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INTELLIGENT TRANSPORTATION SYSTEMS RESEARCH & DEVELOPMENT PLAN FOR CANADA

INNOVATION THROUGH PARTNERSHIP

April 2003

Other Related Publications:

TP 13501E, An Intelligent Transportation Systems Plan for Canada: en Route to Intelligent Mobility, 1999

TP 14054, Straight Ahead - A Vision for Transportation in Canada, 2003

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EXECUTIVE SUMMARY

Canada's Innovation Strategy is challenging Canadians to become more innovative and to develop a highly skilled work force. Innovation in the transportation sector is essential not only to maintain the sector's own growth and competitiveness, but also to contribute to national priorities.

En Route to Intelligent Mobility: Intelligent Transportation Systems Plan for Canada (November 1999), sets out the federal government's strategic plan for stimulating the development and deployment of ITS.

One of the five pillars of *En Route to Intelligent Mobility* involves fostering innovation through ITS Research and Development (R&D).

Straight Ahead: *A Vision for Transportation in Canada* is a key policy document setting out the federal government's objectives and strategy for a safe and secure, efficient and environmentally responsible transportation system.

The *Straight Ahead* vision is guided by a number of principles including support for research and skills development in order to foster innovation.

Transport Canada reaffirms its commitment in *Straight Ahead* to promoting ITS and to supporting the adoption of ITS technologies.

The benefits of ITS R&D derive from the development and application of new technologies and systems, and from refinements to existing ones.

The present document -- *Innovation Through Partnership* -- is Canada's multi-modal ITS R&D Plan. It responds to the challenge of Canada's *Innovation Strategy*, and serves both as the third strategic pillar of *En Route to Intelligent Mobility* and as an important first step in meeting the ITS commitments made by Transport Canada in *Straight Ahead*.

The ITS R&D Plan, which is funded under the Strategic Highway Infrastructure Program (SHIP), is composed of two parts: *Fostering ITS Innovation* and *Funding ITS Innovation*.

Fostering Innovation involves the following activities:

- Establishing a *technology database* of new and emerging ITS products and services;
- Organizing a workshop on ITS R&D;
- Maintaining the Canadian ITS Architecture; and
- Encouraging the training of ITS professionals.

Funding Innovation is designed to meet Transport Canada's ITS R&D priorities. The four broad ITS funding categories are:

- Urban Transportation;
- Safety, Security and Trade Facilitation;
- The Environment; and
- Foundations of Innovation.

The three primary funding mechanisms available under this ITS R&D Plan are:

- R&D Contribution Agreement;
- R&D Contract; and
- Bilateral Federal-Provincial Agreement.

A survey of stakeholder ITS R&D priorities was conducted as part of the development of this Plan. The survey suggests a close match between the priorities of ITS stakeholders and those of Transport Canada; stakeholders strongly value collaboration and partnerships in addressing their ITS R&D requirements.

In the interest of accelerating the knowledge and technology uptake of ITS, Transport Canada intends to disseminate the findings of all funded ITS R&D projects as widely as possible.

INTRODUCTION

THE INNOVATION CHALLENGE

The federal government's current *Innovation Strategy* is challenging all sectors of the economy to become more innovative and to develop a highly skilled work force in order to compete in the global marketplace. Within the transportation sector there is growing recognition that innovation and skills are essential not only to maintain the sector's own growth and competitiveness, but also to contribute to national priorities such as promoting safety and security, improving the quality of life in cities, and meeting Kyoto protocol commitments through the reduction of greenhouse gas emissions.

En Route to Intelligent Mobility: Intelligent Transportation Systems Plan for Canada (November 1999), sets out the federal government's strategic plan for stimulating the development and deployment of Intelligent Transportation Systems (ITS) across urban and rural Canada. ITS refer to the integrated application of information processing, communications, and sensor technologies, to transportation infrastructure and operations. These systems bring together users, vehicles and infrastructure into a dynamic relationship of information exchange, resulting in better management strategies and more efficient use of available resources.

En Route to Intelligent Mobility provides leadership and support to advance the application and inter-operability of ITS technologies. The goals are to maximize the use and efficiency of existing infrastructure and to meet future mobility needs in a more integrated manner.

The ITS strategic plan is based on five pillars of activity:

- Creating knowledge partnerships;
- Developing a Canadian ITS architecture;
- Fostering innovation through ITS research and development;
- Deploying and integrating ITS across Canada; and
- Strengthening Canadian ITS industry.

On February 25, 2003, the Minister of Transport, the Honourable David M. Collenette, released *Straight Ahead: A Vision for Transportation in Canada* (http://www.tc.gc.ca/Straightahead). This document details the federal government's strategy for achieving a safe and secure, efficient, and environmentally responsible transportation system over the coming years. It proposes a common vision for all participants in the transportation system -- one that will provide direction and purpose as the system adapts to meet the challenges of the twenty-first century.

Promoting innovation is one of the guiding principles of this new vision. *Straight Ahead* calls on everyone in the transportation system to focus on supporting skills development, pursuing transportation research and development, and deploying new technologies in order to meet transportation challenges.

Since many of these new technologies lie in the field of ITS, Transport Canada reaffirms its commitment in *Straight Ahead* to promoting ITS and to supporting the adoption of ITS technologies. In particular, Transport Canada is committed to working with partners to develop an ITS Research and Development (R&D) Plan in order to accelerate the growth of knowledge and skills, and promote the uptake and commercialization of ITS technology.

THE BENEFITS OF ITS R&D

The benefits of ITS R&D derive from the development and application of new technologies and systems, and from refinements to existing ones. These innovations, when implemented, can further promote the safety and security of the transportation system, relieve congestion and improve mobility, enhance economic productivity, reduce costs, and minimize the negative environmental impacts due to transportation.

The following examples of Canadian success stories serve to illustrate the benefits that can arise from ITS R&D.

COMPASS Traffic Monitoring and Control System. This system is located on the busiest section of Highway 401 as it passes through Toronto. It enables the Ontario Ministry of Transportation to monitor highway conditions, detect incidents, and initiate timely and appropriate responses in order to mitigate congestion, minimize vehicle delays, and reduce accident risks.

Operating under the Ontario government's investment program for major highways, forward-looking staff and industry partners developed an innovative concept that would connect -- using high-capacity fibre-optic cables -- roadway vehicle detectors, elevated cameras, and overhead message signs to a central traffic control centre. The system development included initial field trials of the ITS equipment, successful deployment along Highway 401, and the measurement of benefits after deployment.

