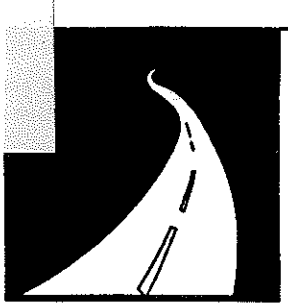


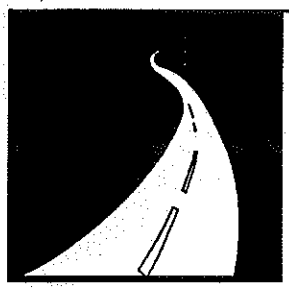
Final Report

Study of Institutional Impacts of New Technology Applications

St. Clair & Detroit Rivers Highway Border Crossings

Prepared by
Marshall Macklin Monaghan Limited
in association with
KPMG Management Consulting
JHK & Associates
Constance Consultants

May 1994



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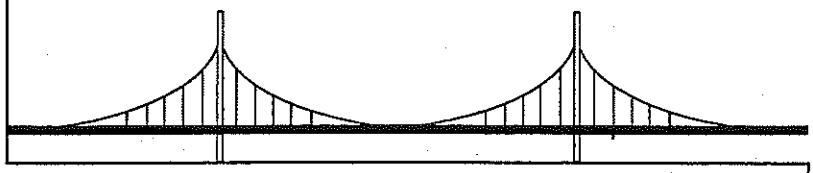

Study of Institutional Impacts of New Technology Applications

St. Clair & Detroit Rivers Highway Border Crossings

Prepared for

New Technology Committee
for the St.Clair and Detroit Rivers
Highway Border Crossings

Funded Jointly by the

Ministry of Transportation, Ontario
Michigan Department of Transportation
Transport Canada
U.S Department of Transportation-
Federal Highway Administration

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EXECUTIVE SUMMARY

ES-1 THE NEED FOR ADVANCED TECHNOLOGY

The purpose of the study was to investigate the institutional issues which related to the proposed improvements to border crossings at the three major highway crossings of the Detroit and St. Clair Rivers. The vision established for the project calls for improvements that could eventually result in a move toward a virtually seamless and transparent border for both commercial and private passenger movements.

The study deals with the Blue Water Bridge, the Ambassador Bridge and the Detroit-Windsor Tunnel. These crossings are critical links in the major highway transportation network of southern Ontario and the mid-western United States connecting major highways and interstate routes of both countries. The North American automotive industry, which is focussed along the highway corridors leading to these crossings, accounts for a major share of goods movement across the border at these crossings. Recent trends in goods movement involving "just in time delivery" and "inventory on wheels" has emphasized the importance of these crossings in minimizing traffic delays for goods movement.

Since 1984, there has been a 40 percent increase in vehicle trips, up to 2.7 million trucks, and 18.9 million passenger cars annually at these border crossings. Statistics indicate that over 25% of U.S.-Canada trade crosses between Ontario and Michigan, and over 2/3 is carried by truck. The U.S.-Canada and North American Free Trade agreements are expected to increase commercial shipments. The Windsor Casino is expected to add another 4 million annual person trips at these crossings. This growing demand when combined with increasing pressure on governments to limit the costs of all services such as customs and immigration inspections points towards the need to consider alternatives which would allow us to "do more with less".

There is a diverse group of stakeholders who have an interest in these crossings, including the five owners and operators of the three crossings, the customs and

immigration agencies of both countries and a wide range of crossing users including shippers, carriers, manufacturers, brokers and individual drivers who may be commuters or recreational users. Moreover, the economic development and trade interests of both countries are dependent upon good access across the border.

There are ongoing improvements at all of the crossings focused on improving toll collection, improving traffic operations in the plaza areas, and providing additional capacity at customs and immigration. Furthermore, there is serious consideration of twinning the Blue Water Bridge.

In addition to North American Free Trade, other government initiatives such as Customs 2000 in Canada and the U. S. Customs Modernization Act to improve customs processes are important considerations at this border. There have been a number of examples and experiments with improving the movement of goods and people across the border such as the PACE program at the Washington/British Columbia border. There are major initiatives on the part of customs in both countries to implement electronic data interchange for the road transport mode which will ease the paperwork required for customs processing at the borders. The Advantage I-75/AVION initiatives to automate truck clearance through inspection stations from Florida through Ontario will establish a market of AVI-equipped trucks which can be integrated with technology at the border. Similar initiatives are proposed in other major highway corridors near the Canada-U.S. border.

All of these initiatives and pressures point to opportunities for the application of automatic vehicle identification technologies to ease the border crossing process.

ES-2 HOW ADVANCED TECHNOLOGY WOULD WORK

Extensive discussions with users and involved participants indicated a willingness to move towards new technologies which can improve the situation at the border crossing. The technology application under consideration would include the following components:

1) Vehicles would be equipped with two-way transponders capable of communicating with antennas located in the vicinity of the border crossing. The transponders would be capable of providing identification of the driver and/or the vehicle. More sophisticated versions of the transponders could accommodate advanced applications such as details on the cargo manifest carried on commercial vehicles, or toll accounts.

2) Antennas would detect the approach of a vehicle to the toll plaza and would provide information on the identity of the vehicle or driver to the toll agencies as well as to customs and immigration.

3) The vehicle would be identified as a vehicle or driver with a toll account and could be processed directly through the toll with a charge to the toll account for the user.

4) The antenna would communicate to the driver via a visual and audible output on the in-vehicle transponder to indicate whether the toll account status would allow the vehicle to use the automated toll lane.

5) Authorized vehicles would be permitted to use dedicated lanes reserved only for enrolled vehicles to by-pass queues at both the toll plaza and the customs and immigration plaza.

6) Weigh-in-motion scales would be provided for automatic weighing of trucks and calculation of truck tolls.

7) More sophisticated versions of the transponder tags could allow vehicles to carry the toll value on the vehicle which would allow distributed toll accounting. Otherwise centralized accounts would be maintained by the toll authority.

8) Once the vehicle has cleared the toll barrier, a second antenna would communicate to the driver whether the vehicle was authorized to proceed through dedicated lanes at the customs/immigration inspection or to use a normal inspection lane.

9) A third set of antenna in the vicinity of the customs inspection plaza would identify vehicles and ensure that they were processed through the appropriate lanes.

10) A verification system would be in place which could include video enforcement technology to record those vehicles that may be using the lanes in a non-authorized fashion.

11) Stringent enforcement procedures and penalties would be in place to penalize those who make unauthorized use of the lane in order to ensure that the dedicated lanes were reserved for authorized users.

12) Each of the participating agencies, including toll, customs and immigration would have their own computer systems to interface with the AVI control computer at each crossing.

ES-3 INSTITUTIONAL ISSUES

ES-3.1 CROSSING OWNER/OPERATOR ISSUES

During this study, a wide range of institutional issues were identified and discussed involving the various parties. These issues can be summarized as follows:

The three crossings are under the operating authority of a total of five agencies, with only the Ambassador Bridge being under a single owner/operator. These agencies share a progressive approach which supports the integrated application of advanced technologies, so long as it applies to all crossings and to toll as well as customs and immigration operations.

The principal issues raised by the owner/operators include the following:

Automated Toll Collection

Vehicle volumes have increased dramatically with over 40% growth since 1984, and growth is expected to continue.

Electronic toll collection (ETC) offers the most cost-effective approach to maximizing user convenience, minimizing congestion and effectively utilizing available crossing

capacity. ETC has added benefits of improved accounting, reduced cash handling, and enhanced scheduling and staffing techniques.

Integration with Customs and Immigration

Automation of toll collection will only be fully effective at these crossings if it is combined with AVI applications which can enhance the traffic processing at the customs and immigration (C & I) control line. Without C & I automation, ETC alone may not be justified.

Competitive Position

The owner/operators want to see application of advanced technologies simultaneously at all three crossings. This will ensure that the current market share at each crossing remains balanced.

Consistency with Other Technologies

It is important that the technology chosen at this border crossing is compatible and consistent with IVHS - related technologies elsewhere. This includes initiatives such as the Advantage I-75/AVION projects, other "smart corridor" projects, and crossings elsewhere on the Canada - U.S.A. border.

Toll Integration with Other Crossings

Implementation of AVI technology will provide for toll accounts which can be pre-authorized and automatically taken from customer toll accounts at each crossing. A single AVI tag will be issued to identify the driver/vehicle. This single tag must be recognized by the toll agency at each crossing, and will be the identifier to determine whether the driver has a toll account at the specific crossing.

Depending on the sophistication of the technology, the accounts may be "centralized" at the toll authority, or "distributed" with the toll funds resident on the vehicle tag.

The convenience to users can be greatly enhanced by an integrated toll arrangement which permits use of any of the three crossings with a single universal toll account, rather than as many as five individual toll accounts. The solution would be a clearing-house arrangement by which a third-party agency would hold the toll account funds and distribute them to the applicable crossing in accordance with usage. The clearing-house would protect privacy and confidentiality of data among the three operators.

User Fees

As the revenue collection agency at each crossing, the owner/operators may be looked upon to collect a user fee to help fund the implementation and the ongoing operation and maintenance of the systems. Such additional user fees will require careful consideration with respect to issues such as:

- should a user fee be applied as a toll surcharge?
- applied to AVI users only? (those who benefit most)
- applied to all crossing users? (on the grounds that all users benefit from the improved capacity, as they would if physical capacity was added)
- how much should the user fee cover?
  - of capital cost
  - of operating and maintenance costs
- are there other means to collect user fees?

Queuing and Dedicated Lanes

The consensus emerging from this study indicates that a dedicated AVI lane must be provided (preferably one each for commercial vehicles and for passenger cars) at both toll collection and at C & I inspection. The dedicated lane is considered necessary to maximize the time savings for users, thereby attracting the maximum possible enrollment to justify the investment.

The physical layout varies considerably at each end of each crossing. The dedicated lane must be designed to provide direct entry as far back from the toll or C & I lane as possible to ensure that users can by-pass the longest possible queues of "non-user" vehicles.

Although the dedicated lanes will reduce the lanes available for non-automated processing, the dedicated lanes are expected to attract sufficient traffic to a single lane so that the vehicle demand in the remaining lanes will be reduced.

Effective Traffic Control

Pavement markings and signing to clearly designate dedicated lanes for AVI vehicles only will be critical to the success of the initiative. The controls must be clearly understood by both users and non-users.

In some cases, truck processing occurs to the right of passenger cars on the crossing approach (i.e. at toll collection), while it switches to the left at the exit from the crossing (at C & I). The location of the dedicated lanes must be clearly indicated in advance.

In-Vehicle Communication

The consensus from this study was that some form of in-vehicle communication to the driver would be a benefit. The communication could be a visual and audible signal confirming authorization to use the dedicated lane when approaching both the toll barrier and C & I inspection. The capability to indicate status of toll account (for example toll deducted, remaining balance) and other word messages is a possibility.

Monitoring and Enforcement

Policies and procedures must be developed to monitor dedicated lane usage to detect unqualified users, and to apply appropriate tolls as well as penalties for non-compliance. Enforcement may initially include staffing the dedicated lanes, video

recording, and procedures to physically apprehend where appropriate, unauthorized users, particularly for attempted evasion of customs or immigration inspection.

Account Management

Policies and procedures must be developed for management of toll accounts. Options for centralized or distributed systems and integration with other crossings are important issues for operators and for users.

Automated account management will improve the management tools available to the operators for monitoring vehicle counts and toll collections, simplifying revenue collection and counting and for monitoring demand for staffing purposes.

Photo ID - Centrally-Stored Images

The current computerized technology facilitates maintenance of centrally-stored photo-ID images of all enrolled users. The images can be used by operators and by C & I inspectors to verify authorized users.

ES-3.2 IMMIGRATION ISSUES

Canadian and United States immigration officials share common interests and issues. One slight operational difference is that all primary inspection of persons entering Canada is undertaken by customs staff who are delegated to act on behalf of Immigration Canada and other government agencies. U.S. Customs and U.S. Immigration share primary inspection responsibilities at U.S. entry points.

Common immigration issues can be summarized as follows:

Personal Interviews

Immigration regulations require all persons to be personally interviewed at the border before being granted entry to either country. However, the personal interview can be

undertaken as part of the enrollment process for an automated immigration pre-clearance program. The existing PACE (Peace Arch Crossing Entry) initiative on the British Columbia - Washington state border allows individuals to be enrolled (on an annual basis) in a system which identifies them with a decal affixed to their vehicle, and allows use of an express lane to bypass peak period queues. Comparable programs are operated by both governments to expedite entry into each country.

Enabling Legislations

Immigration law in Canada permits the use of the PACE type process at any other border crossings. In the U.S., enabling legislation will be necessary to expand the process to other crossings.

