DEVELOPMENT OF AN INTELLIGENT TRANSPORTATION SYSTEMS STRATEGIC PLAN FOR THE CALGARY REGION

Doug Morgan, P. Eng.
City of Calgary
P.O. Box 2100, Stn. M #8124
Calgary, AB T2P 2M5
Doug.morgan@gov.calgary.ab.ca

Robyn V. McGregor, P. Eng.
EBA Engineering Consultants Ltd.
6111 – 36th Street SE
Calgary, AB T2C 3W5
rmcgregor@eba.ca

Prepared for the presentation at the
2003 Annual Conference of the
Transportation Association of Canada
St. John's, Newfoundland and Labrador

ABSTRACT

In the past few years the City of Calgary has enjoyed an extensive growth period, however, the City's transportation infrastructure is under added strain. Several initiatives are underway to address these mobility problems, but the cost of satisfying the increased demand solely through additional infrastructure exceeds the available funding. Intelligent Transportation Systems (ITS) are being considered as part of the solution.

Intelligent Transportation Systems or ITS is the application of technology to better manage traffic and maximize the utilization of our existing transportation infrastructure. The technologies are potential tools that will help to manage congestion, improve emergency vehicle response, optimize the operational effectiveness of transit systems and provide travellers with real-time information.

ITS is seen as an integral component of Calgary's Transportation Plan, supporting many of the City's key policies and directions to achieve a well balanced, efficient and safe transportation network. As such, Calgary recognizes the importance of ITS technologies and supports their deployment where and when it is shown to be a cost-effective solution in achieving an interoperable, seamless, multi-modal transportation network.

The City of Calgary is committed to the development of an ITS Strategic Plan. The primary purpose of this strategic plan is to develop a comprehensive "roadmap" setting the direction and pace of ITS investments within the City over the next ten years and beyond. The objective of this ITS Strategic plan is to develop, program and communicate strategies for the development and deployment of a broad-based ITS program within the City of Calgary and the Calgary Region that:

- supports, enables and enhances a seamless, multi-modal transportation network
- helps ensure the competitive position of the City of Calgary in national and international markets while addressing social and environmental objectives, and
- is supported by major stakeholders.

The process for development of the strategic plan includes six steps:

- Coalition Building Plan
- Establishment of Needs
- Opportunities Analysis
- Define ITS Program
- Develop Architecture to Support Program
- Define Deployment Program

This paper will report on the success and outcomes of the development of the ITS Strategic Plan for the Calgary Region. Conclusions and recommendations will be made on lessons learned that could be considered by other medium sized jurisdictions undertaking similar initiatives.

1.0 INTRODUCTION

In the past few years the Calgary Region has enjoyed an extensive growth period. The growth has placed the transportation infrastructure under added strain. Several initiatives are underway to address these mobility problems including large-scale infrastructure construction. One solution that is being pursued is the implementation of Intelligent Transportation Systems (ITS). These systems vary greatly in complexity and scope. Limited ITS elements have already been implemented within Calgary Region.

For example some elements already in place are:

- Transit priority system (OPTICOM)
- Robust signal control system (MIST)
- Red light camera enforcement (TRANCOR)
- EMS Dispatch
- Road Weather Information Systems

The City of Calgary recognizes the importance of deploying ITS technology whenever it is shown to be a cost-effective solution and to coordinate this effort to achieve an interoperable seamless transportation network.

Calgary City Council has made a conscious effort to promote an advanced transportation system as mentioned in the council priorities:

> "*Improve traffic flow by implementing various programs and technologies (e.g.: traffic signal coordination)*" (1)

With the population growing by 3.5%, or 28,468 people last year, and a total of 904,987 people calling Calgary home, the strain on the transportation infrastructure of the City of Calgary is becoming more evident than ever.

As Calgary experiences growth so does the region surrounding the City. Smaller cities such as Airdrie, Cochrane and Okotoks have also been impacted by substantial growth. As the Calgary Region grows and becomes more integrated as a metropolitan area, a need grows to integrate planning processes. The Strategic Planning Process has the intent of involving the surrounding municipalities in the development of the program. The surrounding municipalities have been included as stakeholders in the Strategic Planning process.