Microwave Sensor Technology. This traffic sensor device uses a microwave beam to detect the presence of passing vehicles; a portion of the beam is then reflected back to the device. The device can detect vehicles in a single lane or in multiple (parallel) lanes, making it very flexible in its application.

The concept for the device originated with a private inventor, who convinced investors to support its development and persuaded the Ontario Ministry of Transportation to test and demonstrate it on sections of its highways. Based on the positive results of these tests and a vigorous program to exploit market opportunities, the device is now an established success in the niche-market of accurate and low-cost traffic sensors.

Weigh-In-Motion (WIM) Technology. This technology was conceived in a Saskatchewan university as a method of weighing heavy commercial vehicles without requiring them to stop at static roadside weigh scales. By measuring vehicle weight while the vehicle is moving at highway speeds, vehicle operators save time and regulatory authorities can gain in efficiency.

The device was tested in the field with assistance from provincial regulators and federal R&D authorities. It was also the technology of choice in a joint U.S.-Canada project to develop a weigh station bypass system for west-coast highways. Market acceptance has made this product the premier WIM system for North America and it has also gained wide application in the global market place.

Visual Communication Network (VCN). This system was conceived as a method of communicating information in real-time to transit riders via in-car displays on the Montreal Metro. Information includes emergency instructions as needed, route guidance instructions such as next stop and upcoming bus connections, and entertainment and advertising between stops.

The system found an early advocate among those advocating support services for the elderly and disabled. The display panels catered effectively to the special needs of the visually impaired and the information displayed gave added security and comfort to riders. The system was developed by a private company and tested on the Montreal Metro as part of a cooperative federal-provincial project. VCN is now widely used in rail transit services in several North American, European and Asian cities, and derivatives of VCN are used on rail transit platforms as well as in airports.

THE ITS R&D PLAN

The present document -- *Innovation Through Partnership* -- is Canada's multi-modal ITS R&D Plan. It responds to the challenge of Canada's *Innovation Strategy*, and serves both as the third strategic pillar of *En Route to Intelligent Mobility* and as an important first step in meeting the ITS commitments made by Transport Canada in *Straight Ahead*.

The ITS R&D Plan, which is funded under the Strategic Highway Infrastructure Program (SHIP), is composed of two parts:

Part A: Fostering ITS Innovation – contains a number of ITS R&D activities designed to foster innovation in support of the strategic objectives of *En Route to Intelligent Mobility*.

Part B: Funding ITS Innovation – contains a scheme for funding ITS R&D project proposals designed to meet Transport Canada's ITS R&D priorities, as documented in *Straight Ahead*.

PART A: FOSTERING ITS INNOVATION

INVENTORY OF NEW ITS TECHNOLOGY

En Route to Intelligent Mobility prescribes the creation of a technology database of new and emerging products and services that use sensors, communications and computer systems, aimed at providing innovative capabilities for transportation. Special emphasis is to be placed on Canadian products and services.

The technology database, which will be both web-based and available in CD format, is intended to serve as a working intelligence tool for those wishing to know about improvements to current ITS applications and to learn about new ITS innovations. In addition to a critical evaluation of the utility and safety benefits of products or services and their inter-operability with other services and applications, data elements will include information on availability and sourcing, as well as on costs and licensing.

Transport Canada will allocate funds under the ITS R&D Plan for the development of this ITS technology database. The work will be carried out in fiscal year 2003/2004 and up-dated in subsequent years.

ITS R&D WORKSHOP

En Route to Intelligent Mobility also requires that a workshop on multi-modal ITS R&D be organized for ITS stakeholders.

The agenda for the ITS R&D workshop will include an information session on this ITS R&D plan and a report on the results of a stakeholder survey aimed at identifying ITS R&D priorities (see Appendix A of this booklet for details).

A major part of the workshop will be devoted to partnership building, one of the strategic objectives of the Strategic Highway Infrastructure Program (SHIP). Collaboration and partnership are not just a matter of a single buyer and a single supplier. Strong partnerships can be formed involving levels of government, suppliers, academic researchers and service operators.

As part of the survey of ITS R&D priorities, respondents from each stakeholder group were asked to indicate their collaborative and partnership interests within the context of addressing their R&D requirements. Details of these partnership interests (see Appendix A) will be shared with participants at the workshop, who will be encouraged to identify R&D topics, discover common interests, develop collaborative proposals, and establish partnerships.

CANADIAN ITS ARCHITECTURE

En Route to Intelligent Mobility provides for the development of a national ITS architecture to ensure that products and services are seamlessly integrated. Indeed, *Developing a Canadian ITS Architecture* is the second pillar of the ITS strategy.

In 2000, Transport Canada commissioned the development of the Canadian ITS Architecture. While, for reasons of compatibility and interoperability, it is similar to the U.S. ITS Architecture, the Canadian version takes account of unique aspects of the Canadian context such as bilingualism, the metric system of measurement, population dispersion and climatic extremes.

The Canadian ITS Architecture provides a unified framework for integration to guide the coordinated deployment of ITS programs within the public and private sectors.
It should be considered as a living document, requiring periodic maintenance to ensure that it remains current and relevant in response to changing conditions and new developments such as the addition of new ITS user services.

Transport Canada will allocate R&D funds for the maintenance of the Canadian ITS Architecture.

TRAINING IN ITS KNOWLEDGE AND SKILLS

The ITS R&D Plan is being funded under the Strategic Highway Infrastructure Program (SHIP). This funding is for a finite period of time up to March 2006. There is a need therefore, to encourage the development of a Canadian ITS R&D knowledge infrastructure for the longer term and to promote the training of ITS professionals. This will be done under the ITS R&D Plan through support for the ATLANTIC project.

The ATLANTIC project (A Thematic Long-term Approach to Networking for the Telematics and ITS Community), is a cooperative research project undertaken by ITS communities in Europe, the U.S. and Canada to build an international ITS knowledge base, with academic, government, consultant and industry participants.

The Canadian ATLANTIC project's main objective is to stimulate an active and self-sustaining ITS R&D community in Canada in cooperation with international partners. The project will be under the direction of two senior university professors: one from the University of Toronto and one from the University of Montreal.

Transport Canada will allocate R&D funds for this activity and will sign a contribution agreement with the Government of Ontario and the Government of Quebec in support of the ATLANTIC project.

PART B: FUNDING ITS INNOVATION

TRANSPORT CANADA'S ITS R&D PRIORITIES

The ITS R&D priorities identified in *Straight Ahead* (Chapter 7: Innovation and Skills) are:

- Developing national standards;
- Traffic management systems, especially incident detection and response, and route diversion strategies;
- Commercial vehicle operations;
- Advanced public transportation systems: fare systems, fleet management, and traveller information systems;
- Road weather information systems; and
- Transportation security for goods and people, including border and container security.

