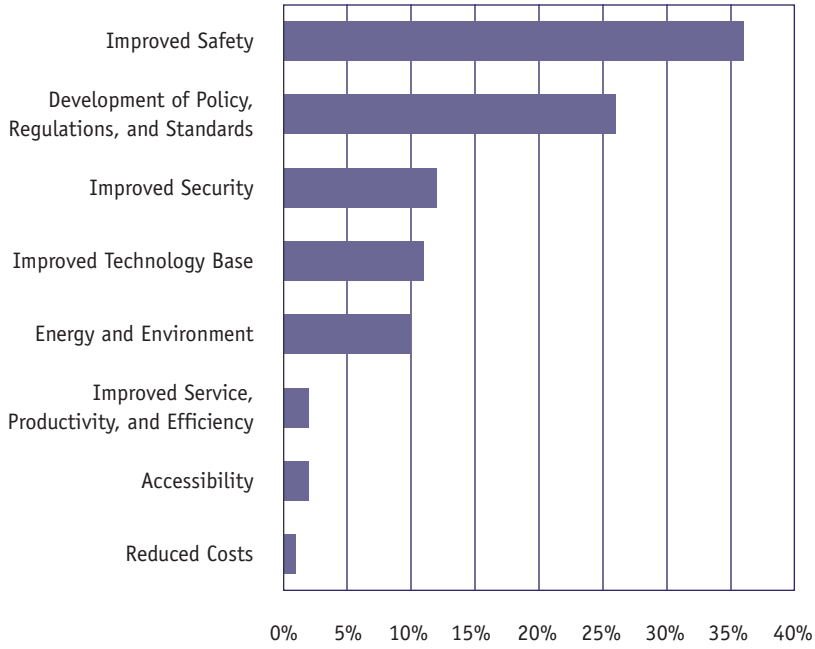


Total R&D Funding: $9.78 million

FINANCIAL Overview

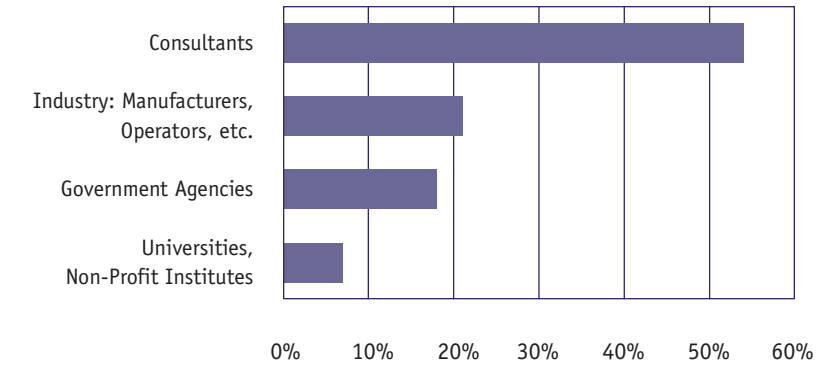
Figure 3 provides a breakdown of R&D expenditures by targeted benefit. Over one-third of 1999-2000 expenditures went towards research primarily aimed at improving transportation safety, while another 26 percent focussed on R&D supporting the development of policy, regulations, and standards.

Figure 3 R&D EXPENDITURES BY TARGETED BENEFIT
(Percentage of 1999-2000 expenditures)