The City of Calgary itself represents a population of over 900,000 citizens. This configuration differs from some jurisdictions in the United States where a plan of this type may cover several separate agencies representing population areas. This configuration requires a more involved coordination scheme. The City is not immune to these challenges but matters are made much more tractable by having the agencies under the umbrella of the City of Calgary.

The City of Calgary is currently undertaking the development of an ITS Strategic Plan for the Calgary Region. This paper will outline the steps taken in this work and will report on the success and outcomes of the development of this strategic plan.

2.0 WHAT IS ITS?

Intelligent Transportation Systems (ITS) provide the opportunity to integrate travellers, vehicles and infrastructure into a comprehensive system through a range of technologies that maximizes or increases the capacity of the infrastructure. ITS has, over the last two decades, attracted worldwide interest from transportation professionals, industry (both automotive and technology) and from political decision makers. Canadian ITS developments can be traced back to the late 1950's and early 1960's when one of the worlds first full-scale traffic signal systems, using digital computer technology, was installed in Toronto. Since then a number of notable ITS applications have been developed including the Toronto COMPASS freeway traffic management system and the Highway 407 all-electronic toll route.

ITS are information systems and therefore, development of ITS requires a systems engineering approach. This approach will model what the system will do and how it will do it, in terms of functions, processes and interoperability. Systems engineering differs from a traditional transportation engineering approach in that is combines a high order planning component to understand the functions and needs of the region (What will the system do?), directly with the technical aspects of delivery (How will it do it?). If ITS is not developed and deployed through a systems engineering approach, it is possible that system failure will occur by:

- unanticipated high operation and maintenance costs due to low reliability or poor design,
- requirements for early replacement, or
- inability to support functional growth including interfacing with other ITS in the region.(2)

Development of information systems through a systems engineering approach involves a detailed planning step that identifies user or stakeholder needs and functions before the design phase begins. Steps are undertaken as follows:

Step 1: Vision – documents the current and future use of information in the organization or region (What does or will the system do?)

Step 2: Architecture – how technology and human assets available to users should be deployed in the future to meet the vision (How will the system do it?)

Step 3: Strategic Plan – Statement of major initiatives based on the architecture, not yet defined precisely enough to be projects, but must be accomplished over some time period to move the region towards the information vision.(3)

Transportation engineers and planners deliver the implementation of new transportation infrastructure and operation of the transportation network in a strategic manner. However, the delivery and operation of ITS to support functions required to meet the needs of system users in the short and long term requires an additional step. That step is development of the ITS Architecture specific to the region that can be developed through the use of readily available tools and guidelines.

A Solid Foundation". In this document, the architecture is described as the communication and information backbone that unites key ITS technologies, enabling them to communicate with each other and a framework that identifies the standards needed to support interoperability across technologies, modes and jurisdictions.

The Intelligent Transportation Systems Architecture for Canada was completed and launched in September 2000.(4) The ITS Architecture for Canada is a guideline to be used by Transportation professionals to provide a blueprint for the integration of systems through the following:

- By providing a framework to identify components and interconnections between functions, for standardization, and to ensure products and services are compatible.
- By creating a common language or vocabulary to better communicate the required activities or functions.
- By providing guidance to facilitate deployment by Canadian transportation providers and to identify opportunities for integration.(5)

The ITS Architecture for Canada is made up of various components including the logical and the physical architecture.