Pre-Screening Low-Risk Travellers

If frequent, low-risk border crossers can be pre-screened for automated clearance, the staff resources which need to be dedicated to this group will be minimized. Vehicle monitoring and video imaging technology could be adapted to eventually permit unmanned operation of automated lanes. Until unmanned operation can be accepted, even with manned operation, the throughput of an automated lane can exceed a manned lane where personal contact must be made with each traveller.

Focus Available Resources

If low-risk, frequent travellers are pre-screened and authorized to use the automated lane, the staff resources can be focussed on the remaining travellers, which will include those higher risk individuals who may be a concern to either country.

Cost Recovery

The pre-screening process of interviews and background checks will itself require dedication of staff resources. The net result can be positive if crossings are frequent enough that normal manual processing of each traveller for every crossing would (in

total), require more time than the interview and pre-screening. Furthermore, experience with the PACE project has demonstrated that travellers are willing to pay an annual enrollment fee for the convenience, which may defray some or all of the administration costs of the pre-clearance interview process.

Staffing to Workload

Immigration (and customs) inspection services will continue to be under increasing pressure to respond to growing border crossing volumes with little growth in staff, or to "do more with less".

Identification of Individual or Vehicle

The PACE system provides identification for a vehicle which may be used by an enrolled individual and certain other qualified family members. If the automated technology can provide for a separate identification for each pre-screened individual, this would be preferable to immigration authorities.

Automated Lane Operation

The proposed technology will allow unmanned operation of the automatic lanes. Monitoring by detectors and video images (or other techniques) would provide for detection and identification of unauthorized users. Immigration (and customs) have expressed concerns about the acceptability of unmanned operation. The lanes can be designed with a booth which allows for manned operation whenever necessary.

Effective Traffic Operations

Provision must be made for effective traffic operations in the dedicated lane to ensure maximum benefit to authorized users. Appropriate signing and markings must clearly identify the lane so that unauthorized users are aware that it is a reserved lane. There must be appropriate provisions to detect unauthorized users and to ensure that they

do not obstruct the lane, and that they are directed to secondary inspection areas and do not avoid required inspections.

Enforcement of Dedicated lane

There must be appropriate procedures, delays and penalties as required, to discourage intentional unauthorized use of the dedicated lane and to deal appropriately with unauthorized users.

ES-3.3 CUSTOMS INSPECTION ISSUES

The role and the procedures used by Customs inspection services in both countries continues to evolve, particularly with Free Trade Agreements, with automated procedures and with the approaching application of Electronic Data Interchange (EDI) to the road transport mode. The principal issues for customs are summarized below.

Staffing to Workload

Customs is experiencing pressure on available staff resources to address the demand at these crossings. Vehicle volume has increased by over 40% since 1984. Opportunities to streamline processing of commercial movements through reductions in paper handling and advance notification of shipments will be welcomed.

Effects of Free Trade

The Canada - U.S. Free Trade Agreement will result in the elimination of customs duties on most goods over a 10 year period (5 years remaining). However, monitoring of imports will continue. Free trade is expected to result in increased trade activity.

Paper Handling Reductions

Both countries have initiated major customs modernization improvements, which include efforts to more toward EDI and to reduce the processing of paper records. The proposed implementation of AVI strongly supports these initiatives.

Integration with Existing Procedures

Present progress indicates that Customs EDI for road transportation may not be fully operational until 1994 or 1995. Even when it is, there will likely be shippers and carriers who will not be willing or able to use EDI to its fullest advantage. Therefore, AVI technology at the border crossings should be capable of supporting and complementing existing customs procedures.

Flexibility for Future Improvements

AVI technology must be sufficiently robust to be adaptable to future enhancements to customs procedures, such as future widespread EDI usage.

Issues such as automated lane operation, effective traffic operations and enforcement of dedicated lane are similar to the issues for immigration.

Response Time

The AVI system must be designed to advise Customs of the identification of transponder equipped vehicles as they approach the toll area. This should provide sufficient time for Customs to match the vehicle to records of the shipment which were sent to Customs in advance. Alternatively, if the vehicle is equipped with a more sophisticated transponder which can carry the cargo manifest, there must be sufficient response time for Customs to reach a decision on the shipment (i.e., cleared, not cleared, random inspection), and to communicate the decision to the driver. The driver should receive the communication by the time he reaches the mid-point of the crossing so that he can take action to enter the appropriate lane at C&I inspection.

Broker Verification

The Customs Broker is involved in many shipments by taking responsibility for the shipment and payment of appropriate duties. The system design must incorporate broker involvement, so that Customs can verify broker actions before clearing shipments.

ES-3.4 USER ISSUES

Contacts were made with a wide range of "users" including commercial carriers, shippers, brokers and representatives of manufacturing and trucking associations. Their issues include the following.

Information and Marketing

There is a need for information and marketing, both for existing customs procedures aimed at streamlining border crossing, as well as for planned AVI technologies.

Reduce/Eliminate Paper Work

Users are supportive of streamlining procedures to reduce or eliminate paper handling and repetitive data entry.

Industry is Using EDI

Industry representatives noted that EDI is already used extensively in many sectors, including the automotive industry. Many shippers, carriers and brokers are ready to expand its applications to border crossing.

Cost Justification

The costs for in-vehicle equipment, and any other user fees should be modest to encourage maximum enrollment.

"Orphan" Technology

Some carriers related previous negative experiences when they were encouraged to add electronic monitoring equipment to their vehicles, only to find that it quickly became an "orphan" technology with limited applications and with a limited lifetime.

The concern was expressed that any in-vehicle equipment should be carefully planned and designed to be compatible with requirements for other initiatives such as Advantage I-75/AVION and technology applications at other border crossings. Carriers want to avoid multiple equipment needs in their vehicles.

Leadership

Industry is looking to government for leadership in defining technology standards and in funding for implementation at the border crossing.

High Proportion of Regular Users

A high proportion of commercial vehicle crossings are made by a manageable number (perhaps 75 to 100) of carriers. Furthermore, the automotive industry is heavily represented among these shipments. Therefore, support for and participation in the implementation of AVI technology at these crossings can be managed.

Maximize Enrollment

Industry advocates encouragement for maximum enrollment on automated crossings, which can be realized through modest technology and enrollment costs, and flexible enrollment requirements and procedures.

Maximize Effectiveness

The effectiveness of the dedicated AVI lanes must be protected to avoid unauthorized use (accidental and intentional) and to maximize the travel time advantages for

properly authorized users. Careful attention to signing, marking, driver notification communications, monitoring and enforcement are essential.

Range of Choices for Users

Although many users will be willing and able to fully utilize advanced technology which incorporates EDI, users expressed the desire for the AVI technology to also support existing procedures. This will ensure that the maximum number of potential users can benefit.

Reliability

Dependence on advanced technology raised the usual concerns about reliability, and back-up procedures.

ES-3.5 IMPLEMENTATION AND OPERATION ISSUES

Several issues related to implementation and system operation were identified. These transcend individual agency or user jurisdictions, and relate to the border crossing as a system.

Co-ordination and Funding for Planning, Design, Installation and Commissioning

An organizational arrangement is necessary to accomplish these tasks. At present, the New Technology Committee, funded jointly by the two federal governments together with the provincial and state governments, is providing overall co-ordination with consultants retained to undertake defined work programs. An allocation of funding responsibility for capital costs is yet to be resolved.

Organization and Funding for Operations and Maintenance

Prior to commissioning of the system, the organization and funding for the ongoing operation and maintenance of the common system elements must be determined. One

option would be a third party to operate and maintain the system on behalf of the crossing agencies.

Common Application

The technology application at these three crossings should be regarded as a test-bed to define a common approach to be used at all Canada - U.S. border crossings, where warranted.

In-Vehicle Communication

The Steering Committee has determined that in-vehicle communication would be a desirable element so that the driver can be notified concerning clearance to use the automated toll or C & I lanes, or other instructions. The exact nature of the visual, audible and text/video display options to be used will be determined.

System Reliability

The system design must ensure very high reliability, incorporating elements such as dual-processor configurations for redundancy.

Data Integrity and Security

Tolls, Customs, and Immigration applications will run in their own process computers to ensure data integrity and security. The border crossing system elements will detect and communicate with drivers and vehicles, providing required vehicle/driver data to the appropriate toll, customs or immigration sub-system computers, and relaying appropriate messages generated by each subsystem to the driver/vehicle.

System Adaptability

The AVI driver/vehicle detection and communication system must be integrated with the toll, customs and immigration subsystems as noted above. The AVI system must

be applicable with current subsystem procedures. However, it must be sufficiently robust to be adaptable to more sophisticated vehicle, data and communications systems and to evolving toll, customs and immigration procedures.

Signal Verification

For verification purposes, the system must retain a record of all vehicle communication commands.

ES-3.6 OTHER GOVERNMENT ISSUES

System Compatibility

Plans are well advanced for implementation of a Mainline Automated Clearance System (MACS) as part of the Advantage I-75/AVION initiatives which will facilitate commercial vehicle movements throughout the length of the I-75 and Highway 401 corridors from Florida to the Ontario/Quebec boundary. Similar initiatives are under consideration on other major U.S. corridors such as I-80. These systems should be mutually compatible with a border crossing system.

Intelligent Vehicle - Highway Systems

Intelligent vehicle - highway systems (IVHS) are being actively supported in both Canada and the United States as an opportunity to maximize the efficiency, effectiveness and safety of the huge investments in road infrastructure.

Application of IVHS Technologies to the border crossings is highly compatible with these initiatives, and will actively strengthen the trade and economic interests of both nations.

Testbed for Electronic Border Crossing

These three crossings account for almost 25% of all Canada - U.S. trade. The needs and opportunities for automated crossings have been well documented. There is an opportunity for these crossings to become the national test-bed for technology which can be applied at other Canada - U.S. highway border crossings.

ES-4 SYSTEM COSTS

The preliminary estimate of the cost of the system is:

Estimated Project Cost - Advanced Technology System

System Design and Engineering	C$	400,000
System Implementation Management	C$	500,000
Equipment Procurement and Installation	C$	6,430,000
Marketing and Public Information Program	C$	300,000
Project Evaluation Plan	C$	250,000
TOTAL PROJECT IMPLEMENTATION COST	**C$**	**7,880,000**
User Costs For Vehicle Transponders	C$	3,500,000

ES-5 SYSTEM BENEFITS

The benefits can be categorized as follows:

- Benefits for users
  - time savings
    - direct, (toll, C&I processing)
    - indirect (queue time)
  - cost savings
  - convenience (avoidance of finding/carrying cash or ticket for toll, rolling down window, stopping, interviews (C&I), inclement weather, etc.)
  - commercial fleet operations
    - training drivers re border crossing procedures
    - accounting (expense reports, paperwork, petty cash),

- reduced errors/omissions in documentation, paperwork)

- other benefits

- Benefits for toll operators
  - collection cost savings
  - increased capacity (reduced expansion cost for same demand volume)
  - toll processing savings (reduced ticket printing, cash counting, commercial accounting, reduced toll revenue shrinkage/loss; debit toll account revenue float)
  - improved management information for staffing, scheduling, planning, performance evaluation, and other decisions
  - improved customer service quality/public relations

- Benefits for Customs and Immigration
  - increased third party user data entry
  - automation of records and systems
  - reduced inspector hours
  - improved management information for staffing, scheduling, planning, performance evaluation, and other decisions
  - improved customer service quality/public relations

ES-6 SYSTEM BENEFIT/COST ANALYSIS

ES-6.1 PASSENGER CAR & TRUCKS

Benefits to passenger cars and trucks are shown in Exhibit ES.1, both as annual benefits and as accumulated over a 5 year period which would be the minimum life expectancy for the AVI vehicle tag.

EXHIBIT ES.1
BENEFIT/COST FOR PASSENGER CARS AND TRUCKS
(C$ 1,000'S)

	One-Year Analysis			5 Year Analysis		
	Initial Cost	**Annual Benefit**	**Benefit/Cost Ratio**	**Cost**	**Accumulated Benefits**	**Benefit/Cost Ratio**
Passenger Cars	C$2,800	C$1,570	0.56	C$3345	C$8,254	2.5
Trucks	C$700	C$2,843	4.06	C$840	C$14,945	17.8
Total	**C$3,500**	**C$4,413**	**1.26**	**C$4,190**	**C$23,199**	**5.5**

The tag costs are shown in Exhibit ES.1 as both a one-time initial expense or as a cost over 5 years, assuming an annual interest rate of 6.25%. The accumulated benefits reflect an annual inflation rate of 2.5%, with no assumed benefit increase resulting from increasing traffic volumes.

The benefits to trucks exceed the tag costs by 4 times in one year alone. For cars, the benefits would exceed the tag costs in less than 2 years.

Tags would be funded through purchase directly by vehicle owners at a total cost of C$3,500,000. This cost would vary depending on the number of vehicles enrolled, and if tag costs differed from the assumed cost of C$94.00 per tag.