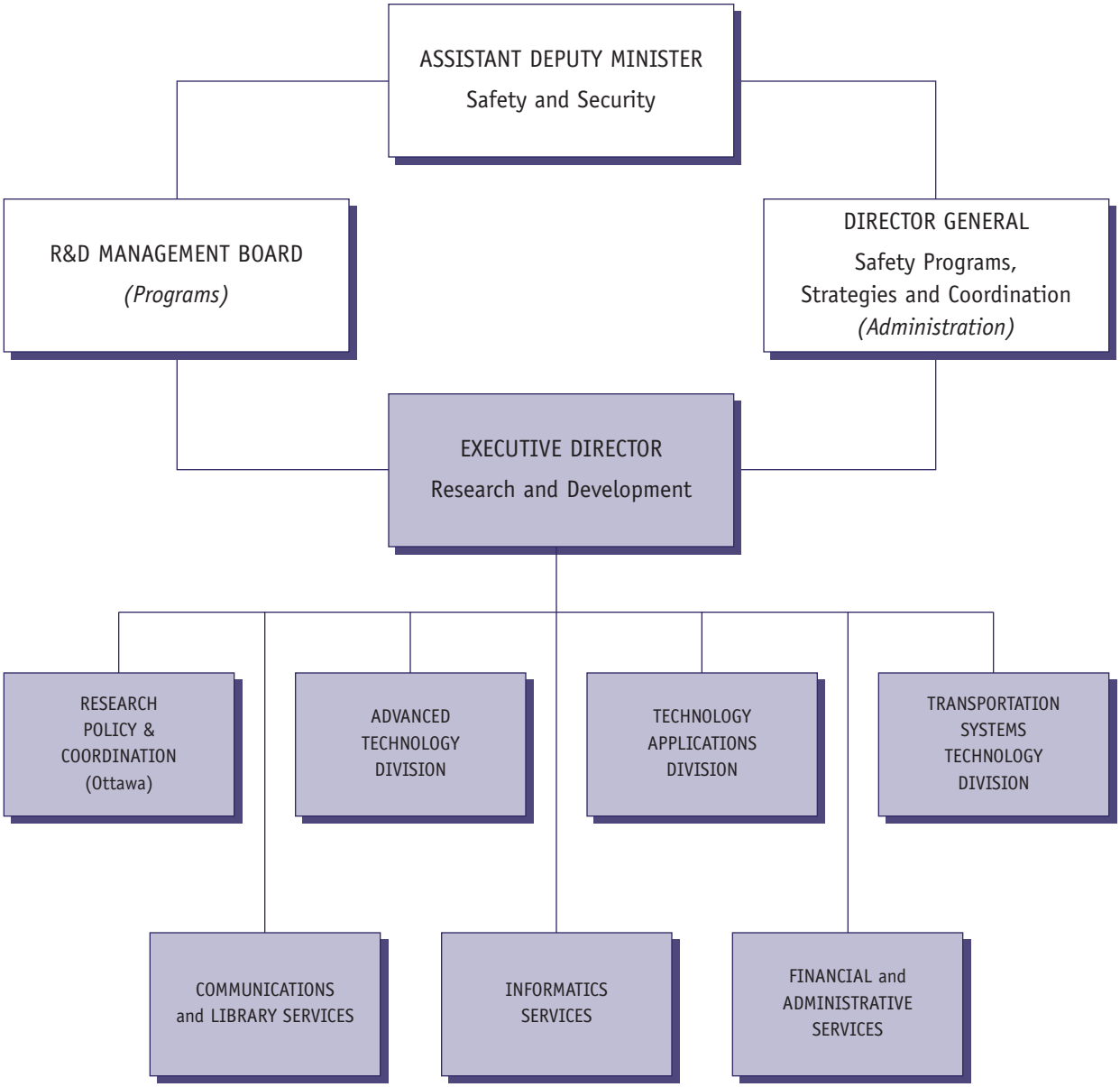


TDC contracts out its research program to a variety of organizations in the public and private sectors. Figure 4 shows the distribution of R&D expenditures in 1999-2000 by type of R&D performer.