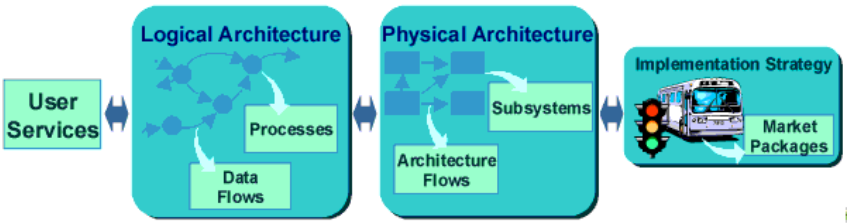


Figure 1 – Architecture Components (4)

The Logical Architecture defines what has to be done to support the services that are required by the user. It defines the processes that perform ITS functions and the information or dataflows that are shared between these processes. The Logical Architecture has also been called an "Essential Model" because it is not technology specific, nor does it dictate a particular implementation.(4)

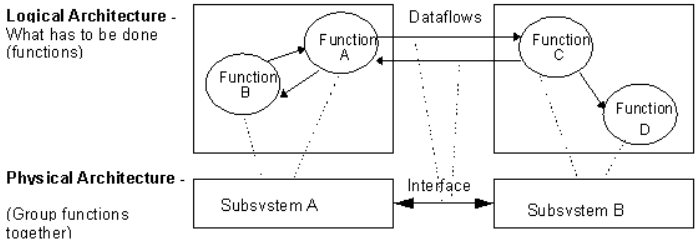


Figure 2 – Relative Architectures (4)

The Physical Architecture provides agencies with a physical representation (though not a detailed design) of the important ITS interfaces and major system components. It provides a high-level structure around the processes and data flows defined in the Logical Architecture. The principal elements in the Physical Architecture are the 23 subsystems and architecture flows that connect these subsystems and terminators into an overall structure. A physical architecture takes the processes identified in the logical architecture and assigns them to subsystems. In addition, the data flows (also from the logical architecture) are grouped together into architecture flows. These architecture flows and their communication requirements define the interfaces required between subsystems, which form the basis for much of the ongoing standards work in the ITS program.(4)

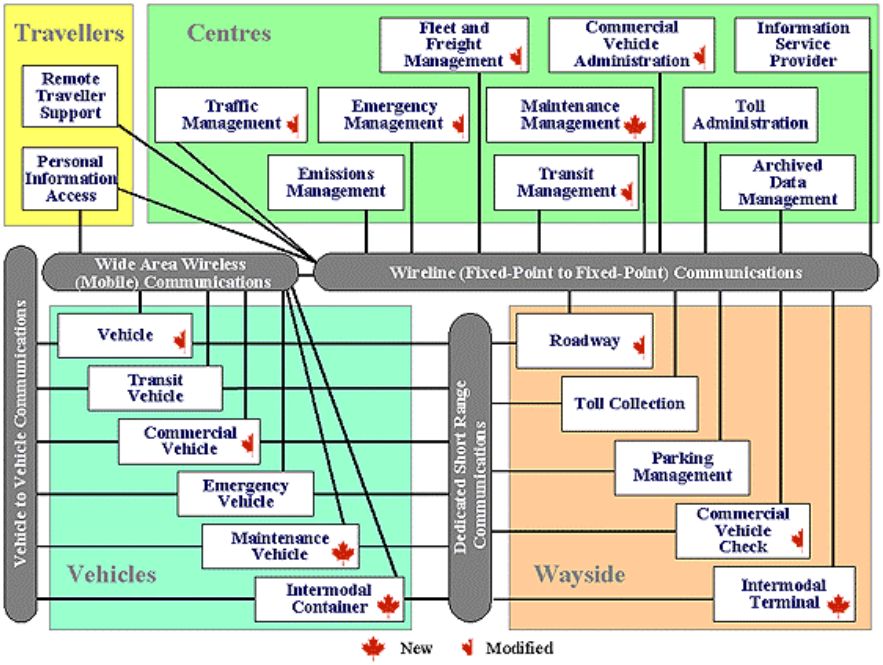
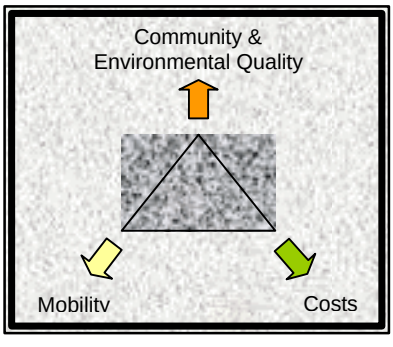