ES-6.2 TOLL OPERATORS

Benefits to toll operators are shown both as annual benefits, and accumulated over 5 years in Exhibit ES.2. The system capital costs shown are the total system costs including cost for toll lanes and systems, and customs and immigration lanes and systems.

ES-6.3 GOVERNMENT, INCLUDING CUSTOMS AND IMMIGRATION

Benefits include economic/trade productivity gains which are of value to the citizens of both nations, as well as savings to customs and immigration agencies. Annual benefits and accumulated benefits over 5 years are shown in Exhibit ES.2.

The system costs include total fixed capital cost of the system, excluding vehicle tag costs.

In one year, the benefits would equal the total system cost. Over 5 years, the benefit/cost ratio would exceed 4.5 to 1.

EXHIBIT ES.2
BENEFIT/COST FOR TOLL OPERATORS, GOVERNMENT, AND CUSTOMS AND IMMIGRATION
(C$ 1,000'S)

	One-Year Analysis			5 Year Analysis		
	Initial Cost	**Annual Benefit**	**Benefit/ Cost Ratio**	**Cost**	**Accumulated Benefits**	**Benefit/Cost Ratio**
Toll Operators	C$2,015	C$470	0.23	C$2,407	C$2,470	1.025
Government:						
- Customs & Immigration	C$5,865	C$680	1.31	C$7,002	C$3,575	5.77
- Economic/Trade Productivity Gains		C$7,000			C$36,800	
Overall	**C$7,880**	**C$8,150**	**1.03**	**C$9,409**	**C$42,845**	**4.55**

Various possible funding options are currently under discussion in conjunction with implementation plans.

Through the course of the study, a strong sense of consensus has been reached between all participants that movement to a system of this type is beneficial and desirable. It appears to be in the direct interest of all of the users as well as in the

overall economic and trade interests of both Canada and the United States.

1.0 EXISTING CONDITIONS AND TRENDS

1.0 EXISTING CONDITIONS AND TRENDS

1.1 INTRODUCTION

Marshall Macklin Monaghan Limited, in Association with JHK & Associates, KPMG Management Consultants Ltd. and Constance Consultants Ltd. were retained in the Fall of 1992 to undertake this Phase 1 study of the institutional impacts of new technology applications at the St. Clair and Detroit Rivers highway border crossings. The crossings include the Ambassador Bridge and the Detroit-Windsor Tunnel, both of which link Detroit, Michigan and Windsor, Ontario and the Blue Water Bridge between Port Huron, Michigan and Sarnia, Ontario.

The study was directed by the New Technology Committee of the St. Clair and Detroit Rivers International Crossings Committee. The New Technology "Sub-Committee" was renamed the New Technology "Committee" as this was the only active committee at this highway border crossing. The New Technology Committee included representation from the following organizations.

- Ontario Ministry of Transportation
- Transport Canada
- Canada Customs
- Canada Immigration
- Canadian Blue Water Bridge Authority
- Detroit-Windsor Tunnel Operator
- Ontario Trucking Association
- Customs Brokers Association
- Michigan Dept. of Transportation
- U.S. Federal Highway Administration
- U.S. Customs
- U.S. Immigration
- U.S. Blue Water Bridge Operator
- Ambassador Bridge
- Michigan Trucking Association

1.2 STUDY OBJECTIVE

The objective of this Phase 1 study is to facilitate the implementation of a demonstration/operational test project by identifying institutional issues and concerns and overcoming potential barriers. The Phase 1 study is expected to be followed by Phase II: Planning and Design, and Phase III: Demonstration.

1.3 THE VISION

To guide this project, the New Technology Committee set out a vision statement:

"We envision an automated system, primarily paperless, using the latest technology to enhance expedient border crossing by commercial and private vehicles. This system will incorporate AVI (Automatic Vehicle Identification), automated toll collection at bridges and the tunnel, as well as advanced clearances through customs of shipments of goods. In addition, pre-screened travellers may be cleared immediately through the customs and immigrations portion of the border crossing. Under this scenario, the pre-screened commercial shipments and pre-screened travellers will cross the border conveniently and speedily unless random enforcement checks are performed by border crossing agencies. To ensure this, we envision that adequate geometric design and electronic devices will be in place so that instrumented and preferred customers will not be delayed due to laneage constrictions.

Imagine a seamless transparent border crossing system for most travellers, except the suspect or the dangerous to either nation from the other. Imagine further that toll collections and border crossing commercial transactions will be coinless and paperless so that automatic debiting and automatic transfers are made using the latest in computer technology.

Also, imagine that the economic advantages of all countries in North America are exploited to the fullest and not hindered by what essentially will be a transparent border in the world of tomorrow."

1.4 THE BORDER CROSSING CONTEXT

There are three major road crossings of the St. Clair and Detroit Rivers.

Blue Water Bridge – a 3-lane bridge crossing the St. Clair River between Port Huron, Michigan to Sarnia, Ontario, linking Interstate routes I-69 and I-94 with provincial Highway 402.

Ambassador Bridge – a 4-lane crossing of the Detroit River between Detroit, Michigan and Windsor, Ontario linking Interstate routes I-75, I-94 and I-96 with provincial Highway 401.

Detroit-Windsor Tunnel – a 2-lane crossing under the Detroit River between the downtown areas of Detroit and Windsor.

Exhibit 1.1 illustrates the regional context of the crossings which form critical linkages in the highway network serving the highly industrialized region including the province of Ontario and the U.S. mid-west.

The two countries share a common language, cultural and economic similarities, good relations, and comparable standards including vehicle and driver safety and vehicle operations regulations. The two nations have a history of significant trade, co-operation and a common interest in reducing trade tariffs and restraints.

1.5 THE IMPORTANCE OF THESE CROSSINGS

Canada and the United States are each others' largest trading partners. As shown on Exhibit 1.2, over $200 billion in trade occurred in 1991, compared to $65 billion in trade between the United States and Mexico. Exhibit 1.3 indicates that approximately 30% of total U.S. exports to Canada occurred at the St. Clair and Detroit River crossings. The total value of exports at these crossings ($25.9 billion) was approximately equal to the total U.S. exports to Mexico.

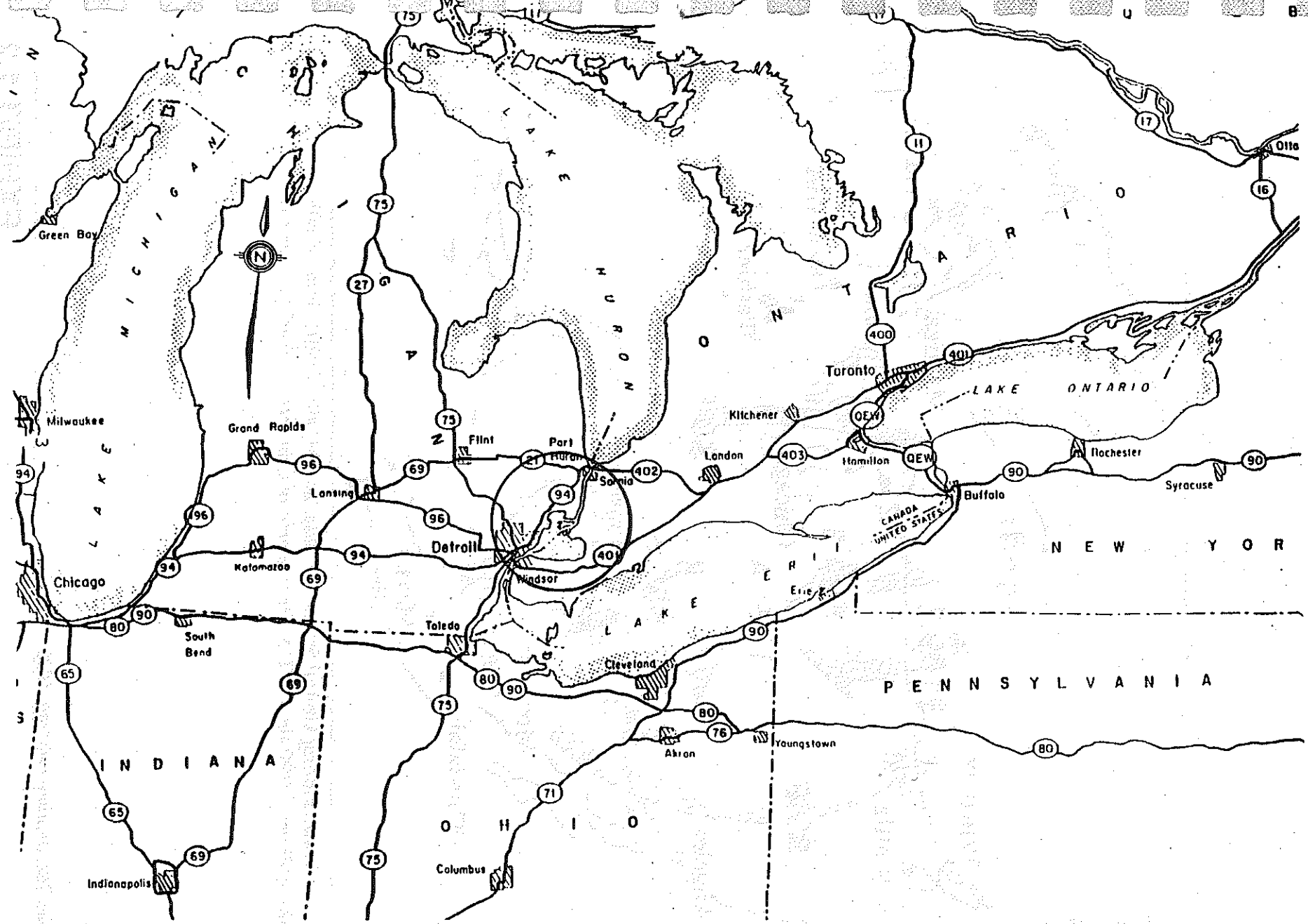
The region served by these crossings is the focus of the North American automotive industry. The industry generates huge volumes of truck shipments of raw materials, manufactured components and finished vehicles in both directions across the border to serve its integrated network of plants in the two countries. Auto industry shipments dominate the truck movements at these crossings.

1.6 TRENDS IN CROSS-BORDER TRAVEL

In the automotive industry and in many other businesses, just-in-time delivery and virtually zero inventory ("inventory on wheels") is the current method of operation. The resulting importance of reliable and timely road transportation has focussed attention on truck transit times at the border crossings.

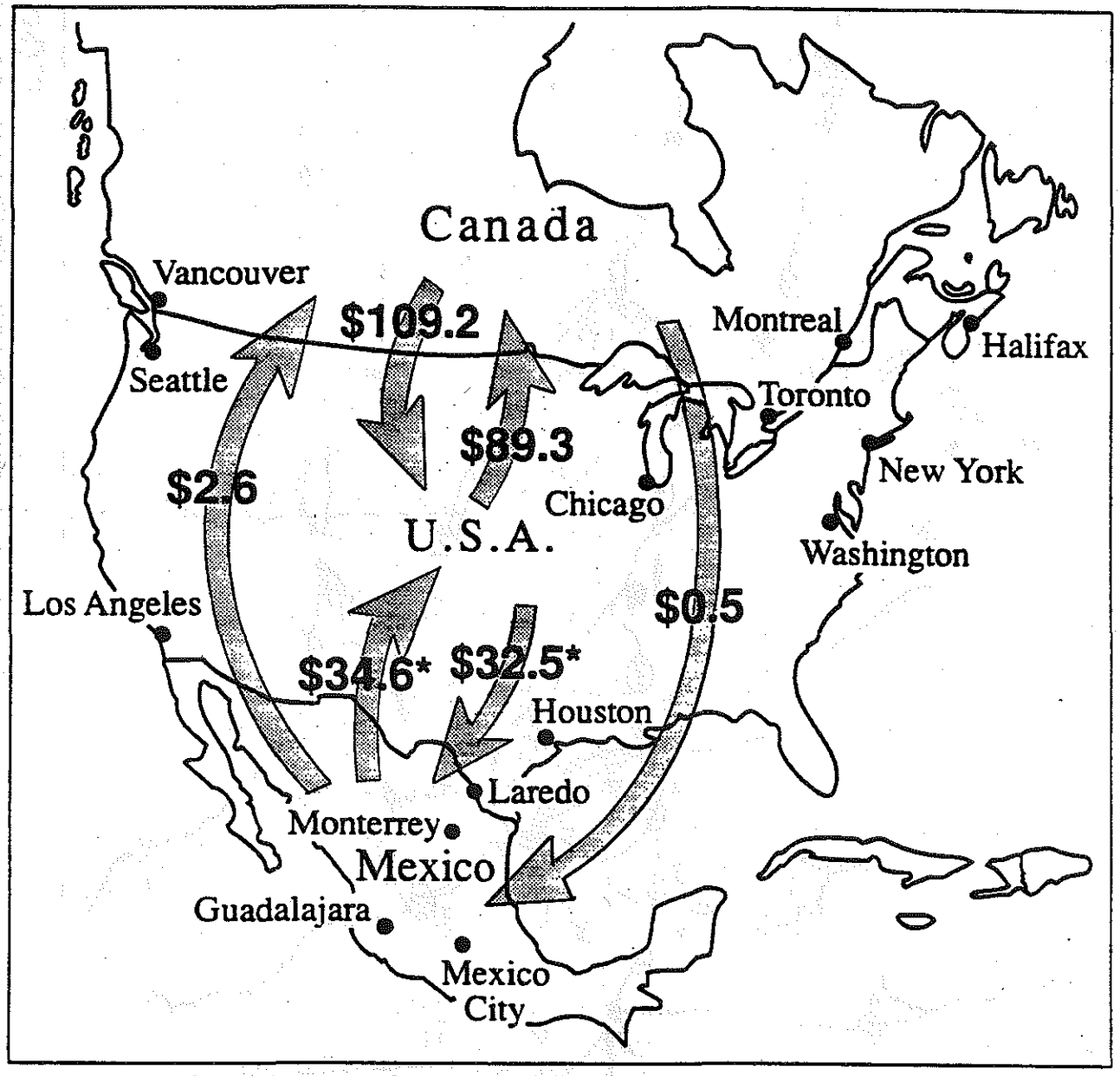
Exhibit 1.4 illustrates the 45% growth between 1984 and 1992 from 15 million to almost 22 million vehicle trips at these crossings. Despite some decrease during the recession years from 1989 to 1992, truck traffic (Exhibit 1.5) has rebounded to over 2.7 million crossings in 1992, a 41% increase since 1984.