Figure 4 R&D EXPENDITURES BY PERFORMING ORGANIZATION
(Percentage of 1999-2000 expenditures)



ORGANIZATION Chart (at 31 March 2000)



TDC Staff

Executive

Executive Director	W.F. Johnson
Executive Assistant	Pierrette Germier

R&D Office (Ottawa)

Chief, Research Policy & Coordination	Michael A. Ball
Research Policy Officer	Christopher English
Administrative Assistant	Barbara O'Connor-Smith

Advanced Technology

Chief (Acting)	Howard Posluns
Senior Development Officer	Barry B. Myers
Senior Development Officer (Acting)	Angelo Boccanfuso

Technology Applications

Chief	Brian Marshall
Senior Development Officer	Claude Guérette
Senior Development Officer	Roy S. Nishizaki
Senior Development Officer	Sesto Vespa
Project Officer, Accessibility	Barbara A. Smith

Transportation Systems Technology

Chief	James D. Reid
Senior Development Officer	Charles Gautier
Senior Development Officer	Ernst Radloff
Senior Development Officer	André Taschereau
Senior Ergonomist	Alex Vincent

Communications and Library Services

Manager	Dina Iwanycky

Financial and Administrative Services

Manager	Antoine Sidhom

Informatics Services

Senior Systems Analyst	Josée Brousseau

PROFESSIONAL Activities

The staff of TDC and the Research & Development component in Ottawa (RDO) serve on many scientific and professional committees and associations, both within Canada and internationally. In 1999-2000 they were active in the following organizations.

NATIONAL AND INTERNATIONAL COMMITTEES

Aircraft Icing Research Alliance

Barry B. Myers

Airport Council International – Europe

Angelo Boccanfuso

American Society for Testing and Materials (ASTM)

Subcommittee E-17.22/96.1, Task Group on Preparation of Standard – International Runway Friction Index: Secretary – Angelo Boccanfuso

Subcommittee E-17.22/96.2, Task Group on Preparation of Standard – Electronic Recording Decelerometers: Angelo Boccanfuso

Subcommittee E-17.22/97.2, Task Group on Preparation of Standard – Pavement Surface Classification: Angelo Boccanfuso

Asia Pacific Economic Cooperation (APEC) ITS Special Interest Group

Transport Canada R&D Contact: W. F. Johnson

Association québécoise du transport et des routes (AQTR)

Environment Committee: Claude Guérette

Goods Transportation Committee: Sesto Vespa

Canada-France Science and Technology Agreement

W. F. Johnson

Canada-Japan Science and Technology Agreement

W. F. Johnson

Canada-U.S. Counter-Terrorism R&D Group

Howard Posluns

Canada's National Climate Change Process

Technology Issues Table: TC Representative – Michael A. Ball (RDO)

Canadian Aviation Regulation Advisory Council

Barry B. Myers

Contaminated Runway Turbo-Jet Take-Off Performance Working Group: Angelo Boccanfuso

Canadian Lightweight Materials Research Initiative

Steering Committee: Michael A. Ball (RDO)

Canadian Marine Advisory Council

Charles Gautier, Ernst Radloff, James D. Reid, André Taschereau

Canadian National Wind and Waves Committee

André Taschereau

Canadian Standards Association

Subcommittee on Automotive Adaptive Driving Controls for Persons with Physical Disabilities: Barbara A. Smith

Subcommittee on Transportable Mobility Aids: Barbara A. Smith

Technical Committee on Transportation Assistive Technologies for Persons with Disabilities: Roy S. Nishizaki, Barbara A. Smith

Vice-Chair, Subcommittee on Mobility Aid Securement and Occupant Restraint Systems for Motor Vehicles: Roy S. Nishizaki

Canadian Strategic Highway Research Program

Executive Committee: Brian Marshall

Canadian Working Group on Evaluation of School Bus Safety Devices

Coordinator: Claude Guérette

Centre for Marine Simulation Technical Advisory Group

Ernst Radloff

Electric Vehicle Association of Canada

Environmental Issues Working Group, Electric Vehicle Infrastructure Council: Claude Guérette

Vehicle Standards Working Group: Michael A. Ball (RDO)

PROFESSIONAL Activities

ENTERPRISE Group

Executive Board Member: Brian Marshall

European Organization for Civil Aviation Equipment

Working Group 54 on On-Board and Ground Ice Detection: Barry B. Myers

Federal Aviation Administration-Transport Canada Committee

Security Bilateral Research and Development Working Group: Howard Posluns

Global Aviation Information Network (GAIN)