In addition, *Straight Ahead* has chapters reflecting other significant strategic departmental priorities. For example, *Chapter 5* reaffirms the federal government's commitment to address the environmental impacts of transportation; and *Chapter 6* focuses on the need for legislative reform, risk reduction and stakeholder awareness as strategic elements of the vision for transportation safety and security. These will also be considered as priorities for the purpose of elaborating a funding scheme under the ITS R&D plan.

Transport Canada's set of ITS R&D priorities correspond very closely with the underlying priority structure derived from an analysis of responses to the stakeholder survey (see Appendix A for details).

R&D FUNDING CATEGORIES

Four broad funding categories were created for the purposes of evaluating and funding ITS R&D proposals. These categories are based on the strategic directions adopted by Transport Canada in *Straight Ahead*, and the specific R&D priorities listed above have been organized under them.

The four funding categories are:

- Urban Transportation;
- Safety, Security and Trade Facilitation;
- Environment Issues; and
- Foundations of Innovation.

Urban Transportation

Most Canadians live in urban centres, where much of Canada's economic activity is generated. Traffic congestion is a major problem in larger urban areas, requiring concerted efforts to minimize its detrimental impact on the environment, the economy and society. In *Straight Ahead*, the federal government recognizes the key role that ITS can play in helping to reduce congestion in urban areas.

There are two R&D priorities in this category: traffic management and control, and public transportation.

Specific examples of R&D topics in the area of traffic management and control include incident detection, congestion management, and traffic signal control. R&D topics addressing public transit include information warehousing, transit signal priority, and vehicle location and tracking.

Safety, Security and Trade Facilitation

There is a long tradition of research in Canada aimed at identifying safety and security problems, developing solutions, and implementing these solutions through actions such as legislation, regulation, programs and education. *Straight Ahead* envisions the continued application of rigorous risk management principles to safety and security across all modes based on sound research. A commitment to safety- and security-related R&D, including ITS R&D, is expected to stimulate innovation and the application of new technology in the traditional and emerging sectors of the transportation industry.

There are three R&D priorities in this category: transportation safety, transportation security, and commercial vehicle operations.

R&D topics under transportation safety include driver distraction, highway-railway crossings, and work zone safety. Security-related R&D projects include supply chain networks, E-seals, and driver-vehicle ID linkage. Examples of commercial vehicle operations (CVO) R&D include highway inspection station screening, border crossing information systems for drivers, vehicles and cargo that facilitate commercial goods movement, travel information systems for CVO, deployment of inter-operable technology, and management of inter-modal freight.

The Environment

A key strategic direction contained in *Straight Ahead* involves reducing the harmful environmental impact of transportation. One important way in which this can be achieved lies in the promotion of R&D aimed not only at making vehicles more environmentally friendly but also at making transportation as an activity more efficient, more integrated and more appropriate to environmental conditions, through the application of ITS technologies.

One of the benefits attributed to ITS is the reduction in energy consumption (fewer greenhouse gas (GHG) emissions) and reduced impact on the environment. This

attribution is based on ITS-improved transportation efficiency yielding smoother flow, less delay, and better operating speeds.

Two R&D priorities have been organized under the Environment category: Environment and Energy (ITS & Kyoto) and Road Weather Information Systems (RWIS).

Examples of possible ITS R&D projects in the energy and environment category include travel-demand management, evaluation tools, and long term versus short-term effects. R&D projects involving weather include identifying the most useful data for road maintenance purposes, and constructing user-friendly interfaces for traveler advisories.

Foundations of Innovation

In *Straight Ahead*, Transport Canada commits itself to working with public, private and academic partners to ensure that the transportation sector remains vibrant and creative. R&D is expected to play a crucial role in this regard especially in terms of providing a "knowledge infrastructure " in which the foundations of innovation are established and available for new and emerging applications.

The main R&D priority falling into this funding category relates to developing ITS standards. R&D topics in the ITS standards area include DSRC, smart card standards, and CVO data exchange protocols.

In addition, on the basis of responses to the stakeholder survey, a number of issues have been gathered as methodological issues -- system modeling, forecasting techniques, and cost-benefit evaluation. R&D priorities falling into the methodological category are incident detection algorithms, cost-benefit models, and integration of freight flows.

R&D FUNDING MECHANISMS

All project proposals will be required to fall into one of the four funding categories and will be expected to focus on the integration and interoperability of ITS applications. In addition, where applicable, the proposed work should lead to stronger institutional ties across jurisdictions, transportation modes and operating agencies.

Those eligible to apply for funding under the ITS R&D Plan include registered Canadian not-for-profit organizations, private enterprises, provinces/territories, municipalities, academic institutions, and first nations. Partnerships between two or more of these entities are strongly encouraged.

Three primary funding mechanisms are available under the ITS R&D Plan:
R&D Contribution Agreement, R&D Contract, and Bilateral Federal-Provincial R&D Agreement.

R&D Contribution Agreement

The Strategic Highway Infrastructure Program is designed to promote partnerships, and for that reason is structured on a contribution agreement basis. Under an R&D contribution agreement mechanism, therefore, the federal government funding contribution from all sources for any given project proposal is limited to a maximum of 50% of the total eligible costs.

Moreover, under the ITS R&D Plan, the maximum contribution under an R&D contribution agreement to any province or territory, municipality, first nation, not-for-profit organization or academic institution is $250,000 per project. The maximum contribution for a private enterprise is $100,000 per project.

A call for proposals for R&D contribution agreements will be made periodically. Unsolicited proposals may also be considered.

R&D Contract

This funding mechanism is available to address project proposals of smaller scope than those envisioned for contribution agreements. Such proposals are more likely to come from small start-up businesses and have a higher degree of technical risk than do projects funded through contribution agreements. Transport Canada will pay 100% of the project costs of R&D contracts. However, sponsors from two or more stakeholder groups must jointly submit an R&D contract proposal, on a partnership basis. The maximum value of an R&D contract will be $100,000.

Bilateral Federal-Provincial R&D Agreement

The third funding mechanism is a bilateral (50-50) federal-provincial agreement. Under this arrangement, provincial/territorial transportation ministries can propose to Transport Canada a number of ITS R&D projects, addressing one or more of the funding categories and based on their provincial strategic ITS plan. The maximum federal contribution to a bilateral R&D federal-provincial agreement is $500,000. Bilateral federal-provincial agreements will be established on a case-by-case basis.