Figure 3 – Physical Architecture (4)

3.0 Calgary Transportation Plan

The Calgary Transportation Plan was adopted by the City Council in May 1995. The plan outlined that the transportation system must be safe, efficient and support the economic growth of the City. It must also be sustainable. The approach taken in the Calgary Transportation Plan reflects a balance or equilibrium among what is described as the three competing forces:

- Community and environmental quality – protection of significant environmental areas, integrity of existing communities and air quality;
- Mobility – provide the benefits of mobility while tempering the undesirable consequences of the Calgarians' collective



car dependent behaviour; and
- Costs and affordability – affordability of the plan.(6)

For any situation, it is recognized that there must be a reasonable balance between the level of mobility provided, and the undesirable consequences of mobility (i.e., congestion, increased costs and environmental damage).

One way of achieving the balanced approach is through efficient and integrated applications of Intelligent Transportation Systems. The ITS Strategic Plan for the City was highlighted as an important asset and must be an integral component of the Calgary Transportation Plan complementing and supporting initiatives undertaken by individual jurisdictions.

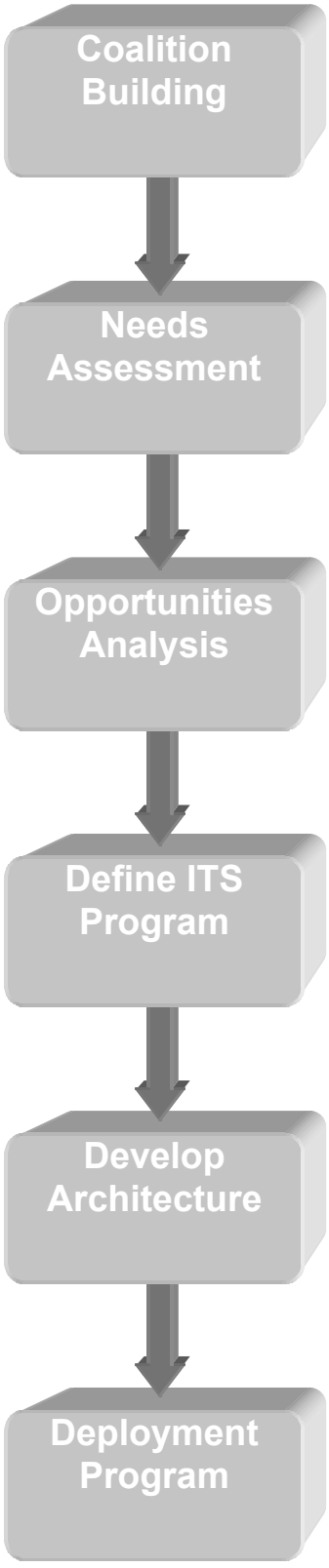
The vision and objectives of the Calgary ITS Strategic Plan are aligned with the Calgary Transportation Plan. The goals of implementing ITS are closely related to the goals of the Calgary Transportation Plan. These aligned goals include:

- Safety for the travelling public.
- Choice between modes of travel.
- Accessibility to all citizens.
- Facilitate the movements of goods and services.
- Respect the Environment.
- User pay.

ITS is one set of tools to address the priorities set out in the Calgary Transportation plan.

4.0 Calgary Region Strategic Planning Process

An ITS Strategic Plan is a roadmap that sets the direction, and priorities of ITS investments in an area over a relatively long term period in a coordinated and focused manner. It clearly defines the ultimate goal and the steps required to achieve it. The development of a strategic plan for the deployment of ITS technologies within the City of Calgary and the Calgary Region, which enables a seamless multi-modal transportation network, will require a well-balanced approach. Such an approach requires consensus building, recognizes all participants' needs, identifies specific benefits and generates a robust plan that lends itself to a staged implementation program. The steps undertaken in the Calgary Region Strategic Planning Process are as follows:



Determine the stakeholders that will need to be consulted through the course of the planning process. Outline and implement an outreach program to encourage active and hands-on participation of the stakeholders as well as provide educational information and opportunities for input and consensus building throughout the planning process

Develop an understanding of the current state of the regional transportation system from a multi-modal perspective, including current issues, concerns and problem areas as well as projects, proposals, strategic plans and inter-governmental agreements pertinent to transportation within the Region.