Working Group C on Global Information Sharing Prototypes: Howard Posluns

Ice Structure Interaction Committee

James D. Reid

Intelligent Transportation Society (ITS) of America

Angelo Boccanfuso

Intelligent Transportation Systems Society of Canada (ITS Canada)

Treasurer-Secretary: W.F. Johnson

International Aviation Snow Symposium

Secretary, R&D Committee: Angelo Boccanfuso

International Civil Aviation Organization

Flight Safety and Human Factors Working Group: Alex Vincent

International Electrotechnical Commission/TC 80

Maritime Navigation and Radio Communication Equipment/Systems: Charles Gautier, André Taschereau

Minister's Advisory Committee on Accessible Transportation (ACAT)

Brian Marshall, Barbara A. Smith

North American Free Trade Agreement (NAFTA) Transport Consultation Group on Science & Technology

Co-Chair: W.F. Johnson

Organizing Committee for 6th ITS World Congress

W.F. Johnson

Railway Research Advisory Board

W.F. Johnson, Sesto Vespa

SAE – International Committee on Aircraft Ground De/Anti-icing (G12)

Member of Steering Committee: Barry B. Myers

Chair, Holdover Time Subcommittee: Barry B. Myers

Host, Fluids Subcommittee Working Group: Barry B. Myers

Standards Council of Canada

Canadian Advisory Committee ISO/TC 204 – Intelligent Transportation Systems: Chair – W.F. Johnson

WG7 – General Fleet Management and Commercial/Freight Operations: Brian Marshall

WG15 – Dedicated Short Range Communications: Brian Marshall

U.S. Aviation Regulation Advisory Council

Working Group on Ice Protection Harmonization: Barry B. Myers

U.S. Ship Structure Committee

André Taschereau

U.S. Transportation Research Board (TRB)

Aircraft/Airport Compatibility Committee: Barry B. Myers

Alternative Transportation Fuels Committee: Michael A. Ball (RDO)

Committee on Vehicle User Characteristics: Alex Vincent

Committee on Surface Properties-Vehicle Interaction: Angelo Boccanfuso

Transit Cooperative Research Program: Alex Vincent

Transportation Energy Committee: Michael A. Ball (RDO)

Board Member: Angelo Boccanfuso

PROFESSIONAL Activities

INTRA/INTERDEPARTMENTAL COMMITTEES

Assistant Deputy Minister's Committee on Science and Technology

W.F. Johnson

Alternate Member: Michael A. Ball (RDO)

Canadian Transportation Agency Accessibility Advisory Committee

Roy S. Nishizaki, Barbara A. Smith, Brian Marshall

Climate Change Technology Early Action Measures (TEAM)

Management Committee:
TC Representative – Michael A. Ball (RDO)

Industry Working Group:
TC Representative – Michael A. Ball (RDO)

Container Tracking and Monitoring – TDC-Port of Montreal

Ernst Radloff, James D. Reid

Council of Science and Technology Advisors

Working Group Member: Michael A. Ball (RDO)

Federal Partners in Technology Transfer

TC Representative: Michael A. Ball (RDO)

Intellectual Property Management: W.F. Johnson

Federal Science and Technology Annual Report

Steering Committee: Michael A. Ball (RDO)

Industry Canada Interdepartmental Core Working Group on Clean Car (PNGV)

Michael A. Ball (RDO)

Interdepartmental Committee on Federal Disability Strategy

Barbara A. Smith

Interdepartmental Committee on International Science and Technology Relations

Michael A. Ball (RDO)

Interdepartmental Committee on Sustainable Transportation

Michael A. Ball (RDO)

Interdepartmental Steering Committee on Ballard/Ford Fuel Cell Engine Development

Michael A. Ball (RDO)

Interdepartmental Steering Committee on Ethanol (ISCE)

Michael A. Ball (RDO)

Natural Sciences and Engineering Research Council Industrial Advisory Research Group