ADMINISTRATIVE PROCESSES

Requests for Proposals

Transport Canada will be responsible for issuing requests for proposals for R&D contracts and calls for proposals for R&D contribution agreements. These calls/requests for proposals will invite submissions addressing the four ITS R&D funding categories outlined above.

A request for proposal for ITS R&D contracts will be posted on the federal government on-line tendering services (MERX) each year (www.merx.com). Terms and conditions, including those addressing intellectual property rights, will be posted for downloading.

The basis for awarding R&D contribution agreements is laid out in an Applicant's Guide, available in a separate document. The Applicant's Guide includes the definition of criteria for selection of proposals to be funded, and the definition of conditions for funding, including assignment of intellectual property rights.

Evaluation and Selection of Proposals

For the purpose of proposal evaluation and selection, Transport Canada will rely primarily on the expertise of the Transportation Development Centre (TDC) and may call on ITS Canada to designate members to assist in proposal evaluation and selection. Transport Canada may also invite other advisors to assist in this process. To assure process integrity, it is important that advisors and evaluators have no conflict of interest, that is, they either are not part of any project application for funding, or refrain from evaluating any project applications in which they have a stake.

In general, and especially where intellectual property rights are an issue, Transport Canada may require its own staff and any external advisors to sign confidentiality agreements committing them not to disclose any material contained in the proposals.

Awarding and Management of Contracts/Contribution Agreements for ITS R&D

When the projects have been selected for funding, within the scope of the funding envelope allocated for ITS R&D contracts and contribution agreements, Transport Canada will advise the successful contractors or applicants.

In the case of R&D contracts, the Transportation Development Centre will fulfill the formal role of scientific authority for the contract.

In the case of contribution agreements Transport Canada will have the right, if it wishes to exercise it, to participate in project steering committees and will receive periodic reports of progress. In all cases, Transport Canada will also administer the payment of invoices against project milestones.

UPTAKE AND COMMERCIALIZATION OF R&D FINDINGS

A major objective of the ITS R&D plan is to disseminate, wherever possible, the results of successful R&D and to accelerate the commercialization of knowledge and technology uptake in the area of ITS. An important part of the ITS R&D plan's management and administration therefore includes:

- Evaluation of R&D results from projects. This evaluation will be the responsibility of the Transportation Development Centre. Independent consultants engaged under contract, co-sponsors of the project, or, in some cases, the parties conducting the R&D may be invited to contribute to the evaluation.

- Dissemination of (non-commercially confidential) information, so that successes can be recognized and deployed. Other Canadian ministries, agencies, companies, and universities need to know what R&D has been successful. This can be done without divulging commercially confidential information. This kind of information dissemination should also be viewed as useful by product developers and manufacturers, as it will assist them in marketing the product both domestically and in the export market.

APPENDIX A

SURVEY OF ITS
RESEARCH & DEVELOPMENT PRIORITIES

Material for this Appendix has been extracted from:

Intelligent Transportation Systems (ITS) Research and Development Plan for Canada. December 2002. Harmelink Consulting Inc. Prepared under contract # T8080-02-0264

Introduction

This appendix summarizes the results of a recent survey of ITS R&D priorities across six stakeholder groups -- federal government, provincial governments, municipalities, industry, service operators, and the academic community.

Within each group, a survey coordinator distributed a standardized questionnaire containing questions on ITS needs and gaps, R&D priorities, and collaboration and partnership interests. The response rate was high for most groups and satisfactory for all. Those who completed the questionnaire within each group constituted the group panel. The results for each panel were analyzed and reported on by the group coordinator. An invited panel chairperson reviewed the report prior to it being finalized.

Findings for each stakeholder group are summarized under panel selection; ITS context; R&D priorities; levels of R&D (technical field trial, development, or demonstration), and partnership interests.

Summary of Stakeholder R&D Priorities

Analysis of R&D priorities across stakeholder groups suggests seven underlying themes:

Safety and Human Factors

Safety is a primary focus of many ITS applications, and human factors play a major role in many ITS safety issues. Safety and human factors issues emerged as R&D priorities in all six ITS stakeholder groups. Specific examples of R&D topics under this theme include:

- In-vehicle communication devices;
- Communication of RWIS safety information to drivers;
- Vehicle inspection & compliance;
- Speed control;
- Work zone safety issues;
- Highway-railway crossings;
- Pedestrian/bicycle detection and safety;
- Wildlife control;
- Hazard warnings;
- Driver distraction issues; and
- Improved train control.

Traffic Management and Control

The theme of traffic management and control covers a broad range of topics, and hence a wide range of interests. While all six stakeholder groups identified traffic management and control issues, provincial governments, municipalities and industry showed relatively greater interest. Specific examples of R&D topics involving traffic management and control include:

- Technologies and applications to reduce travel time;
- Congestion management tools;
- Traffic counting and monitoring techniques and tools;
- Emergency vehicle response and priority;
- Freeway and arterial traffic management strategies;
- Adaptive traffic signal control;
- Low cost solutions for lower traffic roads;
- Non-intrusive vehicle sensing;
- Palm pilot for real-time Advanced Traveler Information Systems (ATIS) for both roads and transit;
- Canada 511 information system;
- Electronic payment systems (including inter-operability);
- Work zone traffic management;
- Enforcement systems (including red light cameras);
- Global Positioning System (GPS)-supported collision reporting;
- Archived data management;
- Affordable cost-effective systems; and
- Measures of effectiveness.

Public Transit

Five of the six stakeholders groups (all but service operators) included public transit issues among their R&D priorities, with the strongest interest shown by municipalities and by industry. Specific examples of R&D topics under the public transit theme include:

- Costs and benefits of public transit ITS applications;
- Management of transit fleets;
- Smart cards and electronic fare payment systems;
- Simple methods of vehicle location and tracking;
- Transit signal priority;
- Automated and integrated transit information; and
- Information warehousing.

Security/Border Crossings/Commercial Vehicle Operations

Security and border crossings are the new areas of ITS application. Efficient border crossings are essential to Canada's economy, a challenge made all the more salient by heightened security concerns. CVO was an early ITS application and continues to be important. All stakeholder groups identified needs in one or more of the listed security/ border crossing/CVO R&D issues, with the strongest interests identified by the federal government, service operators, industry, and academia. Specific examples of R&D projects under this theme include:

- Supply chain networks;
- E-seals;

- Inter-operable technology;
- Driver-vehicle ID linkage;
- Application of Closed-Circuit Television (CCTV) and optical licence readers;
- Travel information systems for CVO;
- Electronic payment systems, including inter-operability;
- Tracking of hazardous goods;
- Communication of emergency detour route information;
- Aggregation of data from shippers and carriers, and archived data management;
- Cost-effective border crossing clearance and security;
- Pre-clearance of vehicles; and
- Management of inter-modal freight.