The strong growth in demand continues to add pressure on human resources, customs procedures and to the physical infrastructure at the crossings.



MMM/JHK & Associates
KPMG/Constance

EXHIBIT 1.1
THE AREA SERVED BY THE ST. CLAIR AND DETROIT RIVER CROSSINGS



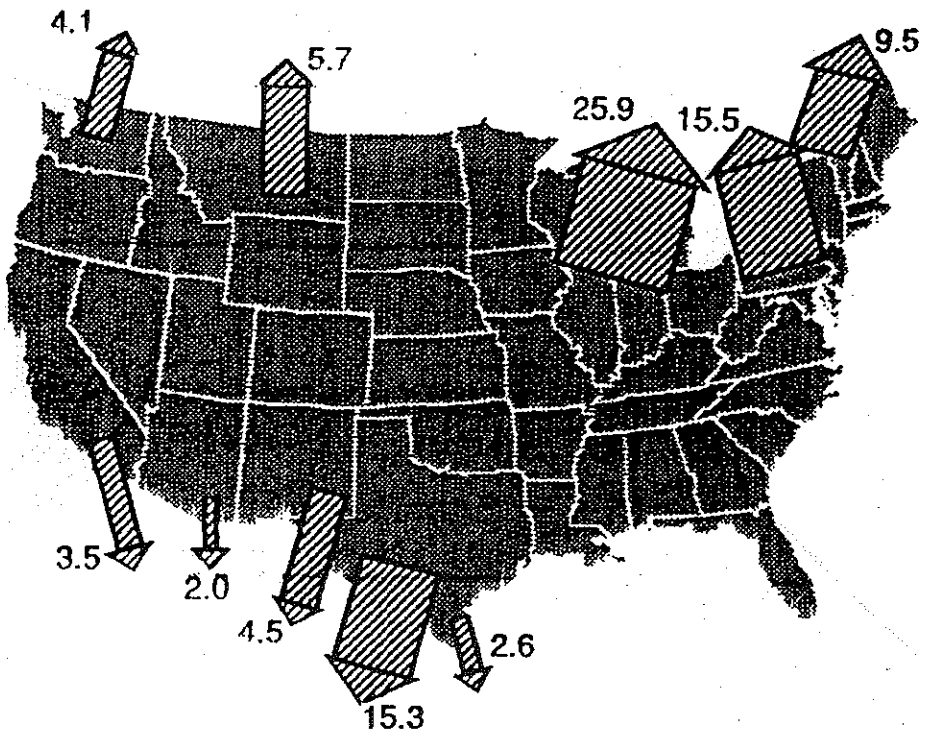
Trade among United States, Canada, and Mexico (1991 data, in billions; asterisks indicate 1990 data). *(U.S. Department of Commerce; Statistics Canada.)*

Source: TR News 164, January-February 1993

MMM/JHK & Associates
KPMG/Constance

EXHIBIT 1.2
NORTH AMERICAN TRADE

1991 U.S. EXPORTS THROUGH BORDER GATEWAYS (BILLIONS OF DOLLARS)



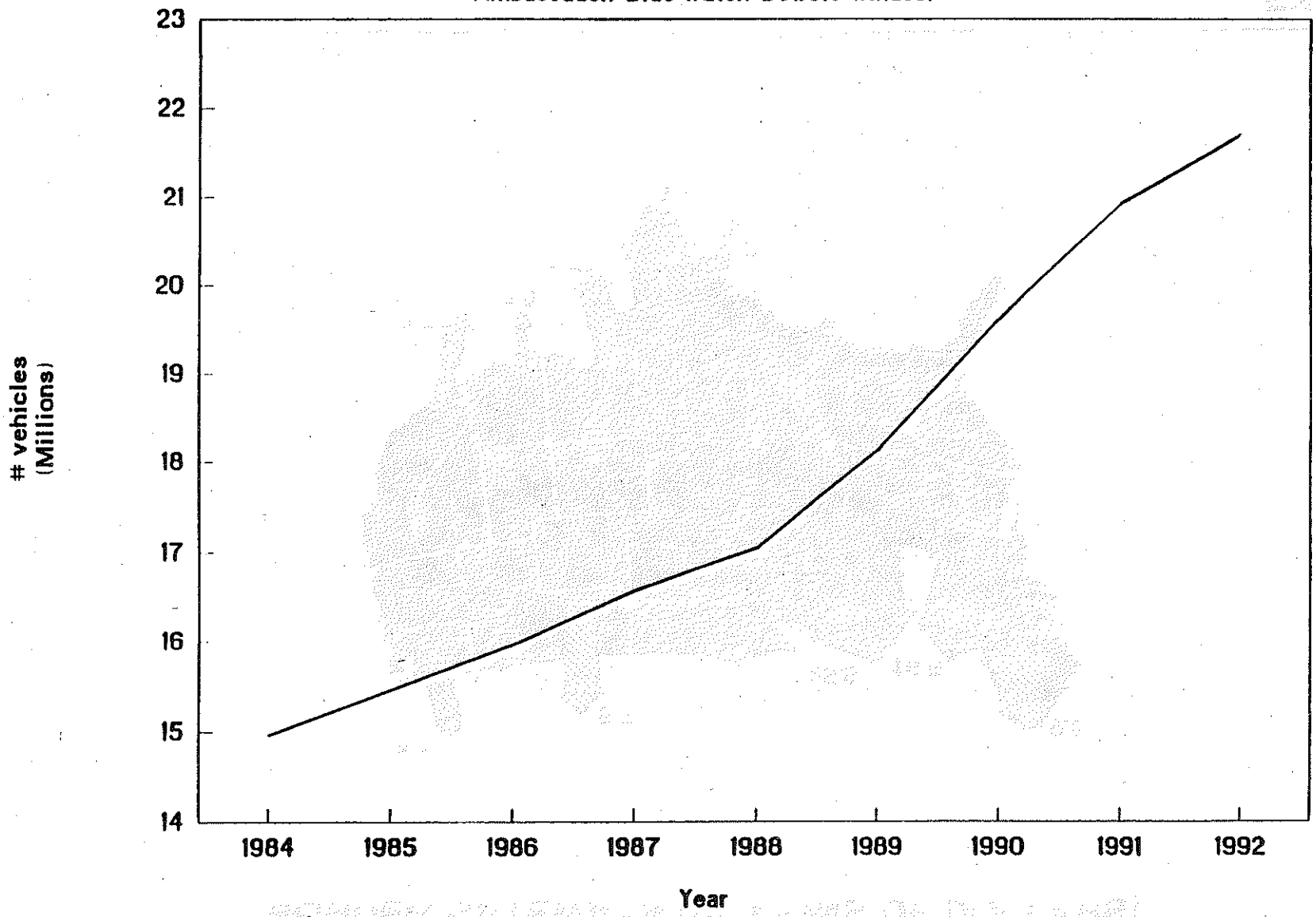
MMM/JHK & Associates
KPMG/Constance

SOURCE: McCray Research, 1992
U.S. Department of Commerce

EXHIBIT 1.3
1991 U.S. EXPORTS THROUGH BORDER GATEWAYS

Total Vehicular Traffic

Ambassador/Blue Water/Detroit-Windsor



Sources

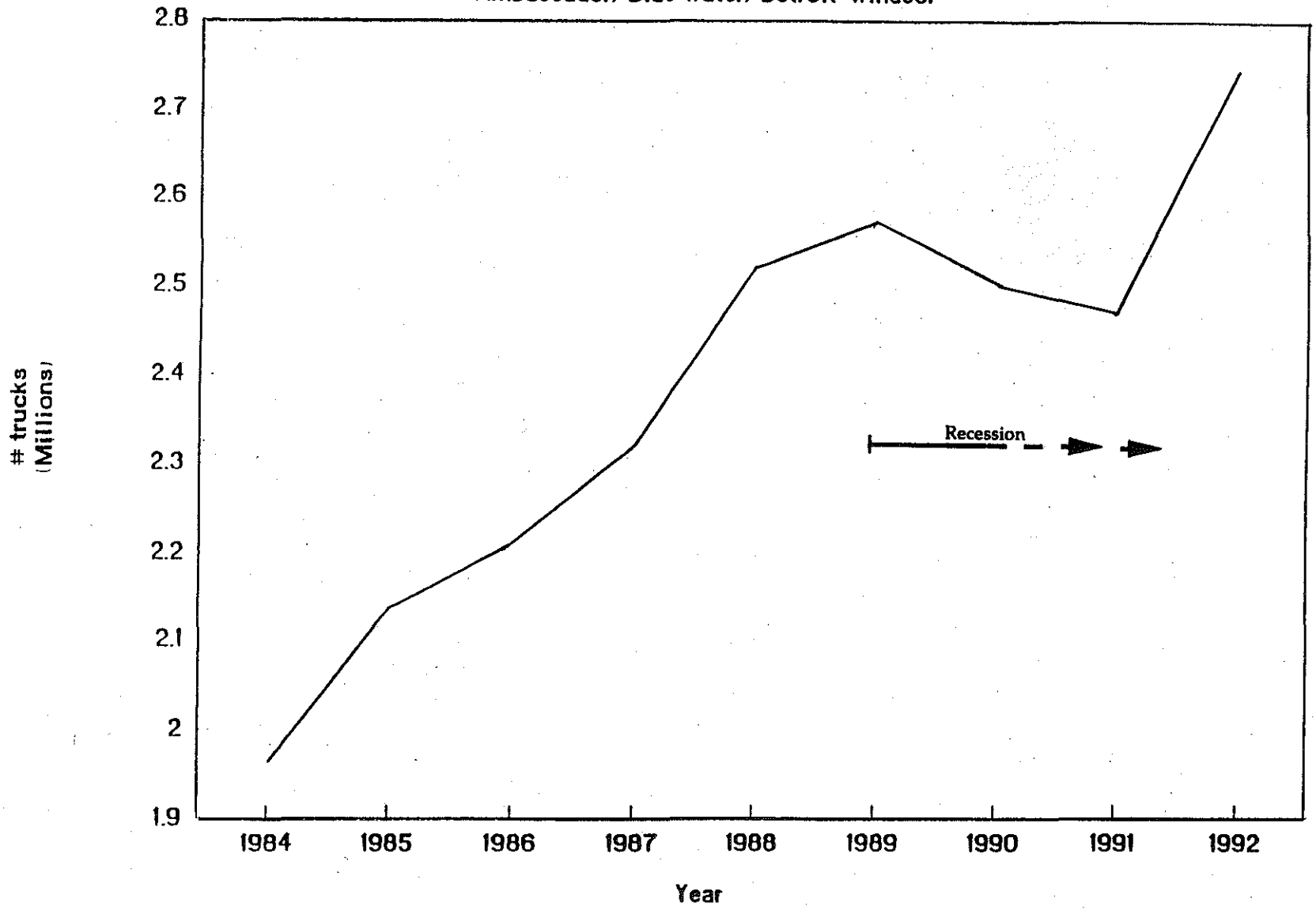
1984 - 88 volumes : St. Clair and Detroit Rivers International Crossing Study, 1990, A.T. Kearney
1989 - 1992 volumes: Border Crossing Operators

MMM/JHK & Associates
KPMG/Constance

EXHIBIT 1.4
TOTAL VEHICULAR TRAFFIC
AMBASSADOR/BLUE WATER/DETROIT-WINDSOR

Total Truck Traffic

Ambassador/Blue Water/Detroit-Windsor



MMM/JHK & Associates
KPMG/Constance

Sources

1984 - 88 volumes : St. Clair and Detroit Rivers International Crossing Study, 1990, A.T. Kearney
1989 - 1992 volumes: Border Crossing Operators

EXHIBIT 1.5
TOTAL TRUCK TRAFFIC
AMBASSADOR/BLUE WATER/DETROIT-WINDSOR

2.0 THE STAKEHOLDERS

2.0 THE STAKEHOLDERS

2.1 A MULTITUDE OF STAKEHOLDERS

The three highway border crossings are highly complex operations which involve a very wide range of stakeholders.