Ernst Radloff

Program of Energy R&D Committees

Panel Member: W.F. Johnson

Alternate Panel Member: Michael A. Ball (RDO)

Industrial Energy R&D Advisory Board Member:
Michael A. Ball (RDO)

Advanced Fuels and Transportation Emissions Reduction:
Michael A. Ball (RDO), Roy S. Nishizaki

Canadian Lightweight Materials Research Initiative (CLiMRI):
Claude Guérette

Fuel Cells, Electric and Hybrid Vehicles: Claude Guérette

Marine Transportation and Safety: James D. Reid

Optimization of the Energy Efficiency of Transportation Systems:
Chair – Michael A. Ball (RDO)
Brian Marshall

Transport Canada Committees

R&D Management Board: W.F. Johnson

Technical Advisory Committee to R&D Management Board:
Chair – Michael A. Ball (RDO)
Brian Marshall, James D. Reid

Joint Winter Runway Friction Measurement Program
Technical Steering Committee: Angelo Boccanfuso

Standing Committee on Operations in Icing Conditions:
Barry B. Myers, Angelo Boccanfuso

Sustainable Development Strategy Committee:
R&D Alternate Member – Michael A. Ball (RDO)

Director General's Climate Change Group:
Alternate Member for Safety Programs, Strategies and Coordination Directorate – Michael A. Ball (RDO)

Human Factors Committee: Alex Vincent

PROFESSIONAL Activities

OTHER SOCIETIES AND ASSOCIATIONS

Air Transport Association

American Institute of Aeronautics and Astronautics

American Society of Mechanical Engineers

Association for Driver Rehabilitation Specialists

Canadian Aeronautics and Space Institute
Alternate Council Member: W.F. Johnson

Canadian Association for Composite Structures and Materials

Canadian Hydrogen Association

Canadian Operational Research Society

Canadian Owners and Pilots Association

Canadian Transportation Research Forum

Centre d'expérimentation des véhicules électriques du Québec
Vice-Chair: Claude Guérette

Human Factors Association of Canada

Institute for Operations Research and the Management Sciences

Institute of Electrical and Electronics Engineers (IEEE)

International Marine Transit Association

National Mobility Equipment Dealers Association

Radio Technical Commission for Maritime Services

SAE International

Society of Manufacturing Engineers

Society of Naval Architects and Marine Engineers (SNAME)

PAPERS AND PRESENTATIONS

Through the delivery of papers and presentations on the Centre's research projects and related topics at national and international conferences, TDC and RDO professional staff ensure the effective transfer of technology. Highlights of 1999-2000 are listed below.

European participation in the Joint Winter Runway Friction Measurement Program

Presentation to the Commission of European Communities
Brussels, Belgium, December 1999

Angelo Boccanfuso

Joint Winter Runway Friction Measurement Program

Presentation at a meeting of the International Aviation Safety Association R&D Committee
Buffalo, New York, April 1999

and at the Sixth Annual NASA Tire/Runway Friction Workshop
Wallops Island, Virginia, May 1999

and at an American Society for Testing and Materials Workshop
New Orleans, Louisiana, December 1999

Angelo Boccanfuso

Management of the Joint Winter Runway Friction Measurement Program

Presentation published in *IMAPCR '99, Proceedings of the Second International Meeting on Aircraft Performance on Contaminated Runways*, TP 13579
Montreal, Quebec, November 1999

Angelo Boccanfuso

Updates – Joint Winter Runway Friction Measurement Program

Presentation at Munich International Airport
Munich, Germany, October 1999 and February 2000

Angelo Boccanfuso

Advanced technology vehicles for sustainable urban transportation

Presentation at the Transportation Association of Canada Conference
Saint John, New Brunswick, September 1999

Claude Guérette

PROFESSIONAL Activities

Bus suspension optimization study

Presentation at the SAE Truck and Bus Conference
Detroit, Michigan, November 1999

S. Rakheja, **Claude Guérette**

Electric vehicle (EV) and hybrid electric vehicle (HEV) technology program at Transport Canada