Architecture and Standards

While the main task with respect to architecture is maintenance, much more work remains to be done on ITS standards. Five of the six stakeholder groups (all but academia) identified R&D needs in architecture and standards, with the strongest interests expressed by the federal government, service operators, and industry. Specific examples of R&D topics in architecture and standards include:

- DSRC standards and inter-operability;
- Smart card standards and inter-operability;
- Intelligent border crossing protocols and standards;
- CVO data exchange protocols;
- Centre-to-centre data exchange communication standards and protocols;
- Wireless communications;
- Compliance, verification and certification; and
- ITS standards across various technologies.

Environment and Energy (ITS & Kyoto)

One of the benefits often attributed to ITS is the reduction in energy consumption (fewer GHG emissions) and reduced impact on the environment. This attribution is based on ITS-improved transportation efficiency yielding smoother flow, less delay, and better operating speeds. It should be noted, however, that unless preventive measures are adopted, these improvements can lead to increased urban sprawl and more dispersed living and working patterns, which in turn can result in increased energy consumption and emissions.

The federal government, industry, and academia expressed the strongest interest in energy and environmental issues. Examples of possible ITS R&D projects under the energy and environment theme include:

- ITS and sustainable transportation;
- Tools for evaluating the impact of ITS applications on the environment;

- Long-term versus short-term effects of ITS on the environment; and
- Travel demand management.

Methodological Issues

Under this theme, a number of loosely related issues have been brought together. They include modeling techniques, methodological issues, institutional and organizational issues, forecasting techniques, and cost-benefit evaluation. All six stakeholder groups identified one or more of these issues among their R&D priorities, with the strongest interests identified by the provincial governments, industry, and academia. Examples of ITS R&D priorities falling under the methodological theme are:

- Integration of ITS in transportation planning;
- Predictive travel time modeling;
- Real-time traffic micro-simulation;
- Improved incident detection algorithms (both freeways and arterials);
- Modeling of ITS network control strategies;
- Optimization strategies and models;
- Integration of freight flows; and
- Cost-benefit models and evaluation frameworks.

The Federal Government

Panel Selection

Within Transport Canada, panel members were recruited from the Transportation Development Centre (TDC), Road Safety and Motor Vehicle Regulation Directorate, Rail Safety Directorate, Surface Transportation Policy Directorate, Security Technology Unit and Transport Canada Pacific Regional Office.

Representatives from other departments, whose mandate extends into the transportation sector, were also invited to serve as panel members for the federal sector. These departments included Industry Canada (IC), Natural Resources Canada (NRCAN), Environment Canada (EC), and Canada Customs and Revenue Agency (CCRA).

The panel chairperson was Susan Spencer, Director, ITS Office, Transport Canada.

The Federal ITS Context

The *Transportation Development Centre*, Transport Canada's central research group, conducts research on ITS technologies and their application to road and inter-modal transportation.

The *Road Safety and Motor Vehicle Regulation Directorate* carries out research on vehicle-, driver- and infrastructure-based safety measures to support the development of new provincial and territorial road safety programs as well as its own information programs.

The *Rail Safety Directorate* sponsors research aimed at reducing the number of incidents occurring at highway-railway grade crossings and along railway tracks.

Transport Canada's ITS Office is responsible for the implementation of Action Item #20 of the *Smart Border Declaration*, which commits the Government of Canada and the U.S. to the "deployment of interoperable technology in support of other initiatives to facilitate the secure movement of goods and people."

Industry Canada's principal interest in ITS applications occurs within the context of its responsibility to regulate the radio-electric spectrum.

Natural Resources Canada's interest in ITS lies in its Office of Energy R&D, the mandate of which is the improvement of energy efficiency.

The Sustainable Transportation Division within Environment Canada supports ITS R&D – in-vehicle, traffic management, vehicle-to-highway – that minimizes environmental damage and promotes sustainable transportation.

The Canada Customs and Revenue Agency's (CCRA) interest in ITS is focused on security and cross-border processes. The agency is currently engaged in a review of ITS technology such as e-seals and transponders.

R&D Priorities

The Federal Government Panel's top ITS R&D priorities are in the following areas (not in order):

- Standards development and deployment;
- Safety and user needs evaluations;
- Human factors requirements for collision warning systems;
- Safety benefits of weather-controlled variable message signing;
- Safety benefits of construction/work zone signing;
- Effects of speed control technologies;
- Advance warning systems of trains approaching grade crossings;
- Border crossing processes;
- Inter-modal freight efficiency and security;
- Security of container supply chain networks;
- Driver-vehicle identification linkage in real time;
- ITS technologies for improved truck fleet and load management;
- ITS and environmental protection; and
- Interoperable ITS technology (smart cards, e-seals, and transponders).

Levels of R&D

Transport Canada and other federal departments would like to see funding for all three types of research: (1) basic research in enabling technologies for communication, location

and sensing and human factors; (2) developmental projects to adapt the technology to a wide range of existing and potential applications, and combine off-the-shelf and emerging ITS technologies; and (3) controlled-environment demonstration projects to promote interoperability, product or service testing, generate awareness, provide appeal, encourage technology transfer, build consensus, and produce technical results.

Partnership Interests

The Transportation Development Center contracts out work to a variety of agencies – government, academic and private industry. It encourages fund matching and partnering. The Road Safety Directorate anticipates working in partnership with vehicle and ITS equipment manufacturers, provincial and municipal transportation authorities; transportation operators such as vehicle rental companies and truck freight transporters; navigation systems and geographic information systems (GIS) suppliers; telecom equipment and communications network operators; road users; and research institutes. The Rail Safety Directorate anticipates working in partnership with railway companies in order to gain access to infrastructure for testing purposes; with municipalities and provincial governments for access and for public outreach; and with universities and institutes for the purposes of conducting the R&D.

ITS R&D addressing security and cross-border processes will require active collaboration from agencies on both sides of the border – Transport Canada, CCRA, Citizenship & Immigration Canada (CIC), ITS Canada, United States Department of Transport (USDOT), Federal Highway Administration (FHWA), United States Customs Services (USCS), Immigration and Naturalization Services (INS), Homeland Security and ITS America – in order to ensure interoperability of technologies and continuity of logistics.

Industry Canada anticipates working with ITS Canada, ITS America, Federal Communications Commission (FCC), International Telecommunication Union (ITU), manufacturers and telecommunications concerns, as well as with Transport Canada.

