SMART COMMERCIAL CORRIDORS

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ABSTRACT

Freight movement in urban areas, has long been considered both an asset and an impediment. While trade and commerce are vital for the financial development of Canada, high volumes of heavy truck traffic introduce a considerable strain on urban traffic management. This phenomenon is very prominent in the Metro Vancouver area, which features numerous marine and rail intermodal terminals highly occupied with Asia-Pacific goods movement. Heavy truck traffic associated with the Asia Pacific Gateway is anticipated to increase significantly over the next 10 years.

In order to better cope with this trend, TransLink, in collaboration with Transport Canada, the BC Ministry of Transportation and Infrastructure, and Port Metro Vancouver commissioned a study to improve the movement of Asia Pacific goods along the region's major road corridors through the inclusion of technology. The purpose of the study was to devise a strategy for Intelligent Transportation Systems (ITS) implementation to improve the efficiency, safety and security of truck-related goods movement in the region by defining and planning the creation of "Smart Corridors".

These "Smart Corridors" will facilitate the transportation of goods between various regional points of entry and major destinations (such as inter-modal yards and logistics centres) in the Metro Vancouver area, and serve to alleviate existing and future issues related to commercial goods movement, as well as its effect on general purpose traffic.

The study included identification of candidate applications and technologies and the formation of a staged implementation schedule by considering prioritization of corridors and ITS technologies, focusing on the most urgent needs in the most troubled areas and corridors, while considering various organizational issues and the stakeholders affected.

SMART COMMERCIAL CORRIDORS

1.0 INTRODUCTION

The Metro Vancouver area and more specifically Port Metro Vancouver serves as a key hub in Canada's Pacific Gateway. Changing trade patterns associated with emerging markets are predicted to result in significant growth in goods movement. More specifically, container cargo through British Columbia ports is expected to increase by up to 300 percent by 2020 [1]. The changing patterns and increases in trade are also seeing significant changes in the way business is being conducted and the subsequent need for rapid, seamless and secure movement of goods around the world in global transport and supply chains.

Although BC ports are increasing throughput capacity, corresponding increases in the capacity and efficiency of the supporting transportation network is essential to maintain the flow of goods between North America and the Asia Pacific region. When combined with the transportation demands of daily commuter traffic, the unprecedented increases in freight movement through Canada's west coast is stretching existing transportation infrastructure to the limit. It is estimated that the cost of congestion exceeds $ 1.5 billion annually [2] which affects goods movement in and out of the Metro Vancouver area and the economic competitiveness of the region.

The objective of the Smart Corridor Strategy is to develop a long term plan that identifies the corridors and ITS applications that will improve the efficiency, safety and security of goods movement across multiple transportation modes and agencies within the Metro Vancouver area. The focus of the strategy is to facilitate the movement of goods to and from the ports of entry, logistics centres, inter-modal yards, and other freight related major destination points through a multi-phased deployment of ITS technologies within major regional road corridors.

The application of ITS technologies to goods movement and the potential benefits in terms of improved safety and efficiency are obvious when one considers the more traditional ITS areas of traffic management and traveller information. Improved signal coordination, truck signal priority, dissemination of traveller information, and incident management are just a few of the applications that will help to improve goods movement throughout the regional road network from an operational perspective. The multi-agency and multi-modal aspects specific to goods movement must also be considered with respect to how technology can be applied to streamline processes in the supply chain that will also result in the improved efficiency and security of freight transport. This may include consideration of tracking and identification technologies and the electronic sharing of information between agencies and organizations.

2.0 PROBLEM DEFINITION

To define the current situation and associated problems in the Metro Vancouver regional road network, several systematic steps need to be taken with the first being the identification of the major transportation corridors used by commercial vehicles. Next, a list of objectives will be drawn to assist in defining the desired performance of the major corridors. This is followed by a focussed assessment of the needs and issues specific to each major corridor and specifically the various associated supply chain processes. Finally, technology related solutions can be defined to address the identified issues and therefore improve the performance of the corridor.

2.1 Inventory of Corridors

To begin the process of identifying corridors that will serve as candidates for the Smart Corridors Strategy, it was first necessary to identify the major routes used by commercial transportation throughout the region. This process involved identifying various components and characteristics for truck freight, such as road types, generators and attractors, and current and future forecasted truck volumes.

After reviewing the key elements of the provincial highway system, the Major Road Network (non provincial routes of regional significance), and several major municipal truck routes, a comprehensive truck route map was created for the Metro Vancouver Region. Numerous points such as marine terminals, inter-modal yards, and logistic centres were identified throughout the region as the key truck traffic generators / attractors and the associated truck traffic volumes were estimated for existing conditions (based on a 2006 report prepared for Transport Canada) and for future 2021 conditions.

Heavy truck volumes from screenline counts at various points in the region were obtained from Transport Canada and supplemented with counts at several key river crossings to establish an estimated distribution of heavy truck trips on the Metro Vancouver regional road network. The basis for the distribution was derived using the regional travel demand forecasting model which incorporates the regional truck model.

The regional travel demand forecasting model also provided predicted distribution maps following the opening and improvement of several highway facilities such as the new Golden Ears Bridge across the Fraser River and the projects associated with the Provincial Gateway Program (Port Mann / Highway 1, North Fraser Perimeter Road, and South Fraser Perimeter Road). The final result of this analysis was the identification of approximately 120 potential corridor segments including almost all provincial roads and significant sections of the Major Road Network.

Definition of the Smart Corridor network topology followed, which served to prioritize and classify the many potential road segments and to facilitate the development and assessment of a candidate list of Smart Corridors.

The following topology components were devised:

- Primary Corridors – interprovincial and international access, high truck volumes;
- Distribution Corridors – connecting inter-modal terminals, connecting primary corridors, high truck volumes;
- Connector Corridors – connecting primary and distribution corridors to terminals, moderate truck volumes.

The following combinations of route segments were identified under these corridor classes:

Primary Corridors

- Highway 1 corridor – Highway 1 from Highway 11 to Main Street, District of North Vancouver;
- Highway 99 / 91 corridor – Highway 99 from Oak Street Bridge to 8th Avenue in Surrey; Highway 91, Knight Street from Highway 91 north; Clark Street from Knight Street north; Highway 15 from 8th Avenue in Surrey to the US border.