Exhibit 2.1 illustrates the various interested parties which include owners, operators, federal government agencies, road authorities and diverse user groups including commuters, tourists, commercial carriers, brokers and shippers.

Efficient operation of the crossings is a complex, highly interdependent process which involves the co-ordination and co-operation of all the stakeholders. The implementation of advanced technologies to reduce delay and improve operating efficiencies for both users and the authorities will also require very close co-ordination.

2.2 CROSSING OWNERS AND OPERATORS

The three crossings have very different ownership and operating arrangements.

The Ambassador Bridge is owned and operated by a privately owned company.

Ownership of the Detroit-Windsor Tunnel is split between the City of Windsor on the Canadian side and the City of Detroit on the United States side. The Detroit and Canada Tunnel Corporation (DCTC) is the operating company responsible for operation, maintenance and toll collection. On the Canadian side, DCTC has been contracted by the Windsor Tunnel Commission to operate, maintain and collect tolls on behalf of the City. On the U.S. side, DCTC acts as the Owner, with payment of taxes and annual royalties to the City of Detroit.

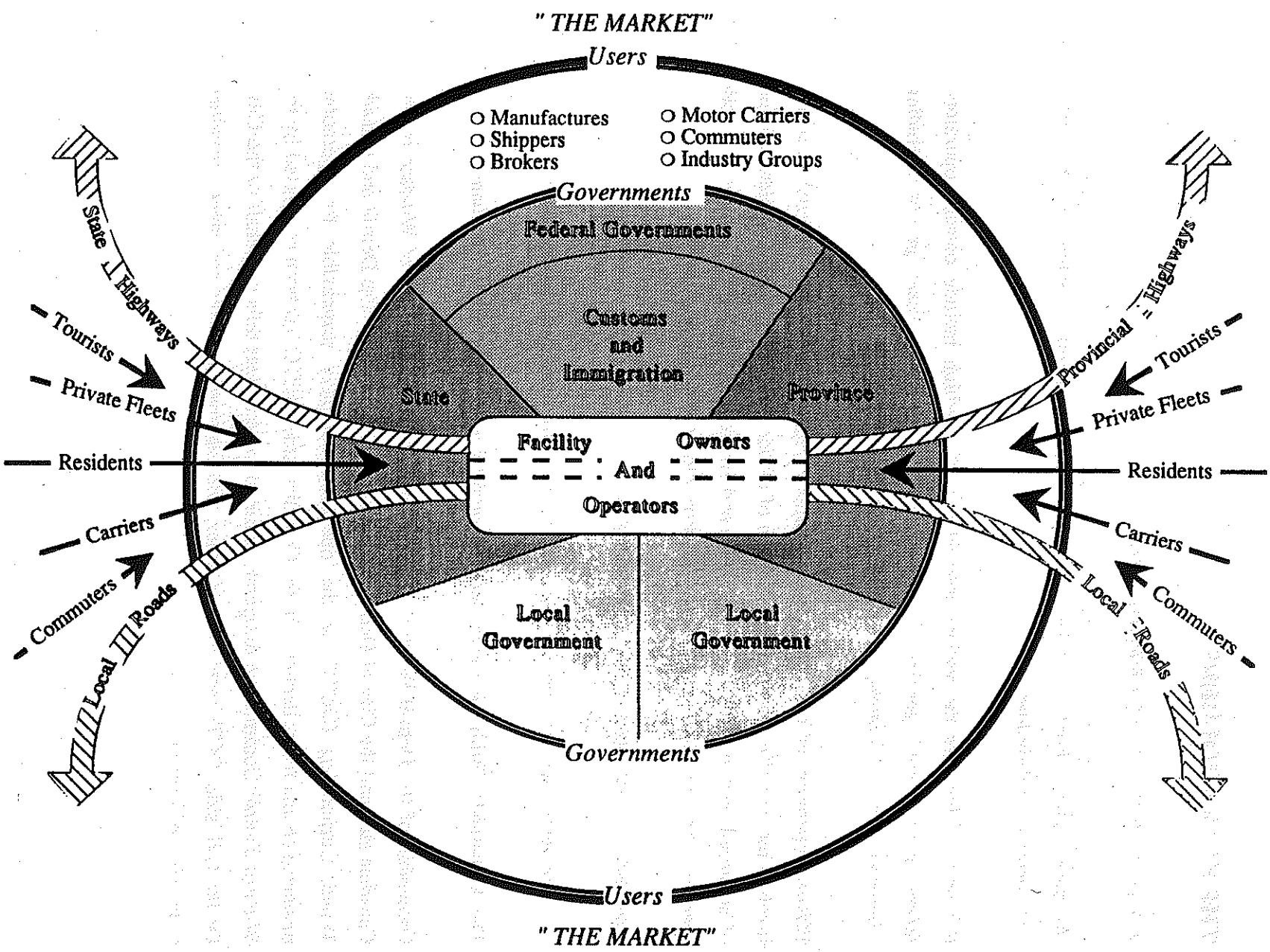


EXHIBIT 2.1
THE STAKEHOLDERS

MMM/JHK & Associates
KPMG/Constance

Ownership of the Blue Water Bridge is also split at the border. On the U.S. side it is owned and operated by Michigan Department of Transportation (M.D.O.T.) On the Canadian side, it is owned and operated by the Blue Water Bridge Authority, which is a federally regulated authority.

Toll Collection

Tolls are collected on entry to the crossings in both directions by the crossing operators. Passenger vehicle tolls can be paid in cash, or with pre-paid tickets or tokens. All lanes are manned, except at the Detroit-Windsor tunnel where some lanes are equipped with coin baskets which accept coins or tokens. Tolls can be paid in the currency of either country.

Truck tolls are collected manually, and paid in cash, or on pre-arranged accounts. At the Blue Water Bridge, truck tolls are based on number of axles, with no weighing required. At the Ambassador Bridge and at the tunnel, all trucks are weighed using static truck scales to determine the applicable toll. A second pair of scales were recently installed at the Ambassador Bridge to provide two scale lanes in each direction. At the tunnel, there is one scale lane in each direction, with plans to add a second scale each way.

Other Services and Facilities

The provision of other services and facilities is also relevant:

- On the Canadian side, the crossing operators provide facilities for both customs and immigration, at no cost to the government.
- On the U.S. side, most of the customs and immigration facilities are provided at some expense to the government.
- Duty-free shopping facilities are owned and operated (sometimes under contract) by the bridge owner.
- Currency exchange.

2.3 CUSTOMS AND IMMIGRATION INSPECTION

Customs and Immigration are the two primary federal government agencies present at the crossings. However, other agencies involved with health, agriculture, livestock, etc. are also present when necessary.

Primary inspection is provided at manned booths through which all traffic must pass. Passengers cars are handled in separate lanes from trucks. Both customs and immigration requirements are handled by a single officer at primary inspection. When necessary, a vehicle may be directed to a secondary inspection area where further processing and inspection by customs and/or immigration officers can be undertaken. All auto secondary inspection and most truck secondary inspection is handled adjacent to the primary inspection areas.

However, at the Canadian side of the Ambassador Bridge and at both the U.S. and Canadian sides of the Tunnel, secondary inspection for commercial vehicles is handled at nearby "offsite" locations.

Immigration officials are charged with ensuring that only authorized persons are permitted entry. Canadian and U.S. citizens are generally permitted to cross freely without passports, although identification is required.

Customs officials monitor the quantity and flow of goods and ensure that appropriate duties and taxes are paid and that necessary inspections are conducted.

2.4 CROSSING USERS

In 1992, the three crossings handled over 21.7 million vehicle movements, of which 87% (over 18.9 million) were passenger cars.

The vehicle movements were distributed as follows:

	Passenger Vehicles		Trucks and Other	
Ambassador Bridge	6,527,000	(30%)	1,625,000	(8%)
Detroit-Windsor Tunnel	7,209,403	(33%)	299,872	(1%)
Blue Water Bridge	5,225,861	(24%)	825,295	(4%)
TOTAL	**18,962,264**	**(87%)**	**2,750,167**	**(13%)**

A recent study[1] of travel characteristics at the Tunnel indicated as follows:

- 79% of all trips had both the trip origin and trip destination within the Detroit - Windsor area
- Only 1.7% of all trips were "through" trips, with origin and destination both outside the Detroit-Windsor area.
- 61% of the passenger vehicle trips were made one or more times per week.
- A total of 82% of passenger vehicle trips were made at least once per month (minimum 12 trips per year).
- 64% of all vehicles had only one occupant.

Similar statistics are not available for the two bridges. The tunnel links the downtown areas of Windsor and Detroit and is a very convenient route for local work trips and for local social/recreational trips. By contrast, the Ambassador Bridge is more conveniently linked to the major highway network, thereby attracting more truck trips and likely a higher proportion of long distance, "through" passenger vehicle trips.

The Blue Water Bridge connects smaller population centres in Sarnia and Port Huron, and therefore would not be expected to carry as many work or social/recreational trips. It is

(1) Windsor Tunnel Plaza Functional Design Study; Prepared by IMC Consulting Group for the Windsor Tunnel Commission.

a convenient truck route which has direct freeway access to both ends of the bridge. As an example, the mileage from Toronto to Chicago is identical via the two bridges. The Blue Water Bridge provides a route which avoids the built-up Detroit-Windsor areas, and has a longer part of the Toronto-Chicago route in the U.S.

The Blue Water share of all truck crossings has increased from 20% to 30% over the past 10 years, partly as a result of the completion of Interstate Highway 69 and Ontario Highway 402.

2.4.1 - Commercial Users

Truck operators are the direct commercial users of the crossings. Many drive for large fleet carriers who contract directly with major industry to move raw materials, components and finished manufactured goods across the border. The automotive industry is a major contributor to cross-border trucking activity.

Indirectly, other groups share a vital interest in the crossings including shippers, brokers and trucking associations.

During this study, interviews were conducted with a wide range of stakeholders and interested parties. This included a total of 30 interviews with private sector carriers, shippers, brokers and trucking association representatives.

In general, the users were positive about existing customs pre-clearance programs, and were supportive of initiatives to implement new technology, subject to concerns that the technology would not become an "orphan" which could not be integrated with other technology initiatives such as Advantage I-75 and AVION.

Many indicated that they had negative experiences with several earlier technology initiatives in the trucking industry which were not mutually compatible. They did not want to see one technology at this border crossing, and different technologies for other crossings and yet again in other commercial corridors such as I-75 and Highway 401.

2.5 GOVERNMENT INTERESTS

2.5.1 - Access Routes

Access routes to the crossings include provincial highways, state highways and municipal streets. These jurisdictions have an interest in maintaining acceptable traffic operations on routes leading to the crossings as well as in the immediate vicinity of the crossings.

2.5.2 - Trade and Economic Development

As previously noted, these border crossings process nearly 1/4 of all trade between Canada and the United States, worth in excess of $50 billion in 1991. The crossings represent the essential transportation linkages in the centre of the North American automotive industrial corridor which extends along I-75 and Highway 401 from Tennessee and Kentucky, through Ohio, Michigan and Ontario. As the dominant manufacturing industry in North America, the automotive industry is the largest generator of truck traffic at these border crossings.

A highly integrated range of automotive manufacturing facilities, geographically distributed throughout the region is linked by the highway network. "Inventory-on-wheels" and "just-in-time" delivery practices make the industry extremely sensitive to truck travel times, and particularly to any delays at the border crossing.

2.6 ONGOING IMPROVEMENTS TO THE CROSSINGS

An earlier report[2] proposed a range of recommendations for improvements to reduce travel delays at the border crossings.

[2] St. Clair and Detroit Rivers International, Crossings Study, Final Report, June, 1990, prepared by A.T. Kearney for Ontario Ministry of Transportation, Michigan Department of Transportation and Transport Canada.

Action has been taken on most of the recommendations. Customs processes have improved and staffing levels have been increased. Some progress has been made on the operational recommendations. Physical improvements are underway or being planned at the toll and customs/inspection areas at all the crossings, and a study of twinning the Blue Water Bridge has been initiated. Toll automation is in the early planning stages at all the crossings.