Collaboration with universities, and linkage between its Program for Energy R&D (PERD) and other federal government programs will be important for NRCAN-sponsored ITS R&D.

Provincial Governments

Panel Selection

Panel members were recruited from the transportation ministries/departments of the ten provinces and three territories. Representatives from other ministries/departments/ agencies with an interest in ITS were also invited to serve as panel members. There were thirty-one (31) provincial government members on the provincial governments panel.

The panel chairperson was Stephen Erwin, Manager, ITS Office, Ontario Ministry of Transportation.

The Provincial Government ITS Context

Interest in ITS is high in all provincial jurisdictions. Several have developed or are developing ITS Strategic Plans. Some of the larger provinces have deployed ITS technologies. Of the eight user service bundles in the ITS Architecture for Canada, interest is greatest in traffic management; traveler information; electronic payment; and CVO. Other areas of interest include trade corridor development; border crossing systems; automatic collision reporting using GPS; geographic information systems; automatic animal warning systems; and personal safety systems.

Technical and institutional problems were identified with the current applications of ITS. Technical problems include human factors; reasonableness or cost effectiveness of ITS applications; ITS standards; need for more reliable and less expensive non-intrusive monitoring capabilities; predictive capabilities; and connections with other developments. Institutional problems include perceptions; performance measures; insufficient resources; ITS awareness and knowledge; intergovernmental co-operation; and legal liability.

R&D Priorities

The Provincial Government Panel's top ITS R&D priorities are in the following areas:

- Technology/service improvements:
  - Improved traffic and road condition monitoring and forecasting;
  - RWIS;
  - Traveller information services;
  - Public transit;
  - Fleet management and other CVO applications;
  - Inter-modal freight transport;
  - Border crossing and pre-clearance systems;
  - Electronic payment services;
  - Environmental conditions monitoring;
  - Data warehousing and management;
  - Cost-effectiveness of ITS deployments; and
  - Vehicle to roadside communications.

- Improved traffic management techniques:
  - Incident and congestion detection and management;
  - Traffic control on single lane roadways;
  - Demand management; and
  - Emergency vehicle priority

- ITS standards:
  - Electronic payment;
  - Centre to centre and DSRC; and
  - Data exchange and sharing protocols.

- Model development:
    - Cost-benefit evaluation models (e.g. ITS deployment analysis systems);
    - Predictive travel time modelling; and
    - Traffic micro-simulation techniques.

- Human factors testing:
    - Driver distraction;
    - Impaired driving;
    - Aging and inexperienced road users; and
    - Communications with the public.

Levels of R&D

The need for fundamental research in ITS is low and the need for ITS product or service development is high; however, the highest need is for ITS demonstration projects. Research needs are in the areas of cost-benefit analysis models; driver distraction models and performance measures. Development needs are in the areas of improved cold weather performance for ITS equipment; improved incident detection algorithms; improved traffic and road condition monitoring and forecasting; improved user interfaces; on-board monitoring technologies; modification and testing of available software packages; and establishment of ITS standards. Demonstration needs are in applying ITS technologies in real world environments to evaluate their performance and effectiveness before committing to larger investments for full-scale system deployment.

While much of the R&D work may extend beyond the mandate and capability of typical provincial transportation departments, provincial government ITS panel members indicated that, as a road owner resource, they would consider participating in field testing or demonstration projects on a case-by-case basis.

Partnership Interests

There is a clear consensus among the provincial/territorial governments that ITS R&D must be undertaken as a collaborative effort among governments, private companies and universities. Interoperability of systems is a key objective. Some respondents felt that collaboration among governments is easier to achieve than collaboration between governments and private companies. Some provincial governments may have difficulty providing direct funding to ITS R&D, and prefer to provide in-kind resources.

Specific roles for governments were identified as setting standards for information sharing, operational concepts and inter-agency co-operation. Specific roles for private companies were identified as development of products that have agreed upon "open architecture" and compatibility of devices. Specific roles for universities were identified as academic research in areas of theoretical modeling, performance measures and qualitative analysis.

Municipalities

Panel Selection

Panel members were recruited from a representative sample of municipalities, with representatives from regional transportation agencies, municipal roads or traffic departments, and municipal transit agencies or commissions. Nineteen (19) municipality representatives participated in the panel.

The panel chairperson was Leslie Kelman, Director, Traffic Management Centre, Transportation Services, City of Toronto.

The Municipality ITS Context

Municipalities operate in a highly constrained fiscal environment. Lack of funding is the greatest challenge impeding ITS deployment. ITS must compete with many other capital and operating needs of the municipality.

Still, there is significant interest in ITS in many municipal transportation organizations, and in the potential it offers to address current problems faced by municipal transportation organizations, as well as to create opportunities to improve the services they deliver.

Some regional or municipal governments have conducted formal ITS Strategic Plans in the last two years, while others are assessing the role ITS may play, or are evaluating individual applications of local priority. The broader the mandate of the organization or department considering ITS, the broader the range of applications under consideration. Four general problem areas, with related R&D needs, were identified by municipality panel members:

- The need for more general and coordinated dissemination of information on ITS;
- The need for more specific information on benefits and cost-effectiveness of ITS technologies in the municipal sector;
- The need to develop effective governance models for complex regional ITS systems, that are multi-agency (and possibly multi-modal); and
- The need to develop and refine ITS standards in order to ensure interoperability of systems.

R&D Priorities

The Municipality Panel's top ITS R&D priorities are in the following areas:

- Cost-benefit evaluation of ITS applications:
    - Documentation of cost/benefit data for Canadian ITS implementation and pilot projects, using a comparable methodology;

- Measurement of changes in traveler behaviour in response to ITS initiatives; and
- Measurement of "safety" benefits resulting from ITS initiatives and pilot projects.

- ITS Standards:
  - Standards for common traffic monitoring equipment, e.g. loops, video detection, variable message signs (VMS);
  - Standards for transit vehicle area networks; and
  - Interoperability standards for multi-application contact-less transit smart cards.

- Traffic management services:
  - Arterial and freeway incident detection algorithms and management systems;
  - Forecasting models for real-time dynamic traffic management schemes;
  - Design of large scale regional integrated traffic information systems;
  - Measurement of real-time travel time information on arterials and freeways; as prerequisite for route guidance systems;
  - Incorporation of weather monitoring system data in traffic management; and
  - Pedestrian and cyclist safety and detection tools.