Distribution Corridors

- North Fraser corridor - Lougheed Highway / Mary Hill Bypass between Maple Ridge and Coquitlam, Front Street / Stewardson Way and 10 Avenue / Southridge Drive in New Westminster, Marine Way through Burnaby, and Marine Drive through Vancouver and extending to Vancouver International Airport;
- South Fraser corridor – Highway 17, River Road in Delta, South Fraser Way, Nordel Way and 88^{th} Avenue / 96^{th} Avenue in Surrey. Future expansion will include South Fraser Perimeter Road and connection to Golden Ears Bridge;
- Highway 10 corridor – Highway 10 from Highway 1 to Highway 91.

Connector Corridors

- This class includes many highways and municipal arterials connecting higher class corridors or terminals such as Highway 11, Highway 7, Highway 13, Highway 15, 200^{th} Street, and Scott Road in Surrey, and many more.

The three classes of corridors and their relative locations to the key Asia Pacific goods movement generators are illustrated in **Figure 1**.

The two Primary Corridors and the three Distribution Corridors were subsequently short-listed as the candidates for the Smart Corridor Strategy based on their respective attributes including classification, connectivity and access, and truck volumes. The route segments included in each of these corridors were also rationalized and modified as necessary with additional segments. One such modification was the inclusion of Highway 17 as part of the Highway 99 / 91 corridor, due to this segment being a connector to the Roberts Bank marine terminal.

2.2 Define Corridor Objectives

The overall goal of the Smart Corridor Strategy is to provide a roadmap of advanced technology solutions that will support economic growth in the region by improving the transportation of Asia Pacific related goods by trucks to and from various ports, terminals, and logistics centres in the Metro Vancouver area.

To assess any potential improvement of goods movement, the short-listed candidate Smart Corridors were evaluated using objectives which are measureable, quantifiable, and comparable. In later stages of the study, current issues related to each objective were analyzed and assessed into specific corridor needs. Those needs were later addressed by considering technology solutions which will serve to contribute to the achievement of the defined objectives.

For the purposes of this study, each corridor or corridor segment encompasses two end points and a connecting transportation link. The link is naturally a roadway and the end points were defined as any of the following:

- Port of Entry (e.g. international border crossing);
- Inter-modal terminal (e.g. CN and CP);
- Vancouver International Airport (YVR);
- Marine terminal (e.g. Centerm, Vanterm, and Deltaport);
- Regional point of entry (e.g. Tsawwassen Ferry Terminal).

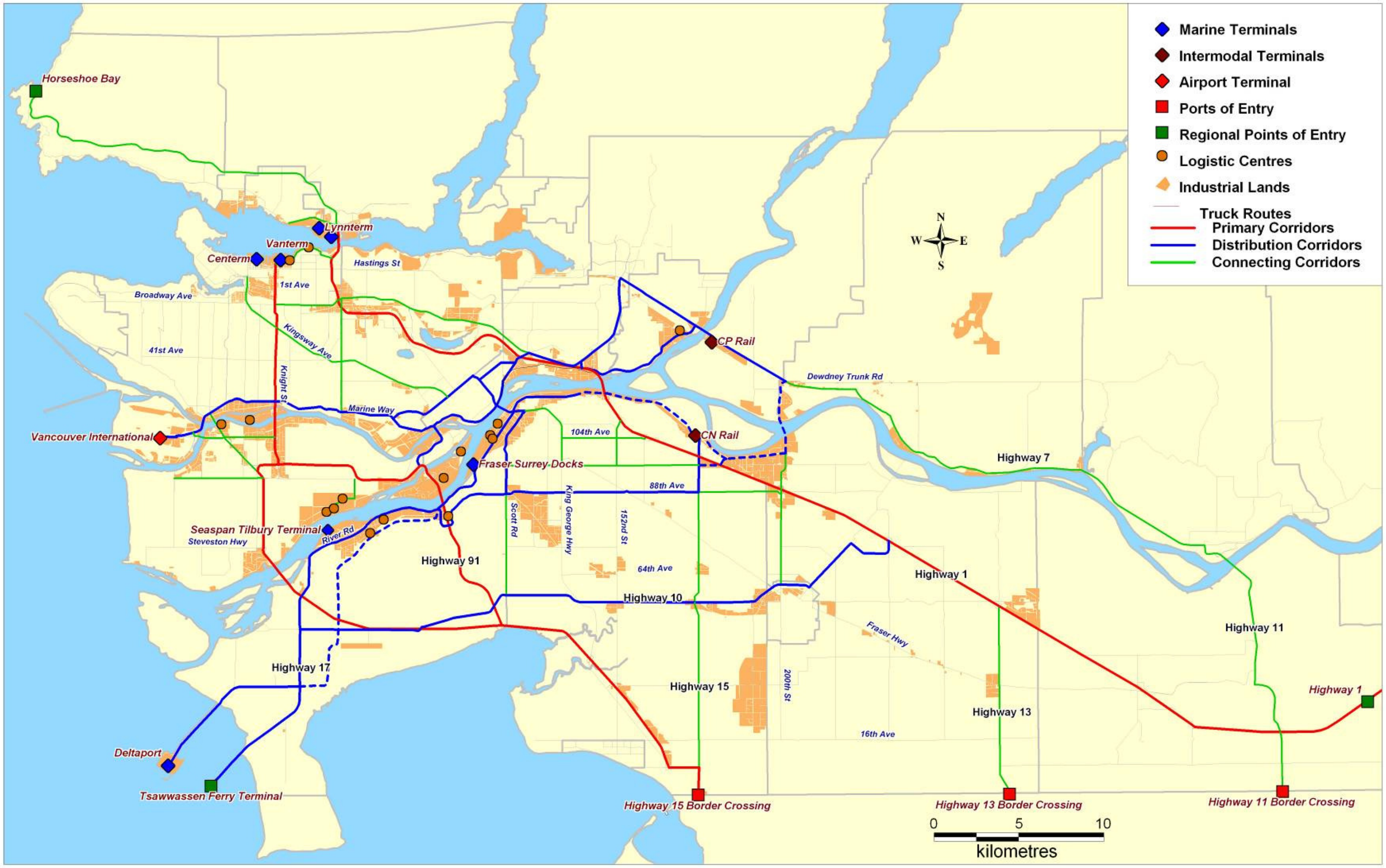


Figure 1 – Smart Corridors Network Topology

The fundamental corridor objectives are defined under the following headings:

- Efficiency;
- Service;
- Safety;
- Security;
- Environment;
- Corridor Capacity.