Develop an operations plan for the City of Calgary ITS Strategic Plan and the related user services identified. Review the user services and their relative priorities from an operational perspective to determine how the ITS Strategic Plan is to be deployed, operated and maintained in the short, medium and long terms within the constraints of the City of Calgary's jurisdictions and related boundaries.

Identify the various ITS components associated with each of the functional areas and those that are common to each of the functional areas identified (enabling technologies). Define sub-services providing the framework to meeting the functional requirements. Once the requirements have been developed the overall framework of the plan is presented.

Define the physical architecture that includes the communications, transportation and institutional layers. An identification will be made of all databases, internal and external interfaces, and communication requirements to support the system architecture and user services.

Provide a summary of the entire project as well as document the Deployment Plan to guide the implementation of ITS strategic projects for the various sponsoring agencies and the Action Plan for ongoing evaluation. Provide specifications for two early winner projects.(7)

Although the original intention for the Calgary ITS Strategic plan was to deliver both a logical and physical architecture within the overall strategic planning framework for the region, at the time of the request for proposals, it was determined that the logical architecture was not to be included. Significant commitment of time and resources that is required in the development of the logical architecture was not available within the fixed budget and time frame for the overall strategic plan. The logical architecture is a key part of the framework in ensuring functions and needs are adequately represented in the overall delivery of ITS initiatives. Although the development of market packages and the physical architecture also represent the functions and needs of the region, detailed dataflows, process specifications and other aspects of the logical architecture will have to be considered on a project by project basis. Ultimately, the overall strategic planning process for the Calgary Region has benefited by focusing on functions and needs as they are represented by the physical architecture as this has allowed the limited budget and timeframe to be utilized on important aspects such as needs assessment, institutional organization and program development.

5.0 KEY OUTCOMES OF THE STRATEGIC PLAN

The review and analysis of stakeholder input revealed that there are seven common themes or functional areas in the various issues and needs that were identified. These common themes or functional areas and the issues and needs that were identified are as follows:

Traveller Information

Definition:

- Collection/assembly and dissemination of information to help travellers decide when to travel, the mode to choose and the route to take. This includes information to assist travellers in planning travel both pre-trip and en-route.

Needs:

- Provide more accurate and timely information on congestion, incidents (including collisions, breakdowns, planned lane closures, etc.) and surface conditions within the Calgary Region.
- Provide information to travellers on parking conditions/availability in key areas of the City.
- Disseminate this information in a manner that is easily accessible to all road users both pre-trip and en route and maximizes use of existing infrastructure.
- Share traveller information with other agencies (e.g. Calgary Transit, National Parks, Alberta Transportation, Airport Authority, etc.) and provide convenient access to this information regardless of geographic or jurisdictional boundary.
- Reduce traffic congestion that results from construction detours or road closures.

Incident Management

Definition:

- Detection and coordination of response to planned and unplanned incidents on the transportation system. Response is through other initiatives such as Traveller Information, Traffic Control, and Fleet Management.

Needs:

- Timely detection and accurate information on incident location in order to reduce response time and incident duration.

- Update and share evacuation plans through Disaster Services on an ongoing basis so coordination at time or emergency is managed more efficiently.
- Reduce traffic congestion that results from unplanned incidents such as collisions and the ensuing collision investigation.

Traffic Control and Management

Definition:

- Changes to the system or activities that control traffic that result in improvements to the efficiency and operation of the existing surface transportation infrastructure and/or create safer conditions for travellers.