- Public transport services:
  - Transit Signal Priority (TSP) operating strategies and detection technologies;
  - Use of GPS-based location data from Automatic Passenger Counting (APC) and Automatic Vehicle Location (AVL) systems to enhance transit management, planning, and customer information;
  - Development of transit system requirements in municipal trunk radio systems in new / reorganized municipalities;
  - GIS applications in transit; and
  - Automated transit customer information systems.

- Electronic payment services:
  - Barriers to deployment of transit contact less smart card automatic fare collection systems;
  - Technical issues related to electronic toll/fare collection technologies; and
  - Interoperability of electronic toll collection (ETC) with smart card devices for other applications.

- Traveller information services:
  - Development of an integrated regional traveller information system with data derived from multiple agencies;

- Multi-modal passenger terminal traveller information systems;
- Public perception and safety benefits of new approaches to disseminating incident detection and traveller information (e.g. Internet, personal digital assistant (PDA), cable);
- Development of methodologies to measure traveler information system effectiveness, in particular for web sites; and
- Development of a national 511 telephone traveller information service.

- Information warehousing services:
  - Integrating ITS with transportation planning methodologies and practice;
  - New ITS applications to data collection for transportation planning purposes; and
  - Data warehousing and deployment of municipal ITS applications (e.g. interfaces to regionally archived and relational databases, such as traffic data management systems, GIS, weather monitoring system data, integration of transit vehicle location and transit scheduling systems).

Levels of R&D

Virtually all of the municipality-identified ITS R&D needs are rooted in real application problems, needs and opportunities. In general, there is interest in development and especially demonstrations, but little interest in basic research, although algorithm development is one area where additional research is identified as necessary.

Partnership Interests

Many municipal ITS applications will require multi-agency and company collaboration. Various partnerships are suggested in the municipality sector:

- The development of ITS applications is increasingly likely to be multi-jurisdictional in nature. Hence, development and system demonstrations will require intergovernmental cooperation (province and multiple municipalities);
- Research can and should involve other parties in possible partnerships, including the federal government (TDC or regional development agencies such as Western Economic Diversification Canada and Atlantic Canada Opportunities Agency) and academia; and
- Private sector companies can and should be involved as partners in demonstration or pilot projects involving testing and refinement of ITS technologies/systems.

Industry

Panel Selection

Panel members were recruited from a representative sample of ITS manufacturers/ suppliers and ITS consultants, all of whom are members of ITS Canada.

The panel chairperson was Joseph Lam, Executive Vice-President, Delcan Corporation, and Chairman, ITS Canada.

The Industry ITS Context

ITS manufacturers/suppliers, aware of ITS applications, have identified areas for developing commercially viable products with profit potential. Their identified ITS R&D needs tend to be closely linked with their product line and/or capability, ranging in scope from broad to narrow. In general terms, ITS consultants tend to take a broad perspective since their capabilities cover a large spectrum of ITS, typically in ITS application studies, ITS systems application and integration, and ITS software development. They often form a "bridge" or link between public clients and manufacturers/suppliers.

The industry sector, made up of private companies, is competitive by nature. Most manufacturers/suppliers, while not divulging commercially confidential information, were nonetheless willing to identify ITS R&D needs of interest to the wider community.

Panel members identified various technical problems/gaps. The most common ones are standards, compatibility, and interoperability; virtual or non-intrusive detectors; better traffic data for adaptive traffic control; improved algorithms for freeway traffic management systems (FTMS) incident management; ITS in work zones for improved motorist and worker safety; wireless communications; driver-vehicle interaction with ATIS; human factors research; and the need for demonstrations to test and validate new technologies.

R&D Priorities

The Industry Panel's top ITS R&D priorities are in the following areas:

- Traffic management and control:
    - Human factors;
    - Traffic counting & monitoring;
    - Virtual or non-intrusive vehicle detection;
    - Adaptive traffic control;
    - Modeling/algorithms (travel time prediction, FTMS & arterial incident detection, traffic simulation, traffic signal priority);
    - Corridor/network traffic management;
    - Light infrastructure FTMS;
    - ATIS (human factors, in-vehicle information devices);

    - Seamless integrated communications network & wireless communications;
    - ITS emergency response;
    - ITS efficiency benefits; and
    - RWIS and variable speed limits.

- ITS & Work Zones:
    - Traffic management in work zones;
    - Queue warning and queue end warning systems;
    - RWIS: icing and friction loss warning;
    - Winter service tracking and reporting; and
    - VMS for lane closures.

- CVO and Border Crossing Efficiency and Security:
    - ITS and border crossings;
    - ITS and intermodal ports and terminals; and
    - Integrated CVO pre-clearance in Canada.

- ATIS:
    - Human factors (in-vehicle communications & information devices);
    - Canada 511 service;
    - Wireless communications for ATIS;
    - Palm-pilot based comprehensive ATIS system; and
    - Data collection and dissemination.

- ITS for safety and security:
    - General; and
    - Wildlife collision avoidance systems;

- Train control:
    - Grade crossing protection, prediction by communications-based train control (CBTC);
    - Movement authority retraction in case of defective crossing protection;
    - GPS as reliable means of determining exact train position;
    - Localized and central control of traffic signal preemption; and
    - Non-intrusive interfaces to existing vital signalling systems.

- Equipment standards verification.

- ITS & Kyoto.

- Matching of funding and demonstration opportunities.

Levels of R&D

Virtually all of the industry-identified ITS R&D needs are rooted in real application problems, needs and opportunities. In general, there is more interest in development and demonstrations than in basic research, although human factors and algorithm development are two areas where additional research is identified as necessary. For most of the other R&D priorities identified, both development and demonstration are considered necessary.

Partnership Interests

Most respondents, both manufacturers/suppliers and consultants, recognize the importance of partnerships, and are interested in such collaboration with complementary partners, but not usually with their direct competitors.

Software and hardware/product suppliers strongly support working collaboratively with their user clients; in fact, they depend on them. Some companies stress the importance of new product development not only for public transportation agency funding, but public transportation agency hosting of demonstrations as well in order to be able to provide references for clients in export markets.

Many companies also indicate a desire and willingness to work with academic partners in certain roles. Typical roles envisaged for academia by the private sector include research work (e.g., human factors or algorithm development) and project evaluation.

Manufacturers/suppliers also recognize the benefits of working with system integrators and with information service providers, whether public or private.

Service Operators

Panel Selection

Panel members were recruited from the Canada (Ontario) - U.S. bridge and tunnel operators, as well as the Canada Customs and Revenue Agency. Eight (8) service operator representatives were members of the panel.

The panel chairperson was Stephen Mayer, President of the Bridge Tunnel Operators Association.