The corridor objectives include the objectives for each specific component of the corridor, which vary widely based on the type and function of the component. The following Table 1 provides a sample of the objective and corridor information which was developed for all six fundamental corridor objectives and all five of the Smart Corridor candidates.

Table 1 – Corridor Objectives

CORRIDOR COMPONENT	OBJECTIVES		
	Efficiency	Service	Security
Port of Entry	• Support customs and international trade responsibilities	• Improve information dissemination related to delays	• Reduce vulnerability of terminals / port facilities to hostile acts • Support customs and international trade responsibilities
Transportation Link	• Achieve satisfactory travel time along entire corridor (Peak periods and non peak periods) • Minimize stoppages	• Achieve satisfactory variance in travel time and improve predictability of travel (Peak periods and non peak periods) • Improve trip planning capabilities (access to information)	• Reduce vulnerability of key segments of corridor (e.g. Port Mann Bridge) • Support customs and international trade responsibilities
Marine Terminal	• Improve process times	• Improve access to information and dissemination to users	• Reduce vulnerability of terminals / port facilities to hostile acts • Support customs and international trade responsibilities

2.3 Needs Assessment

Following the identification of the short-listed candidate corridors and the associated corridor objectives, a detailed analysis was conducted on the various freight movement processes involved within the corridors as related to Asia-Pacific goods movement in the Metro Vancouver area.

The product of this analysis was a list of issues and needs for each corridor and each fundamental objective that served as the basis for the introduction of ITS-based solutions, applications, and initiatives that comprise the framework in developing the Smart Corridor Strategy. Further issues were also identified through consultation with several key stakeholders involved in the Asia Pacific supply chain in the Metro Vancouver region.

Corridor Processes

A review was conducted covering processes that form part of the supply chain of goods movement in the region, such as marine terminals, distribution hubs, empty container storage facilities, trans-load facilities, rail intermodal terminals, and other logistics centres, as well as to points beyond the region.

The processes were identified and detailed in order to pinpoint deficiencies in the movement of container freight per the aforementioned objectives. The various processes involve people, systems, authorities, facilities, programs, and initiatives that directly affect or are involved in the movement of freight through the five candidate corridors. The responsible agencies and authorities for the component processes were also identified and noted.

The processes were associated to one of three components - driver, vehicle, and cargo. An example at a marine terminal is provided below to summarize how the processes for these components were described:

Driver:
- Driving the vehicle.
- Interaction with officials to achieve access to facilities.
- Providing information of the freight such as content, origin, and destination.

Truck:
- License plate recording and verification of registration and insurance.
- Vehicle safety inspections.
- Automatic vehicle identification.

Cargo:
- Recording of container identification.
- Validation of seal and safety.
- Off-loading of container from truck or onto truck.

The processes analyzed were related to the seven key components represented within the five short listed candidate corridors:

- Marine Terminal – Port Metro Vancouver / Terminal Operators;
- Corridor Link – Municipalities / BCMoT (Public Sector);
- Intermodal Terminal – CP Rail or CN Rail Facility;
- Airport – Vancouver International Airport (YVR);
- International Port of Entry – Pacific Border Crossing;
- Regional Point of Entry – BC Ferry Terminal (Tsawwassen);
- Logistics Centre – Private Industries.

An example of one of the processes, corridor link, can be found in **Figure 2** below.

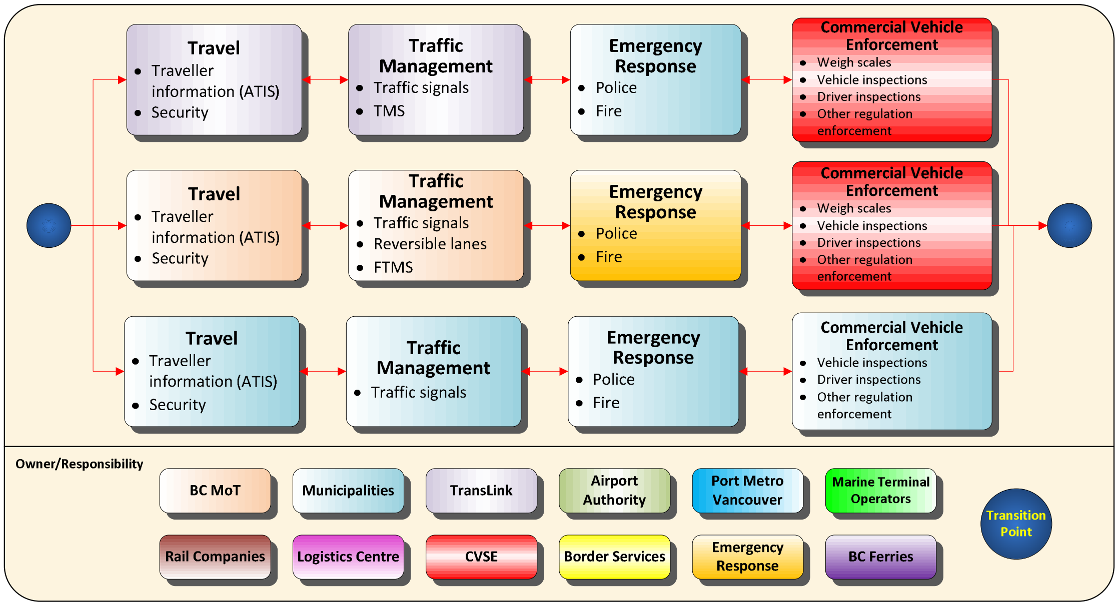


Figure 2 – Corridor Link Processes

Predominant Issues

Several predominant issues that were identified in the analysis and which merited specific attention in the subsequent study stages are:

- Port Reservation System;
- Corridor Traffic Congestion;
- Marine Terminal Inefficiencies;
- Hazardous Material Routing;
- Delays at International Border Crossings;
- Status of Terminals;
- Status of Ferry Terminal;
- Incident Related Delays;
- Traffic Signal Delays.

3.0 PROPOSED SOLUTIONS

Following the detailed definition of specific corridor needs, the study proposed the means to address them through the development of the Smart Corridor Strategy. This strategy identified the numerous projects, systems, and initiatives to be implemented on the candidate corridors. The strategy also covers detailed implementation considerations and the proposed timeframe for a gradual integration of the strategy components.

3.1 The Smart Corridors Strategy

The needs and issues identified in the previous stage of the study, and especially the predominant issues, established the starting point for a more in-depth analysis as to their root causes. This understanding of the issues / needs permitted the identification of solutions and the foundational work in developing the Smart Corridor Strategy.