Needs:

- Improve traffic signal management capabilities through expansion of the City's traffic signal control systems. Having reliable and cost effective communications is a significant factor within the need.
- Provide traffic signal control that can automatically adapt or respond to variations in traffic conditions.
- Monitor traffic flow and conditions on a real-time basis for analytical and traveller information purposes.
- Coordinate traffic movements (both rail and vehicle) at railway crossings to reduce congestion.
- Reduce number of single occupant vehicles on the roadway (e.g., through the automated enforcement of high occupancy vehicle lanes).
- Improve safety measures for vehicles in situations where excessive speed may cause rollovers.

Parking Control and Management

Definition:

- Monitoring and management of parking facilities including monitoring of current parking availability, condition of parking equipment, on site parking guidance and sharing data with information service providers.

Needs:

- Improve management capabilities of parking facilities through monitoring and collection of information with respect to occupancy, turnover, equipment operation, revenues, snow accumulation, etc.
- Reduce hunting time for parking in the central Business District and other areas of the City.
- Improve public safety in parking lots.
- Minimize staff requirements without impacting customer service.

Transit Services

Definition:

- Anything involved in the operation and management of short distance transportation on public transit including transit priority measures and the dissemination of schedule and routing information to travellers in order to encourage people to decide to take transit, and assists in their trip planning.

Needs:

- Improve level of service and efficiency of transit service to keep up with regional growth and minimize costs.
- Improve schedule adherence and route optimization.
- Provide accurate and reliable, real-time vehicle location information (e.g., buses in the garages, C-trains in operation, etc.) to improve maintenance, dispatching, route planning, etc.
- Improve security at stations for both passengers and infrastructure.
- Continue to find efficiencies in scheduling and dispatching of units and drivers.
- Find efficiencies in fare collection.

Fleet Management

Definition:

- Tracking, routing, dispatching and other logistics associated with the movement of emergency, non-emergency (e.g. maintenance) and commercial fleet vehicles. This includes emergency response management; computer aided dispatch, tracking of emergency and non-emergency vehicles and the gathering, fusion and dissemination of weather and environmental data for the purpose of making decisions in fleet deployment and operations.

Needs:

- Improve customer and personnel safety in taxi operations.
- Improve monitoring capabilities for taxi operations.
- Improve commercial vehicle services provided by government agencies for transport and trucking industry to reduce costs and provide better compliance and operations.
- Reduce incident response time and provide opportunities for emergency services to avoid congestion or other incident sites.
- Provide information on dangerous goods movements.
- Improve existing and forecast pavement condition and atmospheric information to improve efficiency of winter operations.

Data Collection and Management

Definition:

- Archiving and sharing of both real-time and historical information between agencies to allow the functional areas listed above to work better as well as reduce the costs of data collection for other analytical or management purposes the City conducts on a regular basis. This functional area is fundamental to the ITS Strategic Plan and one that is considered to be inextricably linked to all of the functional areas identified above, especially Traveller Information.

Needs:

- Improve operational efficiencies through frequent updating of databases and electronic sharing of data between agencies.
- Find efficiencies in data collection and archival.
- Improve access to historical fleet records (vehicle maintenance, inspections, driver records, etc.) by regulatory and inspection personnel to improve enforcement and safety.
- Improve synergies in the above for analytical and strategic planning purposes.(8)

The review of the ITS needs as identified from analysis of the stakeholder input has allowed the following observations:

- The primary needs of the majority of the stakeholders are in the functional areas of traveller information, traffic control & management and fleet management

- Data collection/management is a key aspect that supports the primary needs of all the functional areas. Having information available to correlate the information to an accurate and up to date GIS map base are particularly strong themes.

- Transit needs, while not specifically mentioned by many stakeholders, is seen as a key functional area due to the important role transit plays in Calgary's transportation system.

- There are specialty needs focused on incident management, and parking control and management, which appear to be less of a priority among the majority of the stakeholders. This does not lessen the importance of these needs to the individual stakeholders.

- The provision of timely and accurate information on congestion, incidents and surface conditions was consistently mentioned by many stakeholders. This need for information and the ability to have it easily accessible is a major focus of many stakeholders.