Presentation at the SAE EV & HEV TOPTEC
Toronto, Ontario, February 2000

Claude Guérette

Evaluation of two school bus advanced signalling devices: the eight-light system and hazard lights

Presentation at the Multidisciplinary Safety Conference
Halifax, Nova Scotia, May 1999

Claude Guérette

Recent research on transit buses and electric vehicles

Presentation at the Transportation Association of Canada Conference
Saint John, New Brunswick, September 1999

Claude Guérette

The benefits of ITS: the need to evaluate increased output for firms (1345)

Paper presented at the Sixth World Congress on Intelligent Transport Systems
Toronto, Ontario, November 1999

Richard M. Zavergiu, **William F. Johnson**

Accessible transportation R&D

Presentation at the Spring Meeting of the Advisory Committee on Accessible Transportation
Ottawa, Ontario, April 1999

Brian Marshall, Barbara A. Smith

3D flight data animation program

Presentation at the U.S. National Transportation Safety Board International Symposium on Transportation Recorders
Arlington, Virginia, May 1999

Howard Posluns, Ian Smith

Flight data monitoring – an aviation diagnostic tool for the 21st century

Presentation at the Transport Canada Inspectors Conference
Ottawa, Ontario, June 1999

Howard Posluns

An integrated tracking system for efficient container operations

Paper presented at the Sixth World Congress on Intelligent Transport Systems
Toronto, Ontario, November 1999

Ernst Radloff

Marine vessel emissions

Presentation at the Green Ship Workshop
Halifax, Nova Scotia, December 1999

Ernst Radloff

Port community extranet system

Presentation at the Electronic Community Forum
Orlando, Florida, March 2000

Ernst Radloff

Towards an assessment framework

Presentation published in the summary report, *Workshop on Escape, Evacuation and Rescue in the Offshore Industry*, National Research Council Canada, Institute for Marine Dynamics
St. John's, Newfoundland, June 1999

Ernst Radloff

Web intermodal container tracking

Paper presented at Electronic Commerce 2010, an APEC seminar
Santiago, Chile, April 1999

Ernst Radloff

Automatic tracking of intermodal containerized goods

Paper presented at the APEC Forum on Intermodalism and Satellite-Based Transportation Technologies
Singapore, May 1999

James D. Reid

PROFESSIONAL Activities

Performance analysis techniques for ship machinery

Presentation at the Canadian Coast Guard
Predictive Maintenance Coordinators Conference
Quebec City, Quebec, September 1999

James D. Reid

Risk-based design methods for aids to navigation in the St. Lawrence River

Presentation to St. Lawrence River
marine navigation stakeholders
Quebec City, Quebec, March 2000

James D. Reid

Accessible transportation R&D

Presentation at the Fall Meeting of the
Advisory Committee on Accessible Transportation
Ottawa, Ontario, November 1999

Barbara A. Smith

Fatigue management: summary and future trends

Paper presented at the Annual Meeting of
l'Association québécoise du transport et des routes
Montreal, Quebec, April 1999

Sesto Vespa

Human performance and fatigue management under operational conditions

Presentation at the Transport Canada Inspectors Conference
Ottawa, Ontario, June 1999

and at the Australian National Freight Congress
and Transport Expo '99
Melbourne, Australia, September 1999

Sesto Vespa

Proceedings of the workshop on rail-highway grade crossing research, TP 13536

Sesto Vespa (editor)

Working for innovation in transportation

Presentation at the Annual Meeting of ITS Canada
Montreal, Quebec, March 2000

Sesto Vespa

Airport operators and regulators need to more completely address human factors issues

Paper published in the *ICAO Journal*,
vol. 54, no. 9, June 1999

and presented at the Fourth Flight Safety
and Human Factors Global Symposium
Santiago, Chile, April 1999

Alex Vincent

A universal accessible transportation system framework

Paper presented at the Fourth Global Conference
of the International Federation on Ageing
Montreal, Quebec, September 1999

Alex Vincent

User information systems – developments and issues for the 21st century

Paper published in *Transportation in the New Millennium*,
CD-ROM, U.S. Transportation Research Board,
National Research Council
Washington, D.C., January 2000

Alex Vincent with other members of A3B08:
Committee on User Information Systems

PROFESSIONAL Activities

OTHER ACTIVITIES

In addition to the above, TDC and RDO also participated in the following events.