Needs Summary

Using the issues identified, further research was performed to isolate the specific causes and influences that govern these issues. As this study was not intended to provide recommendations regarding significant civil infrastructure changes or improvements, the analysis focused on the use of transportation related technologies and information systems to mitigate the issues and / or address the needs.

As such, needs and issues were analyzed with the mindset of 'what information, direction, or traffic control can be provided to address the need'. This led to two major categories of needs / issues:

- Information needs / issues – may be addressed by promoting the gathering and distribution of information to users or stakeholders.
- Location specific needs / issues – may be addressed by the local utilization of roadway technology.

Interaction Needs and Information Flows

In order to properly assess and evaluate suitable solutions to information needs / issues, they were translated into information flows, which allowed identification of information elements and the interactions between the various users, agencies, and stakeholders that comprised the need / issue.

The next step was to obtain a better picture of the current availability and flow of transportation related information throughout the region. This analysis focused on information relevant to the short-listed candidate corridors and the corridor processes previously identified. Significant information was found to be available through many agencies and stakeholders, however, this information was not widely disseminated. Other information elements were not available, and were documented as 'required'.

Perhaps the primary conclusion of this process was that information flows need much improvement to facilitate efficient and productive interaction between the numerous agencies, stakeholders, and users in the region. The concept of the 'Traffic Data Hub' was thus introduced, as a conceptual approach to the collection and dissemination of available and required transportation related information.

The basic concept of the hub is that instead of focusing on specific corridors, individual needs and point-to-point information flows, a more broad-minded approach is recommended, which includes streaming of information to a central repository(ies), allowing outward flow of information wherever and whenever it is required. A graphic showing the interaction of information flows between the various agencies is shown in **Figure 3**.

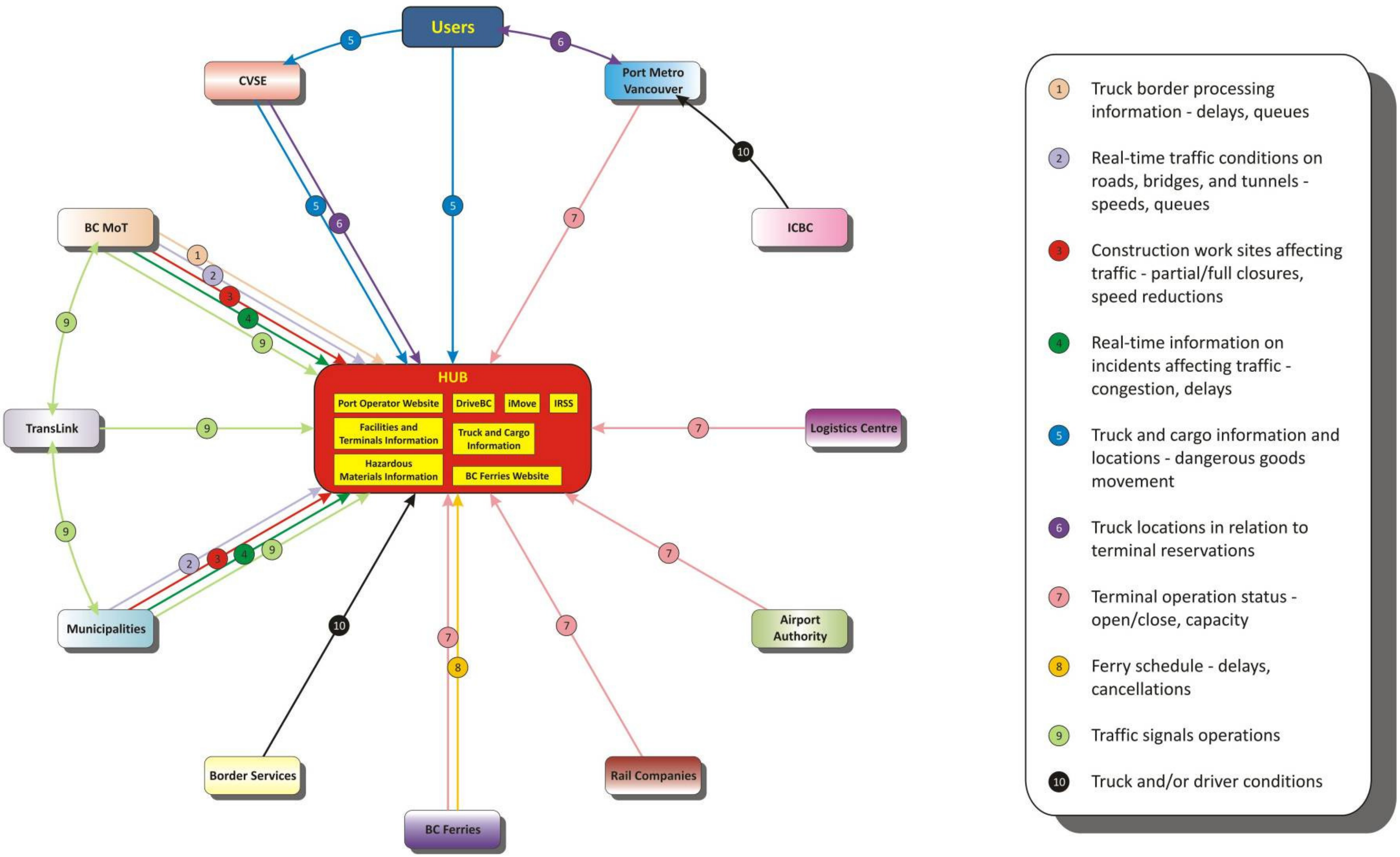


Figure 3 – Smart Corridors Needs Relationship

Candidate Integrated Solutions

The need / flows identified were addressed by proposing solutions that include the implementation of ITS technologies and applications with the purpose of improving the corridor processes and contributing to the corridor objectives.

For information needs / flows, this process is corridor-neutral, as the needs often extend beyond a single corridor. The integrated solutions are described at a high level with emphasis on basic operation and functionality, and also include the Canadian ITS Architecture Market Packages that correspond to these solutions, grouped under User Services categories. The following Table 2 details the solutions related to the information flows, colour coded to correspond to the information flows illustrated in **Figure 3**.