3.0 GOVERNMENT INITIATIVES

3.0 GOVERNMENT INITIATIVES

There are many current government initiatives, some of which will result in increased crossing activity, and some of which will facilitate and complement new technology applications.

3.1 FREE TRADE

The Canada-U.S. Free Trade Agreement, and the soon-to-be implemented North American Free Trade Agreement, are both expected to contribute to growing commercial truck movements at these border crossings.

3.2 WINDSOR CASINO

A large casino owned by the Ontario Government opened in May 1994 in downtown Windsor. The casino is expected to attract the majority of its visitors from the United States, with as many as 4 million new persons trips per year (20,000 new person trips daily) using the tunnel or bridge to cross the Detroit River.

3.3 CUSTOMS 2000 (Canada)

The Canadian Government is implementing a wide ranging program to streamline the customs process including a stronger customer focus, clearance processes which decrease clearance times at the crossing through completion of paperwork in advance, and an increase the proportion of shipments which can be cleared directly at the primary inspection line. Customs 2000 includes movement toward application of EDI to the highway transport mode.

3.4 CUSTOMS MODERNIZATION ACT (U.S.)

U.S. Customs has taken steps similar to those noted above for Canada Customs. The Customs Modernization Act, recognizes EDI and updates customs procedures. It has now been adopted in conjunction with NAFTA.

3.5 CUSTOMS PROCESSES

Both Canada and U.S. Customs operate a variety of programs which facilitate the processing required by customs, and which expedite shipments with the required paperwork. The principal customs clearance programs include:

U.S. Customs

- Line release: At present, a line release authorization is issued by U.S. customs upon application for specific shipper, consignee and commodity movements. A line release does not require paperwork or transmittal in advance of each crossing. The only variable is the quantity of each cargo - this information is now provided on the manifest carried by the driver and handed to the customs officer for each crossing transaction. The manifest carries a bar code which is wanded by the customs officer which allows the computer to access the appropriate file containing the release authorization. Any necessary inspections will be communicated to the officer on the computer screen. Entry of the quantity of goods by the officer allows the shipment to be released.

- Master Manifest: Now used by the big three auto manufacturers. Pre-clearance is provided for a manifest (specific shipper, consignee, commodities), with the quantity provided to the customs officer. The manifest details are entered later in the customs computer. The shipper submits a monthly total which must be reconciled with the customs computer totals.

- BCS (Border Cargo Selectivity): At present, the driver is directed from primary to secondary where a broker handles data entry to the customs computer system. The driver then obtains a clearance from customs.

Canada Customs

- FIRST (Frequent Importer Review System): Now allows for repetitive shipments having the same shipper, consignee and specific commodities. Quantities and

actual commodities are specified on the manifest which is handed to the officer by the driver. Officers "wand" the bar code affixed to the manifest in order to access the computer file related to the shipment.

- Line Release: Now used by the auto industry for specific shipper, consignee and commodity combinations. The paper manifest handed by the driver to the customs officer provides information on quantity of pre-authorized commodities.

- PARS (Pre-Arrival Review System): This procedure involves FAX transmission of the manifest from the shipper or carrier to the broker (located at the crossing) who then passes it to customs for entry into the customs computer. Bar codes on the PARS data sheets are wanded when the truck arrives at primary inspection.

3.6 IMMIGRATION PRE-CLEARANCE

3.6.1 - Passenger Vehicle Pre-Clearance

Passenger vehicle pre-clearance is not currently available at any of these crossings.

In 1990, Canada Customs and Immigration undertook their first experiment with dedicated pre-clearance lanes which operated for a few months at the tunnel and at the Ambassador bridge.

Only commuters crossing the border to work or to attend school were permitted to enroll. Each was screened, personally interviewed, and issued a photo ID card to be shown at the primary inspection line. The enrollment was small. The result was inefficient use of available staff since the dedicated, manned lane was sometimes underutilized during peak periods, while queues existed at other lanes. The experiment was discontinued after a short trial.

In 1992, a "NO GOODS TO DECLARE" lane was instituted for entry to Canada at the Ambassador Bridge. Currently, the bridge operates two lanes during certain "window" hours, including 4:00 p.m. to 8:00 p.m. weekdays and noon to 8:00 p.m. on weekends.

A successful and popular model is the Peace Arch Crossing Entry (PACE) project which has operated for over 2 years at the Douglas, British Columbia - Blaine, Washington border crossing. The concept is that low risk, frequent travellers can obtain pre-clearance authorization that permits them to use special lanes to avoid the normal primary inspection lanes and associated queues. This reduces the level of effort required by C & I officers to check low-risk travellers, and allows available staff resources to be concentrated on other travellers. The PACE model has less restrictive immigration requirements than the 1990 trial at the Ambassador Bridge.

Over 20,000 have enrolled and paid an annual fee of US $25 for pre-cleared entry to the U.S., and over 35,000 have paid an annual fee of C $10 for pre-cleared entry to Canada. Participants are checked, interviewed, photographed and provided with a vehicle decal which permits exclusive use of an express by-pass lane to avoid long queues during peak hours. No goods can be taken into the U.S.. Participants are given encoded cards which can be deposited on entry to Canada to voluntarily declare imported goods. Applicable duties are charged to a pre-authorized credit card account.

The large enrollment indicates the popularity of the program. The more liberal enrollment requirements, and the provision of a dedicated lane which benefits both travellers (time savings) as well as C&I agencies (better use of available staff resources) are keys to its popularity.

The Canada Immigration Act permits similar programs at other locations. In the U.S., Congress must act to allow the program to be extended to other locations. An application to permit implementation in the Detroit/Port Huron area is being prepared.

3.7 E.D.I. FOR THE ROAD TRANSPORT MODE

Electronic Data Interchange (EDI) offers the advantages of reducing repetitive data entry, reducing handling of paperwork and reducing the opportunity for error.

Data concerning a shipment can be entered once to a computer system by the shipper. The data entered would fulfil the requirements of shipper, manufacturer, consignee, carrier

and customs. The appropriate data required by each agency can then be transmitted electronically in any required format. Paper back-up data can also be generated where necessary. There is no subsequent need for data to be re-entered from a paper copy by each agency, thereby increasing productivity and accuracy and reducing the potential for errors.

EDI is already extensively used by business, including the automotive industry. EDI is being actively applied by industry and by customs agencies to the air, sea and rail modes. Implementation for the road transport mode is now under development, although full implementation may not occur until 1995 or 1996.

EDI is an ideal complement to AVI technology at the border crossings.

3.8 ADVANTAGE I-75/AVION

Intelligent Vehicle Highway Systems are the focus of much attention, research and planning in Europe, Japan and North America. With respect to commercial vehicle operations, Advantage I-75/AVION is one of the most advanced of the IVHS initiatives which are receiving government support and funding.

Advantage I-75/AVION will assist in the movement of trucks throughout the entire length of the I-75 corridor from Florida to Michigan, and will be extended by AVION along the length of Highway 401 across Ontario. A fleet of participating trucks will be equipped with AVI transponders which will allow them to communicate with AVI readers at truck inspection stations, and to be cleared automatically to bypass a station after being electronically weighed and checked for compliance and proper documentation.

This program will establish an available market of AVI-equipped trucks which could use an AVI system at the border crossings. An improved border crossing will reduce one of the major sources of travel delay for trucks using the corridor.

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4.0 OPPORTUNITIES FOR NEW TECHNOLOGY APPLICATIONS

4.0 OPPORTUNITIES FOR NEW TECHNOLOGY APPLICATIONS

4.1 PRESSURES ON EXISTING INFRASTRUCTURE

Both auto and truck crossing volumes have demonstrated consistent significant growth of over 40% since 1984. Ongoing physical improvements will provide additional capacity and improved traffic flow. However, limitations on the ability of government to continue to increase customs and immigration staff will result in the need to "do more with less" in future years.

Streamlining and automation of procedures including toll collection, customs processing and immigration clearances are essential to ensure that future growth in cross border travel and commercial shipments can be accommodated to the economic and social benefit of both Canada and the United States.

Automatic identification of vehicles (AVI), passengers and cargo is an essential element in achieving these objectives. At a border crossing, the AVI system must be integrated for use by toll, customs and immigration if it is to be effective and efficient. The economies of cooperative development, implementation and operation should benefit the three operating jurisdictions at each crossing.

4.2 USER PERSPECTIVES

The willingness of auto owners to participate (and to pay an annual fee for the privilege) in a streamlined immigration pre-clearance program has been demonstrated by the PACE experiment. Interest and benefits can be expected to be even greater at the subject crossings, which are located in the midst of large urban areas where daily or weekly trips are common for work, school, shopping and social/recreational reasons. The recently opened Windsor Casino will add significantly to the crossing traffic.

Auto users can save time at toll processing as well as at customs/immigration (C & I) primary inspection. More significantly, they will qualify to use dedicated lanes at both toll and C & I to avoid queue delay.

Extensive interviews with commercial user groups, including manufacturers, carriers and brokers indicated a desire to continue with streamlining of border crossing transit times. AVI applications can include weigh-in-motion and automatic toll accounting, non-stop clearance through C & I, and use of dedicated lanes to bypass queues at both toll and C & I plazas. Users are supportive and are willing to participate under certain conditions. The principal concerns are:

- The technology must be usable for automated toll and automated C & I clearance;
- The technology standard should be established for all border crossings, and to be consistent with other initiatives such as Advantage I-75/AVION;
- The in-vehicle equipment should be available at a reasonable cost;
- Dedicated lanes are necessary;
- The technology must incorporate future EDI applications.

4.3 TECHNOLOGY APPLICATION

The concept of applying AVI technology to the border crossing would involve a conceptual arrangement capable of the following:

- In-vehicle tag(s) and associated road-side readers which can detect and identify the vehicle, the driver and other passengers.
- As an option, vehicle tag(s) and readers which can process pre-paid toll accounts and/or commercial cargo manifests.
- A central computer which can communicate the relevant information to independent computer systems operated by the toll agency, customs and immigration.
- A dedicated electronic lane through both toll collection and C & I inspection.
- Vehicle processing through a non-stop electronic toll lane, with weigh-in-motion (WIM) truck weighing where appropriate.

- In-vehicle communication on the AVI tag to confirm to the driver that he is qualified to enter the dedicated electronic toll lane and to confirm as he passes the toll "barrier" that the toll has been paid.
- In-vehicle communication on the AVI tag to confirm to the driver, once he is committed to the crossing, that he is authorized to enter the dedicated electronic C & I lane, or alternatively that he is required to use a normal C & I lane.
- Provision of an integrated tracking and monitoring system for commercial shipments using the AVI system.

Implementation of AVI technology will require a co-ordinated effort by the crossing owner/operators and the customs and immigration (C & I) agencies to design, install and operate a system of hardware including express lanes with appropriate signs and markings, detectors, antennas, readers, signs/signals, and weigh scale/axle counters. There will also be a large investment in computer hardware and software to integrate detection and communication for each agency (toll, C & I) and to independently perform the administrative and regulatory tasks for each.

User acceptance will be related to cost and system effectiveness. Evidence from electronic toll initiatives and the PACE projects has demonstrated a willingness of drivers to enroll and pay a fee where there is a perceived convenience to be gained.

The effectiveness and user acceptance will be highly dependent on well organized parallel operating procedures which must be established by the agencies:

- The toll operator must establish convenient toll accounts for all users, which may include outlets to "refill" the toll account on value cards type devices which may be used with the vehicle tags.
- C & I will be involved with brokers and shippers in establishing appropriate methods to provide pre-arrival notification of commercial shipments. This may include EDI networks. If future technology allows cargo manifests to be transmitted by the AVI tag, these methods may not be needed by all users.

- There will need to be convenient application, review and personal interview procedures for drivers wishing to obtain immigration pre-clearance.

- Appropriate penalties and enforcement procedures must be in place to discourage unauthorized use of the privilege.

- A well planned marketing initiative is essential, involving development and distribution of information on electronic tolls, and customs and immigration pre-clearance.

- There will also need to be a common service to obtain the appropriate AVI tags for use in the system.

5.0 INSTITUTIONAL ISSUES

5.0 INSTITUTIONAL ISSUES

Extensive interviews and discussions were held with a wide range of stakeholders who have considerable interest in the efficient movement of people and goods across the Canada-U.S.A. border. The issues of concern to each group are summarized here.

5.1 CROSSING OWNER/OPERATOR ISSUES

The three crossings are under the operating authority of a total of five agencies, with only the Ambassador Bridge being under a single owner/operator. These agencies share a progressive approach which supports the integrated application of advanced technologies, so long as it applies to all crossings and to toll as well as customs and immigration operations.

The principal issues raised by the owner/operators is documented below.