Aerovision 2000, Aerospace North America
Vancouver, British Columbia, August 1999
TC exhibit host: Howard Posluns

Airports Council International – European Airport Operators Meeting
Warsaw, Poland, December 1999
Angelo Boccanfuso

Annual Assembly Meeting of the Radio Technical Commission for Maritime Services
Orlando, Florida, May 1999
James D. Reid

Association québécoise du transport et des routes (AQTR), Forum sur les gaz à effet de serre reliés au transport urbain
Montreal, Quebec, February 2000
Member of Organizing Committee: Claude Guérette

Australian National Freight Congress and Transport Expo '99
Melbourne, Australia, September 1999
Keynote Speaker: Sesto Vespa

Canada-Australia Meeting on Accessible Transportation
Montreal, Quebec, July 1999
Barbara A. Smith

Canada-U.S. Counter-Terrorism R&D Bi-Annual Meetings
Ottawa, Ontario, May 1999
Washington, D.C., December 1999
Howard Posluns

Canadian Council of Motor Transport Administrators Annual Meeting
Winnipeg, Manitoba, May 1999
Sesto Vespa

Conference on Ocular-Based Measures of Driver Alertness
Washington, D.C., April 1999
Sesto Vespa

Congrès de l'Union internationale des transporteurs publics
Toronto, Ontario, May 1999
Claude Guérette

Deicing Facilities Environmental Task Force Meeting
Montreal, Quebec, July 1999
Barry B. Myers

Direction 2006 National Consultation
Ottawa, Ontario, November 1999
Sesto Vespa

Electronic Commerce and EDI Conference and Symposium
Orlando, Florida, October 1999
Ernst Radloff

EUROCAE Working Group 54 (Icing Instruments Standards) Meeting
Vancouver, British Columbia, April 1999
Barry B. Myers

Federal Aviation Administration Flight Operations Quality Assurance 2000 Symposium
Irvine, California, March 2000
Howard Posluns

Federal Aviation Administration Flight Operations Quality Assurance Datalink Presentations
Washington, D.C., April 1999
Howard Posluns

Federal Aviation Administration-Rutgers University Aviation Safety Workshop
Piscataway, New Jersey, July 1999
Howard Posluns

PROFESSIONAL Activities

Fourth Global Conference of the International Federation on Ageing

Montreal, Quebec, September 1999

Roy S. Nishizaki, Alex Vincent

Global Aviation Information Network (GAIN) Working Group C Meetings

Ottawa, Ontario, June 1999

Paris, France, November 1999

Montreal, Quebec, March 2000

Howard Posluns

Holdover Time Testing Procedures Task Group Meeting

San Francisco, California, October 1999

Barry B. Myers

Ice Protection Harmonization Working Group Meetings

NASA Langley Research Center
Hampton, Virginia, April 1999

Gatwick Airport, U.K., June 1999

Toronto, Ontario, September 1999

Brussels, Belgium, November 1999

Atlantic City, New Jersey, February 2000

Barry B. Myers

International Organization for Standardization (ISO) TC 204 Plenary Meetings

Amsterdam, Netherlands, June 1999

Montreal, Quebec, November 1999

W.F. Johnson

ITS Canada Annual General Meeting

Montreal, Quebec, March 2000

Michael A. Ball (RDO)

Laboratory Holdover Time Testing Rationalization Meeting

Montreal, Quebec, July 1999

Barry B. Myers

Meeting of Transport Canada Standing Committee on Aircraft Operations Under Icing Conditions