Table 2 – Addressing Information Needs / Flows

No.	Needs / Flows	Integrated Solution	User Services / Market Packages
1	Delays at borders, specific to trucks	• Measure border processing delays for trucks and relay the information to users using mobile applications or roadway equipment. • Measure border queues (for trucks if separate lane exists) and relay the information to users using mobile applications or roadway equipment.	**Traveller Information** • ATIS1 – Broadcast Traveller Information **Route Guidance and Navigation** • ATIS9 – In-Vehicle Signing **Traffic Control** • ATMS02 – Probe-Based Flow Monitoring • ATMS06 – Traffic Information Dissemination
2	Congestion and delays on highways and bridges (Real time traffic conditions)	• Measure average speeds on highways and bridges and relay the information to users using mobile applications or roadway equipment. • Measure vehicle queues on major routes and relay the information to users using mobile applications or roadway equipment.	**Traveller Information** • ATIS1 – Broadcast traveller information **Route Guidance and Navigation** • ATIS4 – Dynamic Route Guidance • ATIS9 – In-Vehicle Signing **Traffic Control** • ATMS02 – Probe-Based Flow Monitoring • ATMS04 – Highway Control • ATMS06 – Traffic Information Dissemination • ATMS07 – Regional Traffic Control
3	Planned and incidental construction work and other road conditions affecting traffic	• Gather construction site and road conditions information and relay to users for pre-trip on en-route planning.	**Traveller Information** • ATIS1 – Broadcast Traveller Information **Route Guidance and Navigation** • ATIS4 – Dynamic Route Guidance
4	Congestion and delays due to incidents (accidents and / or other events affecting traffic)	• Rapid detection of road incidents to assist in timely response and deployment of emergency services.	**Traffic Control** • ATMS06 – Traffic Information Dissemination • ATMS07 – Regional Traffic Control **Incident Management** • ATMS08 – Incident risk Prediction System **Emergency Vehicle Management** • EM1 – Emergency Response Management • EM2 – Emergency Vehicle Routing

No.	Needs / Flows	Integrated Solution	User Services / Market Packages
5	Location and movement of dangerous goods	• Track truck movement in the region through various systems and consolidate the information in a centralized system (e.g. for Emergency Response use) • Electronic manifest information gathering and dissemination (new Hazmat Registration System) • Provide users with optimal time-based routing of the transport of dangerous goods based on risk to population and environment.	**Traffic Control** • ATMS02 – Probe-Based Flow Monitoring **Commercial Fleet Management** • CVO02 – Freight Administration **Commercial Vehicle Electronic Clearance** • CVO03 – Electronic Clearance **Hazardous Materials Planning, and Incident Response** • CVO10 – Hazardous Materials Planning and Incident Response
6	Truck routing in relation to terminal reservations (early arrival, no reservation)	• Detect and identify trucks en-route to terminal, notify users of expected terminal clearance process and divert to staging areas, if necessary.	**Traveller Information** • ATIS2 – Interactive Traveller Information **Route Guidance and Navigation** • ATIS9 – In-Vehicle Signing **Commercial Vehicle Electronic Clearance** • CVO03 – Electronic Clearance **Intermodal Freight Management** • CVO12 – Freight Terminal Management
7	Terminal operation status (to avoid redundant travel due to terminal closures)	• Relay terminal operation status to users using mobile applications or roadway equipment	**Traveller Information** • ATIS1 – Broadcast Traveller Information **Route Guidance and Navigation** • ATIS9 – In-Vehicle Signing **Traffic Control** • ATMS06 – Traffic Information Dissemination **Intermodal Freight Management** • CVO12 – Freight Terminal Management
8	Ferry schedule (to avoid unexpected waiting times due to ferry delays)	• Relay ferry arrival/departure updates to users using mobile applications or roadway equipment	**Traveller Information** • ATIS1 – Broadcast Traveller Information **Route Guidance and Navigation** • ATIS9 – In-Vehicle Signing **Traffic Control** • ATMS06 – Traffic Information Dissemination **En-route Transit Information** • APTS1 – Transit Vehicle Tracking
9	Traffic signals operations	• Enhance IRSS deployment	**Traffic Control** • ATMS03 – Surface Street Control • ATMS07 – Regional Traffic Control
10	Truck conditions and driver status	• Truck conditions (CVSE) and driver status (ICBC) information dissemination to Port Metro Vancouver.	**Commercial Fleet Management** • CVO09 – CVO Fleet Maintenance

For the location specific needs, a general description was first proposed for the needs, integrated solutions, and ITS Architecture elements, followed by a detailed list of location specific solutions along the five candidate corridors. The following table details the general solutions.

Table 3 – Addressing Localized Needs

No.	Need	Integrated Solution	User Services / Market Packages
11	Reduce congestion and delays due to traffic signals	• Facilitate traffic signal priority for trucks along arterial routes where traffic signal delay is prevalent	**Traffic Control** • ATMS02 – Probe-Based Flow Monitoring • ATMS03 – Surface Street Control
12	Reduce truck travel time prolonged by stopping at weigh scales	• Expand and support deployment of Weigh-In-Motion system	**Commercial Vehicle Electronic Clearance** • CVO03 – Electronic Clearance • CVO06 – Weigh-In-Motion (WIM)
13	Reduce truck incidents due to inappropriate speeds at specific locations (e.g. interchange ramps)	• Detect dynamic truck characteristics, and advise speed adjustment accordingly using mobile applications or roadway equipment	**Route Guidance and Navigation** • ATIS9 – In-Vehicle Signing **Automated Dynamic Warning and Enforcement** • ATMS26 – Dynamic Roadway Warning

To provide further rationale on the processes involved and the proposed solutions, a review was undertaken with respect to the influence on user behaviour, especially on the decision making processes before and during the actual trip. The issue of interoperability in the region was also addressed, stating various technical, procedural, and institutional issues that should be taken into consideration when planning the implementation of the integrated solutions and applications. The related issue of Radio Frequency Identification (RFID) interoperability is detailed below.

Automatic Vehicle Identification / RFID Interoperability

Currently, there are three types of RFID transponder tags deployed or that are planned to be deployed in the region:

- Green Light Transportation System Tags (GLTS) – based on ASTM v6 technology. These tags are CVISN compatible and used in WIM programs in the US.
- Golden Ears Bridge Tolling System Tags – based on Caltrans (California Department of Transportation) Title 21 technology;
- Port Mann / Highway 1 Tolling System – required to be interoperable with the Golden Ears Bridge Tolling System (Caltrans Title 21);
- Port Metro Vancouver EchoPoint Tags – based on ISO18000-7 technology.