5.1.1 – Automated Toll Collection

Vehicle volumes have increased dramatically with over 40% growth since 1984, and growth is expected to continue.

Electronic toll collection (ETC) offers the most cost-effective approach to maximizing user convenience, minimizing congestion and effectively utilizing available crossing capacity. ETC has added benefits of improved accounting, reduced cash handling, and enhanced scheduling and staffing techniques.

5.1.2 – Integration with Customs and Immigration

Automation of toll collection will only be fully effective at these crossings if it is combined with AVI applications which can enhance the traffic processing at the customs and immigration (C & I) control line. Without C & I automation, ETC alone may not be justified.

5.1.3 – Competitive Position

The owner/operators want to see application of advanced technologies simultaneously at all three crossings. This will ensure that the current market share at each crossing remains balanced.

5.1.4 – Consistency with Other Technologies

It is important that the technology chosen at this border crossing is compatible and consistent with IVHS - related technologies elsewhere. This includes initiatives such as the Advantage I-75/AVION projects, other "smart corridor" projects, and crossings elsewhere on the Canada - U.S.A. border.

5.1.5 – Toll Integration with Other Crossings

Implementation of AVI technology will provide for toll accounts which can be pre-authorized and automatically taken from customer toll accounts at each crossing. A single AVI tag will be issued to identify the driver/vehicle. This single tag must be recognized by the toll agency at each crossing, and will be the identifier to determine whether the driver has a toll account at the specific crossing.

Depending on the sophistication of the technology, the accounts may be "centralized" at the toll authority, or "distributed" with the toll funds resident on the vehicle tag. The convenience to users can be greatly enhanced by an integrated toll arrangement which permits use of any of the three crossings with a single universal toll account, rather than as many as five individual toll accounts. The solution would be a clearing-house arrangement by which a third-party agency would hold the toll account funds and distribute them to the applicable crossing in accordance with usage. The clearing-house would protect privacy and confidentiality of data among the three operators.

5.1.6 – User Fees

As the revenue collection agency at each crossing, the owner/operators may be looked upon to collect a user fee to help fund the implementation and the ongoing operation and maintenance of the systems. Such additional user fees will require careful consideration with respect to issues such as:

- should a user fee be applied as a toll surcharge?
- applied to AVI users only? (those who benefit most)
- applied to all crossing users? (on the grounds that all users benefit from the improved capacity, as they would if physical capacity was added)
- how much should the user fee cover? - of capital cost
  - of operating and maintenance costs
- are there other means to collect user fees?

5.1.7 – Queuing and Dedicated Lanes

The consensus emerging from this study indicates that a dedicated AVI lane must be provided (preferably one each for commercial vehicles and for passenger cars) at both toll collection and at C & I inspection. The dedicated lane is considered necessary to maximize the time savings for users, thereby attracting the maximum possible enrollment to justify the investment.

The physical layout varies considerably at each end of each crossing. The dedicated lane must be designed to provide direct entry as far back from the toll or C & I lane as possible to ensure that users can by-pass the longest possible queues of "non-user" vehicles.

Although the dedicated lanes will reduce the lanes available for non-automated processing, the dedicated lanes are expected to attract sufficient traffic to a single lane so that the vehicle demand in the remaining lanes will be reduced.

5.1.8 – Effective Traffic Control

Pavement markings and signing to clearly designate dedicated lanes for AVI vehicles only will be critical to the success of the initiative. The controls must be clearly understood by both users and non-users.

In some cases, truck processing occurs to the right of passenger cars on the crossing approach (i.e. at toll collection), while it switches to the left at the exit from the crossing (at C & I). The location of the dedicated lanes must be clearly indicated in advance.

5.1.9 – In-Vehicle Communication

The consensus from this study was that some form of in-vehicle communication to the driver is desirable. The communication would be, at minimum, a visual and audible signal confirming authorization to use the dedicated lane when approaching both the toll barrier and C & I inspection. The capability to indicate status of toll account (for example toll deducted, remaining balance) and other word messages is a possibility.

5.1.10 – Monitoring and Enforcement

Policies and procedures must be developed to monitor dedicated lane usage to detect unqualified users, and to apply appropriate tolls as well as penalties for non-compliance. Enforcement may initially include staffing the dedicated lanes, video recording, and procedures to physically apprehend where appropriate, unauthorized users, particularly for attempted evasion of customs or immigration inspection.

5.1.11 – Account Management

Policies and procedures must be developed for management of toll accounts. Options for centralized or distributed systems (see 5.1.5) and integration with other crossings are important issues for operators and for users.

Automated account management will improve the management tools available to the operators for monitoring vehicle counts and toll collections, simplifying revenue collection and counting and for monitoring demand for staffing purposes.

5.1.12 - Photo ID - Centrally-Stored Images

The current computerized technology facilitates maintenance of centrally-stored photo-ID images of all enrolled users. The images can be used by operators and by C & I inspectors to verify authorized users.

5.2 IMMIGRATION ISSUES

Canadian and United States immigration officials share common interests and issues. One slight operational difference is that all primary inspection of persons entering Canada is undertaken by customs staff who are delegated to act on behalf of Immigration Canada and other government agencies. U.S. Customs and U.S. Immigration share primary inspection responsibilities at U.S. entry points.

Common immigration issues can be summarized as follows:

5.2.1 – Personal Interviews

Immigration regulations require all persons to be personally interviewed at the border before being granted entry to either country. However, the personal interview can be undertaken as part of the enrollment process for an automated immigration pre-clearance program. The existing PACE (Peace Arch Crossing Entry) initiative on the British Columbia - Washington state border allows individuals to be enrolled (on an annual basis) in a system which identifies them with a decal affixed to their vehicle, and allows use of an express lane to bypass peak period queues. Comparable programs are operated by both governments to expedite entry into each country.

The process of personal interviews, positive identification and background checks is effectively a pre-screening of low-risk travellers who are afforded certain privileges which

make crossing the border easier. The authorities are able to focus their resources on other travellers.

5.2.2 – Enabling Legislations

Immigration law in Canada permits the use of the PACE type process at any other border crossings. In the U.S., enabling legislation will be necessary to expand the process to other crossings.

5.2.3 – Pre-Screening Low-Risk Travellers

If frequent, low-risk border crossers can be pre-screened for automated clearance, the staff resources which need to be dedicated to this group will be minimized. Vehicle monitoring and video imaging technology could be adapted to eventually permit unmanned operation of automated lanes. Until unmanned operation can be accepted, even with manned operation, the throughput of an automated lane can exceed a manned lane where personal contact must be made with each traveller.

5.2.4 – Focus Available Resources

If low-risk, frequent travellers are pre-screened and authorized to use the automated lane, the remaining staff resources can be focussed on the remaining travellers, which will include those higher risk individuals who may be a concern to either country.

5.2.5 – Cost Recovery

The pre-screening process of interviews and background checks will itself require dedication of staff resources. The net result can be positive if crossings are frequent enough that normal manual processing of each travellers for every crossing would (in total), require more time than the interview and pre-screening. Furthermore, experience with the PACE project has demonstrated that travellers are willing to pay an annual enrollment fee for the convenience, which may defray some or all of the administration costs of the pre-clearance interview process.

5.2.6 – Staffing to Workload

Immigration (and customs) inspection services will continue to be under increasing pressure to respond to growing border crossing volumes with little growth in staff, or to "do more with less".

5.2.7 – Identification of Individual or Vehicle

The PACE system provides identification for a vehicle which may be used by an enrolled individual and certain other qualified family members. If the automated technology can provide for a separate identification for each pre-screened individual, this would be preferable to immigration authorities.

5.2.8 – Automated Lane Operation

The proposed technology will allow unmanned operation of the automatic lanes. Monitoring by detectors and video images (or other techniques) would provide for detection and identification of unauthorized users. Immigration (and customs) have expressed concerns about the acceptability of unmanned operation. The lanes can be designed with a booth which allows for manned operation whenever necessary.

5.2.9 – Effective Traffic Operations

Provision must be made for effective traffic operations in the dedicated lane to ensure maximum benefit to authorized users. Appropriate signing and markings must clearly identify the lane so that unauthorized users are aware that it is a reserved lane. There must be appropriate provisions to detect unauthorized users and to ensure that they do not obstruct the lane, and that they are directed to secondary inspection areas and do not avoid required inspections.

5.2.10 – Enforcement of Dedicated lane

There must be appropriate procedures, delays and penalties as required, to discourage intentional unauthorized use of the dedicated lane and to deal appropriately with unauthorized users.

5.3 CUSTOMS INSPECTION ISSUES

The role and the procedures used by Customs inspection services in both countries continues to evolve, particularly with Free Trade Agreements, with automated procedures and with the approaching application of Electronic Data Interchange (EDI) to the road transport mode. The principal issues for customs are summarized below.

5.3.1 – Staffing to Workload

Customs is experiencing pressure on available staff resources to address the demand at these crossings. Vehicle volume has increased by over 40% since 1984. Opportunities to streamline processing of commercial movements through reductions in paper handling and advance notification of shipments will be welcomed.

5.3.2 – Effects of Free Trade

The Canada - U.S. Free Trade Agreement will result in the elimination of customs duties on most goods over a 10 year period (5 years remaining). However, monitoring of imports will continue. Free trade is expected to result in increased trade activity.

5.3.3 – Paper Handling Reductions

Both countries have initiated major customs modernization improvements, which include efforts to move towards EDI and to reduce the processing of paper records. The proposed implementation of AVI strongly supports these initiatives.

5.3.4 – Integration with Existing Procedures

Present progress indicates that Customs EDI for road transportation may not be fully operational until 1994 or 1995. Even when it is, there will likely be shippers and carriers who will not be willing or able to use EDI to its fullest advantage. Therefore, AVI technology at the border crossings should be capable of supporting and complementing existing customs procedures.

5.3.5 – Flexibility for Future Improvements

AVI technology must be sufficiently robust to be adaptable to future enhancements to customs procedures, such as future widespread EDI usage.

5.3.6 – Automated Lane Operation

This issue is similar to the issue discussed in Section 5.2.8.

5.3.7 – Effective Traffic Operations

See Section 5.2.9.

5.3.8 – Enforcement of Dedicated Lane

See Section 5.2.10.

5.3.9 – Response Time

The AVI system must be designed to advise Customs of the identification of transponder equipped vehicles as they approach the toll area. This should provide sufficient time for Customs to match the vehicle to records of the shipment which were sent to Customs in advance. Alternatively, if the vehicle is equipped with a more sophisticated transponder which can carry the cargo manifest, there must be sufficient response time for Customs to reach a decision on the shipment (i.e., cleared, not cleared, random inspection), and to

communicate the decision to the driver. The driver should receive the communication by the time he reaches the mid-point of the crossing so that he can take action to enter the appropriate lane at C&I inspection.

5.3.10 – Broker Verification

The Customs Broker is involved in many shipments by taking responsibility for the shipment and payment of appropriate duties. The system design must incorporate broker involvement, so that Customs can verify broker actions before clearing shipments.

5.4 USER ISSUES

Contacts were made with a wide range of "users" including commercial carriers, shippers, brokers and representatives of manufacturing and trucking associations. Their issues include the following.

5.4.1 – Information and Marketing

There is a need for information and marketing, both for existing customs procedures aimed at streamlining border crossing, as well as for planned AVI technologies.

5.4.2 – Reduce/Eliminate Paper Work

Users are supportive of streamlining procedures to reduce or eliminate paper handling and repetitive data entry.

5.4.3 – Industry is Using EDI

Industry representatives noted that EDI is already used extensively in many sectors, including the automotive industry. Many shippers, carriers and brokers are ready to expand its applications to border crossing.

5.4.4 – Cost Justification

The costs for in-vehicle equipment, and any other user fees should be modest to encourage maximum enrollment.

5.4.5 – "Orphan" Technology

Some carriers related previous negative experiences when they were encouraged to add electronic monitoring equipment to their vehicles, only to find that it quickly became an "orphan" technology with limited applications and with a limited lifetime.

The concern was expressed that any in-vehicle equipment should be carefully planned and designed to be compatible with requirements for other initiatives such as Advantage I-75/AVION and technology applications at other border crossings. Carriers want to avoid multiple equipment needs in their vehicles.

5.4.6 – Leadership

Industry is looking to government for leadership in defining technology standards and in funding for implementation at the border crossing.

5.4.7 – High Proportion of Regular Users

A high proportion of commercial vehicle crossings are made by a manageable number (perhaps 75 to 100) of carriers. Furthermore, the automotive industry is heavily represented among these shipments. Therefore, support for and participation in the implementation of AVI technology at these crossings can be managed.

5.4.8 – Maximize Enrollment

Industry advocates encouragement for maximum enrollment on automated crossings, which can be realized through modest technology and enrollment costs, and flexible enrollment requirements and procedures.