Ottawa, Ontario, October 1999

Barry B. Myers

National Mobility Equipment Dealers Association Annual Conference

Reno, Nevada, February 2000

Barbara A. Smith

North American Electric Vehicle Infrastructure Conference

Atlanta, Georgia, November 1999

Claude Guérette

Railways and the Environment Workshop

Winnipeg, Manitoba, June 1999

Roy S. Nishizaki

Rural Advanced Technology and Transportation Systems International Conference

Flagstaff, Arizona, August 1999

Brian Marshall

S3 Workshop Meeting – Precarn-Stear Research Project: Intelligent Tools for Non-Destructive Evaluation and Monitoring

Vaudreuil, Quebec, October 1999

Roy S. Nishizaki

SAE AC9C Weather Environment Meeting

Vancouver, British Columbia, April 1999

Barry B. Myers

SAE Future Transportation Conference

Costa Mesa, California, August 1999

Roy S. Nishizaki

SAE G-12 Aircraft Ground Deicing Meetings and Association of European Airlines De/Anti-Icing Task Force Meetings

Toronto, Ontario, May 1999

San Francisco, California, October 1999

Barry B. Myers

PROFESSIONAL Activities

SAE Ground Deicing Conference and Exposition

Montreal, Quebec, July 1999

Barry B. Myers

Sixth World Congress on Intelligent Transport Systems

Toronto, Ontario, November 1999

Michael A. Ball (RDO), Dina Iwanycky, W.F. Johnson, Brian Marshall, Ernst Radloff, Sesto Vespa

Summer/Winter Integrated Friction Technology Conference

Calgary, Alberta, September 1999

Angelo Boccanfuso

Transport Canada Inspectors Conference

Ottawa, Ontario, June 1999

W.F. Johnson, Howard Posluns, Ernst Radloff, Sesto Vespa

U.S. National Oceanic and Atmospheric Administration 1999 Beacon Manufacturers' Workshop

Orlando, Florida, May 1999

Howard Posluns

U.S. Transportation Research Board Meetings

79th Annual Meeting – Session Chair, Topics in Personal Vehicle Choice and Energy Use

Meeting of Committee on Transportation Energy

Meeting of Committee on Alternative Transportation Fuels

Washington, D.C., January 2000

Michael A. Ball (RDO)

Visiting Delegations

Canada-China Transport Training Group, May 1999

Moroccan Ministry of Transportation and Merchant Shipping, June 1999

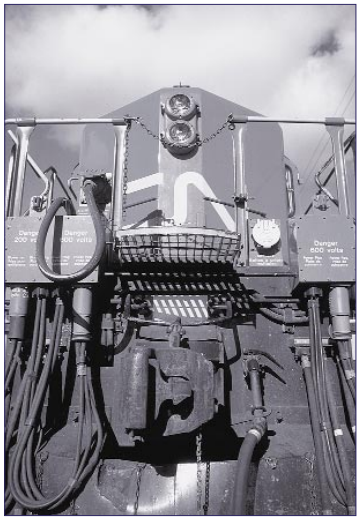
South African Delegation, November 1999

ITS Delegation from China, November 1999

Windsor Workshop on Transportation Fuels, 1999

Toronto, Ontario, June 1999

Michael A. Ball (RDO), Roy S. Nishizaki



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- ☐ Please correct my mailing address.
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  - ☐ *TDC Annual Review*
  - ☐ *R&D Update*
    (a one-page bulletin featuring a selected project)

These documents are also available on our Web site.

NAME _____

TITLE _____

ORGANIZATION _____

ADDRESS _____

CITY and PROVINCE _____

COUNTRY _____

POSTAL CODE _____

E-MAIL _____

We welcome your comments and questions about the *Annual Review* and our R&D program.

_____

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Please mail this form to us or fax it to **(514) 283-7158**

THANK YOU FOR YOUR ASSISTANCE

For up-to-date information on TDC,

its program, and its publications,

visit our Web site at:

http://www.tc.gc.ca/tdc/index.htm