The technical interoperability between the Golden Ears Bridge and the Port Mann / Highway 1 Tolling Systems can increase the efficiency of toll operations in the region by allowing, for instance, joint collection and back office services (one transponder, one invoice). This depends, of course, on agency cooperation and mutually beneficial financial agreements.

The BC MoT Green Light Transportation System transponders are not currently compatible with the aforementioned tolling systems, so a truck equipped with a GLTS tag will need to install another tag to benefit from the lower tag toll rates. This situation may change in the future, as the technology exists to integrate these two applications by using multi-protocol readers. Using these types of readers can allow 'Green Light' transponders to be utilized by the Golden Ears Bridge Tolling System, and vice-versa, following proper registration and procedures.

While this is not yet the case, it is constructive to strive towards the goal that any future project intending to use Automatic Vehicle Identification (AVI) in the Metro Vancouver area investigates the option to use the Green Light Program tags, the tolling system tags for the Golden Ears Bridge, or RFID tags compatible with either system. This may support interoperability at a later stage with minimal technical issues.

Common Practice

To provide a level of validity to the integrated solutions being considered, a review of several ITS applications in North America currently being used to improve the movement of goods was assessed. The examples provided in the study included applications which facilitate Traffic Management Services, Commercial Vehicle Operations, and Emergency Management Services and bear a similarity to some of the applications proposed in the integrated solutions review.

Existing Applications

As previously mentioned, many ITS applications and information sources already exist in the region. A review of these applications under the jurisdiction of various agencies was included, with a general description of the information available and level of dissemination for each application. The review indicated that although much information exists, there is considerable room for improvement and promotion of further regional integration.

Smart Corridor Strategy

The next stage of the study included the foundation for the Smart Corridors Strategy, detailing the corridor specific integrated solutions. The solutions were based on addressing the specific needs and the generally described initiatives proposed in Tables 2 and 3 above.

The following table, **Table 4**, includes an extract from the complete list of integrated solutions, sorted by corridor and associated market package. The need notation correlates to the Need Number referenced in **Tables 2** and **3**.

Table 4 – Smart Corridors Strategy

Market Package	Candidate Corridor	
	Highway 1	Highway 99/91
Traveller Information Services		
ATIS2 – Interactive Traveller Information	Dynamic Information for En-Route Trucks (Need 6)	Dynamic Information for En-Route Trucks (Need 6)
ATIS4 – Dynamic Route Guidance	Traffic Conditions (Need 2) Regional Road Conditions (Need 3)	Traffic Conditions (Need 2) Regional Road Conditions (Need 3)
Traffic Management Services		
ATMS02 – Probe-Based Flow Monitoring	Border Delay Information (Need 1) Traffic Conditions (Need 2) Traffic Signal Priority for Trucks (Need 11) Hazardous Materials Routing (Need 5)	Border Delay Information (Need 1) Traffic Conditions (Need 2) Traffic Signal Priority for Trucks (Need 11) Hazardous Materials Routing (Need 5)
ATMS06 – Traffic Information Dissemination	Border Delay Information (Need 1) Traffic Conditions (Need 2) Incident Management (Need 4) Dynamic Information for En-Route Trucks (Need 6) Terminal Operational Status (Need 7) Ferry and Ferry Terminal Status (Need 8)	Border Delay Information (Need 1) Traffic Conditions (Need 2) Incident Management (Need 4) Dynamic Information for En-Route Trucks (Need 6) Terminal Operational Status (Need 7) Ferry and Ferry Terminal Status (Need 8)
ATMS07 – Regional Traffic Control	Traffic Conditions (Need 2) Incident Management (Need 4)	Traffic Conditions (Need 2) Incident Management (Need 4)
ATMS08 – Incident risk Prediction System	Incident Management (Need 4)	Incident Management (Need 4)
ATMS26 – Dynamic Roadway Warning		Truck Safety Improvement (Need 13)
Commercial Vehicle Operations		
CVO03 – Electronic Clearance	Dynamic Information for En-Route Trucks (Need 6) Hazardous Materials Routing (Need 5) Green Light program (need 12)	Dynamic Information for En-Route Trucks (Need 6) Hazardous Materials Routing (Need 5) Green Light program (need 12)
CVO06 – Weigh-In-Motion (WIM)	Green Light program (need 12)	Green Light program (need 12)

The initiatives marked by green text in the table represent regional initiatives, which apply to all corridors.

It is evident from the sample table that the many of the needs apply almost identically to both corridors, which is not surprising, as most objectives and many needs are common to more than one corridor. The implementation strategy however, may differ significantly between the candidate corridors noting that different systems exist, are planned to be installed, or are proposed here on a local or even corridor scale, but not at a regional scale. The recommended efforts to integrate systems and to seek a high level of interoperability will result in combining systems over different corridors and / or involving different stakeholders, thus improving overall performance especially at the regional level.

3.2 Implementation Guidelines

Integrating with Existing or Planned Implementations

It is always beneficial to not try to "reinvent wheel" when implementing a new system or systems. For example, if a similar application already exists in the region, and there are advantages to integration with this system, it may be better to expand it into a new area or deploy an equivalent system that will later integrate with the first to increase the value of both (e.g. existing detection systems).

Likewise, if a future application is already planned to be deployed and there is an opportunity to combine the process of implementation with another planned system (or an extension to an existing system), the overall process can be even more efficient.

The "Traffic Data Hub" Concept

The "Traffic Data Hub" concept was presented as a more efficient method for gathering and disseminating information amongst the many agencies and users. The basic premise of this concept is to share information by making it available without the need to consider if it is required at a certain time or by a specific stakeholder. This can be performed by sending the information (real time or statistical) to a "repository" that can store the information and make it available to others. The repository can be part of the same system, such as a web site with external access, or a separate server designed for that purpose.

This concept supports both the known information needs and flows as well as future ones, since it is reasonable to assume that once it is made known that the information is available, additional agencies or stakeholders will desire access to it.

Leveraging Fielded Applications

It was mentioned earlier in this document that vehicle AVI / AVL is one of the most effective types of information for ITS implementations. In addition to the actual location of specific vehicles, it can be used for link speed calculations, occupancy, and capacity information, traffic signal priority, freight tracking, and other applications.

While AVI can be performed passively, by computer vision techniques, pavement sensory, and plate number reading, it can be much more efficient if it were possible to use existing vehicle transponders previously (or planned) deployed for other applications.