The Service Operators' ITS Context

The major motivations for ITS solutions for service operators are security, safety and advance warning of changing traffic volume levels. Gaps identified include:

- Systems to support pre-arrival processing;
- Technology which links toll collection and border inspection processes;
- Visual security systems;

- Early warning systems to identify traffic peaks to permit appropriate inspection and toll collection staffing changes (in time to do something about it);
- Tracking of hazardous goods;
- Emergency detour routes and supportive communications systems accessible to travelers;
- Better traffic management systems;
- Identification and removal of institutional barriers to effective ITS deployment;
- Consensus by inspection and governmental agencies on operational priorities at international border crossings;
- Implementation of NEXUS could result in more delay if other systems are not adapted simultaneously.(e.g. separate lanes could reduce capacity for other traffic unless integrated with electronic toll collection systems);
- Recent plans for the US Federal General Services Administration (GSA) physical enhancements at border crossings run the risk of slowing traffic if these enhancements are not integrated with initiatives in other process and technology changes;
- Integration of FAST and NEXUS technologies to minimize implementation costs and maximize traffic management;
- Funding of simultaneous implementation of NEXUS at all border crossings; and
- Lack of access by US and Canadian inspection personnel to all available intelligence databases, increasing the requirement for secondary inspections and potentially less effective security screening than would otherwise be possible.

R&D Priorities

Many of the R&D priorities identified by service operators fall within the mandate of other federal departments. In such cases, Transport Canada's role will be to promote ITS R&D while acknowledging that the final say resides with those other lead departments on those issues.

The Service Operators Panel's top ITS R&D priorities are in the following areas:

- Interoperable technology to support proactive traffic management, toll collection, safety and security, and border inspection processes;
- Removing institutional barriers to implementation and coordination of effective systems;
- Specific implementation of available technologies;
- Human factors research into technology applications; and
- Funding of initiatives by Federal agencies.

Levels of R&D

Research and planning to remedy institutional barriers to efficient traffic management:

- Institution of mandatory pre-arrival processing in both Canada and the US, preferably away from the border crossings;
- Examination of co-location of US and Canadian inspection agencies;
- Continual work to create a consensus on common data sets for customs and immigration processes;
- Joint planning of transferable and inoperable technology between agencies (NEXUS is a good example); and
- Customer expectations of NEXUS/FAST need to be supported at all crossings or the maximum market penetration will not be achieved.

Research and demonstration of available technologies:

- VMS - more of them linked to early warning systems;
- Vehicle identification systems using DSRC;
- Testing of hand held technology to support more efficient inspection processes, better utilizing current staff levels;
- CCTV for security and traffic management;
- Optical character recognition license plate readers;
- Infrared vehicle classification devices;
- Weigh-in-motion technologies;
- Interoperable GPS, proximity and transponder pilots;
- Development of a means to use NEXUS as the basis for electronic toll collection; and other systems such as "early warning" traffic systems; and
- Improved camera systems for security and safe traffic management systems.

Partnership Interests

Border operators emphasize the basic requirement of gaining consensus for changes with Canadian and US inspection agencies, the importance of linkages to universities/colleges for education and applied research and the linkages between regional transportation authorities.

Academia

Panel Selection

Panel members were recruited from university academics who are active in the field of ITS R&D and related technologies. Seventeen (17) academics were members of the panel.

The panel chairperson was Professor Teodor Crainic, Université du Québec à Montréal, and Centre de recherché sur les transports (Université de Montréal).

The Academic ITS Context

ITS forms part of undergraduate and graduate courses at the universities contacted, although coverage varies considerably. The larger universities have active ITS-related research programs, including specialized laboratories for test-bed analyses, simulation studies, human factors research and vehicle structure analyses.
A selected list of problem/gap areas, which universities can address, includes:

- Gaps Perceived in ITS Field Practices:
    - State of practice lags behind the state of the art, e.g., integrated control systems are lacking in many fields;
    - Field implementations emphasize deployment of ITS infrastructure elements rather than software support systems; and
    - Lack of procedures for pre-deployment evaluations.

- Gaps in Traffic Network Modeling Techniques:
    - Demand estimation for new temporal simulation models;
    - Modelling of integration of freight flows;
    - Network control and optimization; and
    - Relationship between network performance and model predictions.

- Gaps in Knowledge of User Behaviour:
    - Driver response to travel guidance information; and
    - Driver expectations and workload implications for the driving task, especially for commercial vehicle drivers.

- Gaps in Knowledge of ITS Impacts on Safety and Other Issues:
    - Impact of ITS applications on safety from driver's perspective and needs;
    - Methods to measure in-vehicle safety of ITS applications; and
    - Driver-vehicle-infrastructure-environment interactions.

- Gaps in Planning Tools:
    - Intelligent support tools for planning and real-time operational management; and control for transit demand-responsive services, car sharing, urban freight distribution services, multi-modal itinerary planning; and
    - Tools to measure the impacts of ITS applications on safety, the environment, efficiency and productivity.

R&D Priorities

The Academic Panel's top ITS R&D priorities are in the following areas:

- Strategic planning priorities:
- Development and sustaining of ITS R&D capacities at universities in Canada;
- Establishment of transportation and ITS as a strategic domain of the Natural Sciences and Engineering Research Council of Canada (NSERC);
- Development of an ITS network of excellence to engage active players and spur collaboration;
- Establishment of an academic advisory body to assist Transport Canada to prioritize ITS R&D;
- Development of an academic ITS R&D agenda for Canada; and
- Encouragement of private sector collaboration with university ITS R&D activities.

- Project-level priorities:
  - Impacts of ITS applications on safety and other socio-economic measures;
  - Planning, operation and design tools;
  - Network modeling and control techniques;
  - Demonstrations and field trials; and
  - User behaviour and human factors.

Levels of R&D

Academic panel members would like to see sustained funding, primarily for fundamental and basic ITS research. There is also a need to fund demonstrations to transfer laboratory research results to real-life contexts, and participation in international research activities.

Partnership Interests

All panel members considered collaboration with provincial government ministries, municipalities, public transit operators, federal departments and regulators as an important linkage for the advancement of ITS R&D. Collaboration with private firms is also valuable for the application of research results and provision of input on practical matters. Issues related to intellectual property rights (e.g. ownership and non-disclosure) as well as to different research objectives (e.g. basic research versus early deployment) need to be resolved.

Panel members also recognize that cooperation within and among the Canadian university research community can enhance capabilities by sharing expertise and knowledge. Mechanisms are needed to bring potential partners together to foster co-operation and facilitate project initiation.