6.0 CONCLUSIONS

The areas of focus for the overall ITS strategic plan that have been identified as a results of these needs are:

- **Traveller Information Database:** The provision of a central database acting as a common repository for all traffic and traveller-related information in the City will significantly increase the amount of information available as well as ease with which it can be accessed. It will also act as a platform to enable the electronic sharing of data and information between City business units as well as with external agencies.

- **Traffic Management Centre:** Traffic control and management is one of the primary needs expressed by the various stakeholders. This will involve the use of a wide variety of elements associated with traffic monitoring and control. Traffic control must also be approached from a multi-modal and regional perspective, recognizing that strategies must be developed and implemented from a regional perspective. The Traffic Management Centre provides a focal point for traffic management decisions as well as a point of contact with other control centers within the City (e.g., Tri-Services, Roads Maintenance, Transit) through which information and strategies are jointly developed from a regional perspective.

- **Partnerships:** Development of partnerships between City Business Units as well as with outside agencies is fundamental to the ITS Strategic Plan. Partnerships will form the foundation for data sharing, joint use of infrastructure and development of close working

relationships in order to achieve a regional approach to traffic management within the Calgary Region. (8)

From a review of the stakeholders needs and the related ITS initiatives required to address them, it is clear that there are many overlapping areas of interest. This presents both challenges and opportunities since any related initiatives will required significant cooperation and collaboration between these agencies, yet it provides and opportunity for partnerships to form and share in the cost of deployment, operation and maintenance.

As with any multi-agency project or operation, one agency must take the "lead" and act as the "champion" in order to get the job done. The lead agency will lead the individual project, and take overall ownership for its successful deployment and operation. Responsibilities of the lead agency will also include facilitating supporting agencies in their contributions as well as providing for their needs. Supporting agencies are the stakeholders that have an interest in this functional area, should be involved in its development and are potential partners in its deployment and operation. They are agencies that will either make functional contributions to the development and operation and/or make use of the service that is ultimately provided.(8)

Ultimate delivery and ongoing championship of the overall ITS Strategic Plan is important. The planning of such initiatives is not complete when the Strategic Plan is complete. The delivery and operation in a strategic and efficient manner requires the blending of planning and design/deployment initiatives to ensure the continued development of services and functions that meet the needs of the stakeholders. With the rate that technical developments are being achieved in the ITS industry, the technological issues associated with meeting stakeholders needs are not difficult. The institutional issues such as who will ultimately design the systems and deliver the functions required are more significant. Along with identification of lead and supporting agencies, within the institutional structure, an overall ITS Champion should be identified. This entity, be it an individual, a business unit, or an operating committee of general managers, will function to ensure the ongoing success and integration of ITS initiatives throughout the region.

7.0 REFERENCES

(1) City of Calgary, "Looking Ahead, Moving Forward - Council's Priorities 2002-2004", City of Calgary, 2002.

(2) Tarnoff, Phil, "Interoperability: System Architectures and Standards", Module No. 5, CITE On-line courses, Consortium for ITS Training and Education, www.cite.org, 2002.

(3) Martin, E. Wainright, et al, "Managing Information Technology, What Managers Need to
rd Edition, Prentice-Hall, New Jersey, 1999.

(4) Transport Canada, "Intelligent Transportation Systems Architecture for Canada", Transport Canada, TP 13666E, September 2000.

(5) Transport Canada, “Development of a Canadian Architecture for Intelligent Transportation Systems (ITS) – Preliminary Outcomes”, Transport Canada, www.its-sti-gc.ca, 2000.

(6) City of Calgary, “Calgary Transportation Plan”, City of Calgary, 1995.

(7) City of Calgary, “Workplan, ITS Strategic Plan”, City of Calgary, www.calgary.ca/transportation/its, 2002.

(8) City of Calgary, “Stakeholder Consultation Workbook, Workshop No. 3, ITS Strategic Plan”, City of Calgary, www.calgary.ca/transportation/its, 2003.