If previously (or planned) deployed transponders were used, the deployment time of a new system can be greatly reduced, as there is already an established base of probe-enabled vehicles that can quickly begin "activation" of the new system. The most relevant example to this is the forthcoming Green Light program, which will initially include deployment of truck transponders for trucking companies in British Columbia. By installing a new system benefiting truck drivers or commercial vehicle operations using these transponders, further incentives will be created for increasing the deployment of the Green Light program transponders, since drivers not registered initially will see the advantage of registration to benefit from the new system(s).

3.3 Implementation Timeframe

The recommended integrated solutions were classified in three categories with regard to the implementation timeframe – short, medium, and long-term.

- Short-Term Projects - to be implemented in the first two years of the strategy;
- Medium-Term Projects – to be implemented between years two and five;
- Long-Term Projects – to be implemented between years five and ten.

Several corridors, Highway 1 and the South Fraser corridor, were de-prioritized since both are scheduled to undergo substantial improvements in the next five years as part of the Provincial Gateway Program. The various parts of this program will include significant construction work on the highways as well as installation of ITS applications to address various transportation issues.

As one of the goals of the Smart Corridors Strategy is to promote integration and interoperability between various ITS applications throughout the region, it is reasonable for any ITS initiative or proposed system to be reviewed and examined in conjunction with existing or planned applications on the candidate corridors. Thus the priority of the Highway 1 and South Fraser corridors was reduced in terms of the implementation of any ITS applications with the various recommended integrated solutions for these corridors categorized mostly in the long-term timeframe.

Other implementation considerations were related to regional initiatives, such as the Regional Transportation Management Centre (RTMC). During the development of the Smart Corridors Matrix and the examination of the various corridor needs and issues, it was postulated that a majority of the information flows between the various agencies and stakeholders could be made more efficient by using the ‘Traffic Data Hub’ that will serve as a central nexus of information.

While it is technologically possible to realize this concept using data links and IT interfaces, it only seems natural that the hub be part of this RTMC especially when there is a current initiative to establish a facility. Furthermore, the centre could serve not only to collect and distribute the vast traffic information available (now and in the future) but also to store, archive, process, and utilize the information for various management uses.

Several initiatives that are proposed in the Smart Corridor Strategy would benefit greatly if they were to be implemented following the completion of the RTMC. For example, any application that is regional in nature or that is dependent on automatic interfaces between different agencies will be implemented much more efficiently if it is integrated with the RTMC. Since the implementation of a RTMC is still many years away, several initiatives with a strong affiliation for automation and traffic data / information sharing were set to the medium-term or long-term timeframes.

4.0 BENEFIT- COST ANALYSIS

The intent of the benefit-cost analysis for a proposed application is to evaluate the present value of benefits arising from the implementation of the application relative to the estimated cost of implementation. A benefit-cost ratio greater than 1.0 for a proposed application generally indicates that the quantifiable benefits exceed the estimated cost of implementation.

A review of the potential benefits expected to arise from several proposed initiatives that were previously consulted as potential Pilot Project candidates was conducted. The Smart Corridor Strategy Pilot Projects include:

- The Roberts Bank truck management system
- The Burrard Inlet South Shore Port truck management system
- Traveller information for Fraser River crossings
- US Border Crossing information for trucks
- Regional terminal status information

In conducting the analysis of the benefits, many assumptions had to be made in order to quantify the potential benefits, for example:

- The Implementation of the application be in 2009/2010
- The amortization period be 10 years
- The annual discount rate be %6
- The on-going operations of terminals be 5 days a week (50 weeks per year)
- The estimated value of time for heavy trucks (Containers) be $46.94 (BC MoT Guidelines)
- The estimated operating costs for heavy trucks be $0.50/km

In addition, sensitivity analysis was conducted for each Pilot Project candidate.

The Roberts Bank truck management system was selected as a relevant example to demonstrate the potential benefits given the lower implementation costs and duration, and anticipated project benefits.

<u>The Roberts Bank Truck Management System benefit cost analysis:</u>

The implementation costs for this initiative, including electronic systems, staging area construction, integration and 10 year maintenance were estimated at $4,100,000.

The potential benefits expected from the implementation are as follows:

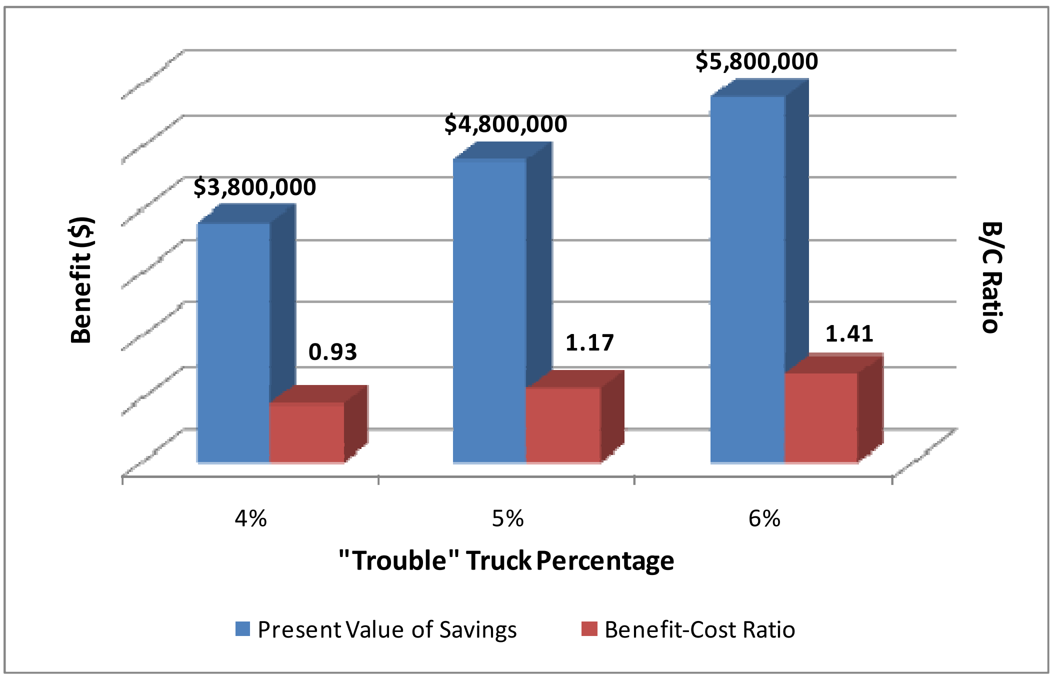
- Diverting from the main gate, trucks with no valid reservation or trucks that are early / late with respect to their reservation window, thereby eliminating redundant truck travel between the proposed staging area and the main gate.
- Provide terminal operators with real-time information on expected truck arrivals and the potential for gate queues.
- Improve enforcement by providing AVI for trucks on approach roads (by lane).
- Enable control of sequence in which trucks enter the terminal thus reducing waiting and turn-times and potentially increasing trucker satisfaction.
- Pre-clearance and AVI based processes can lead to future reduction in the main gate processing area and potentially a higher annual throughput in containers.

- Reduction of manned clearance and enforcement by facilitating automatic processes that may enable potential reduction of staff.
- Eliminate truck parking along highway shoulders and municipal roads which in turn can reduce the corresponding safety issues.

Of these potential benefits, the benefits associated with the first bullet (diverting trucks without valid reservations or trucks that are early / late for their reservation window) are the only benefits that result in direct operational cost savings. The benefit calculations for this element have therefore been conservatively based on these direct operational cost savings.

The savings were calculated to include travel distances, travel time, and processing time that are saved as a result of this implementation. The basic assumption, which was also used in the sensitivity analysis, was the percentage of "trouble" trucks to which this implementation will apply. A measure of 5% was taken as the basic assumption, with 4% and 6% also calculated as sensitivity tests.

The results are as follows:



As can be seen, the potential benefits exceed the costs resulting in a benefit to cost ratio exceeding one for the base assumption. Given the conservative nature in estimating the benefits, it can be reasonably assumed that the combined benefits (including those not quantified herein) would exceed the costs even for the low range of the sensitivity analysis.

5.0 CONCLUSIONS

The strategy composed in this study is designed to promote the facilitation of "Smart Corridors" for commercial traffic in the Metro Vancouver area. A Smart Corridor is created when Intelligent Transportation Systems and technologies are implemented and used to improve the performance of a transportation corridor and the associated processes as they relate to goods movement. Additional attributes of a Smart Corridor can include other fundamental objectives such as the improvement of service provided to stakeholders and users, reduction of environmental footprint, and increased utilization of existing corridor capacity.

The use of systems and technologies is envisioned not as individual, separate applications but as integrated components, forming complex systems, fulfilling numerous objectives, and benefiting multiple agencies, stakeholders, and users. The deeper the integration of these applications, the "smarter" the corridor, and the better the service can be provided to enhance the utilization of the road network in the region for the movement of goods.

The integration of ITS initiatives also needs to consider existing systems and components, already installed and used by various agencies. Today, many such assets are managed by individual agencies or stakeholders that form parts of the supply chain in the area. It is of the utmost importance to strive to combine existing assets and as many stakeholders as possible in this process, to improve the utilization of resources and increase efficiency of the various processes in the supply chain, that today may consider themselves independent and self-contained. The advancements in information technology today, and information safety, can assist in supporting integration of proprietary systems while maintaining data integrity and information security, which are often of concern and contribute to institutional barriers that decrease inter-agency cooperation and thus the level of desired interoperability.

The Smart Corridor Strategy follows a tiered, gradual approach for implementation of various ITS solutions and initiatives, building upon previous successes and striving to achieve and maintain inter-operability with past and future systems and technologies, leveraging existing technologies where possible. The specific initiatives proposed as part of the strategy support the establishment of new processes and to increase the exchange of information between various stakeholders and agencies with the purpose in increasing cooperation between them.

The concept of the "Traffic Data Hub" was introduced as an either virtual or actual mechanism to facilitate the information collection and dissemination. The flow of information such as facility status and schedules, real time vehicle and cargo location, and road conditions can introduce significant changes to the way users and stakeholders regard and make maximum use of the road system. It is these types of changes that can result in increased efficiency in the supply chain by eliminating redundant truck trips, reducing idling, and improving vehicle utilization.

One significant example of the required integration and interoperability was related to RFID interoperability. The use of Automatic Vehicle Identification / Localization has proven to be very useful in automation of manual processes and various initiatives or systems now employ RFID tags mounted in vehicles. As the number of such implementations increase, it is crucial to maintain compatibility between these systems to minimize the number of conflicting technologies deployed in the area and support the utilization of existing resources and leveraging of deployed systems to increase not just the quantity of information but also the quality of it.

Following the formation of the Smart Corridor Strategy, the partner agencies were confident that a strong case was made to move forward into the implementation phase with a two part pilot project to garner further support for the overall strategy. The pilot project, to be implemented in 2010, would be monitored and their benefits and overall effects measured such that this information could be used to gauge the effectiveness of Smart Corridor Strategy at the local level. Successful implementation of the pilot project and favorable results would provide the quantitative support for subsequent full-scale implementation of the Smart Corridor Strategy.

The two stages of the pilot project include:

1. Roberts Bank Truck Management System – A system that will use AVI and AVL to verify that container trucks approaching the Roberts Bank Marine Terminal ('Deltaport') have a valid reservation to enter the terminal. If the approaching container truck is early, late, or the reservation system and truck identification information is incomplete, the system will divert the truck to a staging area to reconcile any issue with the terminal operator. The system is anticipated to address several issues such as redundant trips, reduced idling, and traffic safety concerns related to truck parking on the shoulders of the adjacent municipal road network. The system will integrate with the terminal reservation system and potentially with other CVO systems, such as the Green Light Transportation System. The benefits sought from this system include reductions in truck queues and idling at the terminal gate, reduction of truck parking/idling in nearby municipalities, and reduction in redundant trips – all of which will result in the reduction in GHG emissions.

2. Traveller Information for Fraser River Crossings – A system that will measure traffic speeds, volumes and queue length for two alternative Fraser River crossings and approach roads used extensively for the movement of Asia Pacific goods. This system will provide drivers with projected travel time information for each route via dynamic message signs, the purpose of which is to balance the traffic volumes through the two crossings, and reduce congestion and overall travel times. The system will serve most useful when one route is severely congested due to incidents especially near the river crossings where they affect traffic most. The traffic information would also be disseminated through the web (TransLink's iMove site) for pre trip planning.

If the Smart Corridor pilot project is successful, it is expected that the program will serve as the basis for other deployments in Canada, eventually supporting a national initiative to support goods movement.

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