5.4.9 – Maximize Effectiveness

The effectiveness of the dedicated AVI lanes must be protected to avoid unauthorized use (accidental and intentional) and to maximize the travel time advantages for properly authorized users. Careful attention to signing, marking, driver notification communications, monitoring and enforcement are essential.

5.4.10 – Range of Choices for Users

Although many users will be willing and able to fully utilize advanced technology which incorporates EDI, users expressed the desire for the AVI technology to also support existing procedures. This will ensure that the maximum number of potential users can benefit.

5.4.11 – Reliability

Dependence on advanced technology raised the usual concerns about reliability, and back-up procedures.

5.5 IMPLEMENTATION AND OPERATION ISSUES

Several issues related to implementation and system operation were identified. These transcend individual agency or user jurisdictions, and relate to the border crossing as a system.

5.5.1 – Co-ordination and Funding for Planning, Design, Installation and Commissioning

An organizational arrangement is necessary to accomplish these tasks. At present, the New Technology Committee, funded jointly by the two federal governments together with the provincial and state governments, is providing overall co-ordination with consultants retained to undertake defined work programs. An allocation of funding responsibility for capital costs is yet to be resolved.

5.5.2 – Organization and Funding for Operations and Maintenance

Prior to commissioning of the system, the organization and funding for the ongoing operation and maintenance of the common system elements must be determined. One option would be a third party to operate and maintain the system on behalf of the crossing agencies.

5.5.3 – Common Application

The technology application at these three crossings should be regarded as a test-bed to define a common approach to be used at all Canada - U.S. border crossings, where warranted.

5.5.4 – In-Vehicle Communication

The Steering Committee has determined that in-vehicle communication is a desireable element so that the driver can be notified concerning clearance to use the automated toll or C & I lanes, or other instructions. The exact nature of the visual, audible and text/video display options to be used will be determined.

5.5.5 – System Reliability

The system design must ensure very high reliability, incorporating elements such as dual-processor configurations for redundancy.

5.5.6 – Data Integrity and Security

Tolls, Customs, and Immigration applications will run in their own process computers to ensure data integrity and security. The border crossing system elements will detect and communicate with drivers and vehicles, providing required vehicle/driver data to the appropriate toll, customs or immigration sub-system computers, and relaying appropriate messages generated by each subsystem to the driver/vehicle.

5.5.7 – System Adaptability

The AVI driver/vehicle detection and communication system must be integrated with the toll, customs and immigration subsystems as noted above. The AVI system must be applicable with current subsystem procedures. However, it must be sufficiently robust to be adaptable to more sophisticated vehicle, data and communications systems and to evolving toll, customs and immigration procedures.

5.5.8 – Signal Verification

For verification purposes, the system must retain a record of all vehicle communication commands.

5.6 OTHER GOVERNMENT ISSUES

5.6.1 – System Compatibility

Plans are well advanced for implementation of a Mainline Automated Clearance System (MACS) as part of the Advantage I-75/AVION initiatives which will facilitate commercial vehicle movements throughout the length of the I-75 and Highway 401 corridors from Florida to the Ontario/Quebec boundary. Similar initiatives are under consideration on other major U.S. corridors such as I-80. These systems should be mutually compatible with a border crossing system.

5.6.2 – Intelligent Vehicle - Highway Systems

Intelligent vehicle - highway systems (IVHS) are being actively supported in both Canada and the United States as an opportunity to maximize the efficiency, effectiveness and safety of the huge investments in road infrastructure.

Application of IVHS Technologies to the border crossings is highly compatible with these initiatives, and will actively strengthen the trade and economic interests of both nations.

5.6.3 – Testbed for Electronic Border Crossing

These three crossings account for almost 25% of all Canada - U.S. trade. The needs and opportunities for automated crossings have been well documented. There is an opportunity for these crossings to become the national test-bed for technology which can be applied at other Canada - U.S. highway border crossings.

6.0 A SOLUTION CONCEPT

6.0 A SOLUTION CONCEPT

The basic conceptual requirements of an AVI system are outlined in Section 4.3 of this report. Exhibit 6.1 summarizes the major system features in terms of the minimum functions, and the required adaptability to possible enhancements. The proposed system is designed to work with existing customs commercial clearance programs, with the AVI tag fulfilling the current function of the bar codes on cargo manifests. However, the AVI system will provide the capability to work effectively with possible future customs processes that may be adopted by some commercial carriers, such as pre-arrival notification by EDI or possibly cargo manifests transmitted directly by the AVI tag.

The tag will also transmit driver and passenger identification which can be used by the immigration computer subsystem to verify against records of individuals who have enrolled in the immigration pre-clearance program.

For the electronic toll system, the vehicle ID will be associated with a toll account. The minimum system requirement would require a pre-authorized credit card type of account. The enrolled driver would provide an initial deposit, which would be reduced for each crossing by the amount of the toll. When a minimum account balance was reached, the account would be replenished by a charge against the pre-authorized credit card. Commercial accounts may be handled on a deposit basis. Detailed accounting statements may be available on request for a fee.

EXHIBIT 6.1

SYSTEM FEATURES

	Minimum Functions	Adaptable to Possible Enhancements
Technology Tags and Readers	• 2-way Tag • Vehicle I.D. • Driver I.D. • Passenger(s) I.D. • In-Vehicle Communication (Visible and Audible)	(1) Multiple Passengers I.D. (2) Trailer(s) I.D. (3) Cargo Manifest Data
Tolls	• Toll Account at each crossing • Pre-authorized credit card account - with "Automatic Refill" • Optional "For Fee" Account Statements to Users • Centralized Toll Accounting • Weigh in Motion Toll System for Trucks	(1) Clearing House System - one toll account good at all crossings (2) Toll accounting on "smart card" or plug in device; would carry toll value on card; requires outlets to "refill" card value; could allow either centralized or distributed toll accounting.
Commercial Customs and Immigration	• Driver enrollment in immigration pre-clearance. • Pre-arrival notification to customs (FAX or EDI)	(1) Cargo manifest carried on smart card or plug in device; transmitted directly via tag as truck approaches crossing; shippers would program manifest data onto plug-in device and provide to driver (along with paper back-up copy).
Passenger Vehicle Customs and Immigration	• Driver/Passenger Enrollment in Immigration Pre-Clearance • Rules would establish eligibility of passengers • Rules would define customs flexibility (i.e., nothing to declare, voluntary declaration etc.)	(1) Tag may be able to accommodate several plug-in devices to provide I.D. for multiple occupants.

Possible enhancements could include:

- a common toll account operated by a central clearing house which would allow drivers to use any of the crossings with only a single deposit and account;

- adaptability to toll tags which carry their own value and which can be replenished at "refill" locations when the value is reduced by frequent usage.

6.1 KEY DESIGN CRITERIA

The New Technology Committee established the following key design criteria for the project:

1. Prototype for Demonstration Project
2. Cost Effective
   - users
   - operating agencies
3. Flexibility for Upgrading
4. Not Limited by Current Legislation
   - meet vision
   - identify institutional adjustments
5. Not Constrained by Advantage I-75/Avion Technology
6. Capable of Immediate Implementation
7. Evaluate Cost Effectiveness for Full Implementation
8. Product Will Lead Directly to Design of Demonstration Phase

6.2 OPERATING METHODOLOGY

The system would employ 2-way (read/write) AVI tags as in-vehicle units which also provide in-vehicle communications to drivers. In-vehicle communications may take the form of synthesized voice messages or visual display, or a combination of both. External message signboards and signals are used to deter untagged vehicles from using express lanes. Deterrence can take the form of untagged vehicles being directed to park at

enforcement/emergency areas for toll collection, or to proceed to secondary inspection areas at C&I.

A tag could identify the vehicle. A second tag could identify the driver. One or more passengers may be identified by additional tags. The qualifications would determine the number of tags required. For example, for a passenger car, it may be possible for a single tag to allow the driver to cross alone, or together with other specific pre-cleared passengers such as family members. Also in the case of a passenger vehicle, a personal ID tag may be sufficient, without the need also for a vehicle tag.

For commercial vehicles where drivers may vary, both a vehicle tag (which will be associated with the pre-arrival notification of the shipment) and a driver tag will likely be necessary. A more sophisticated tag that may be desired by some shippers or carriers could transmit information contained on programmable plug-in devices such as PCMCIA[1] cards used with laptop computers. For example, the tag fixed in the vehicle may identify the vehicle, while one plug-in card could provide driver ID. Another plug-in card programmed by the shipper and provided to the driver with his bill of lading could carry the cargo details. It is conceivable that the entire cargo manifest could be carried on a card and transmitted to customs as the vehicle approaches the crossing. This would replace pre-arrival notification. This is regarded as a future opportunity to be considered.

Another plug-in card could be used to carry a pre-paid toll value and to maintain a record of the individual toll account.

An AVI tag which could accommodate plug-in cards is a possible future application that would introduce a higher level of sophistication and higher cost. The system could be designed to accommodate this type of card for some users, while continuing to support a simpler AVI tag which may be the tag of choice for the majority of users, including most passenger car drivers

(1) PCMCIA: Personal Computer Module Card Interface Adaptor

Toll Charge

The toll operator may offer one or more methods of payment. The options could include a pre-authorized credit card account with the toll authority to authorize toll charges, or purchase of pre-paid toll payments to put into a plug-in card. The toll computer maintains records of credit accounts and issues statements to these users at scheduled intervals. The toll computer maintains only passage records for the value card holders.

Customs Commercial Clearance

Commercial vehicles are identified to customs while approaching the toll lane, and can be authorized for customs clearance while making the crossing. The vehicle ID would be matched to the pre-arrival notification stored in the customs computer. The customs clearance would be based on a set of clearance criteria set out by customs and subject to selective interventions or checks by customs officers. A vehicle which is released at the customs primary line will have its shipment details recorded in the customs computer and transmitted electronically by customs to the importer/broker for completion of the "paperwork" and payment of duty and taxes.

Automated customs clearance through the use of AVI tag requires either that a shipper or importer obtains an authorized ID issued by customs or that it obtains clearance through an authorized and bonded customs broker.

Immigration Clearance - Passenger Vehicles

Immigration clearance is linked to individuals or family members and not to entities such as vehicles, shippers, brokers, etc.

An individual and, if permitted, his/her immediate family members who are enrolled in the program (Immigration Pre-clearance Program) and who have nothing to declare at the border crossing will be identified automatically, cleared to pass through the C&I express lane, and logged in a transaction history database. Details of the qualification for pre-

clearance will be established by immigration, but may allow self-declaration of limited imported goods, carrying another pre-cleared individual as a passenger, etc.

Immigration Clearance - Commercial Vehicles

Individual commercial vehicle drivers must also enroll in the Immigration Pre-clearance Program and be authorized to travel on the C&I express lane by immigration.

The AVI tag would identify the auto driver as pre-cleared. The personal AVI tag carried in the cab would identify the commercial driver as pre-cleared.

Occasionally when a random inspection is necessary, C&I will need a procedure to verify that the user is the qualified owner of the AVI key. Since the AVI tags may not carry a photo ID, it would likely be necessary for the enrolled individual to carry some identification. This could be a photo ID, a validated a driver's licence photo ID, a passport to confirm his identity as a condition of using the pre-clearance system. The system may incorporate video images of each individual for verification purposes.

Dedicated Approach Lane

It is essential that a dedicated approach lane can be provided for as far as possible in advance of both the toll barrier and the C&I inspection line. The full benefit of the system cannot be realized if queues develop and impede entry for AVI-tagged vehicles.

Verification

It is expected that both customs and immigration would randomly select enrolled vehicles or individuals to be inspected. Those vehicles would be directed to a regular lane at primary inspection. It is proposed that all lanes would be equipped with an antenna to identify the vehicle and its related driver/cargo data to the officer on duty.

It is important to recognize that the officer has this information about the approaching vehicle. He can then undertake routine questioning and inspection of pre-clearance

identification cards, passengers, cargo manifest, etc., and may elect to require a secondary inspection.

There must be stringent sanctions coupled with cancellation of pre-clearance participation rights if there are violations.

Other Verification Techniques

For vehicles which are permitted to pass non-stop through the automated lane, there are a range of verification techniques which could be considered by the authorities. These include:

- manned booth for visual observations.
- video recognition monitoring.
- both of the above can be compared to on-line video images of the enrolled individual. In the case of visual observations, the image could be displayed on the officer's computer monitor.
- automatic video licence plate recording and reader systems.
- random stopping of vehicles after passage to check pre-clearance authorization.
- the in-vehicle communication display would be designed to retain the clearance authorization for up to 30 minutes so that it could be verified.

Enforcement procedures for non-authorized use of the automated toll lane could range from video licence readers combined with the ability to mail a summons for payment of a traffic violation fine, to physical pursuit. Enforcement procedures for violation of an automated C&I lane would not necessarily be different than current enforcement when a vehicle attempts to pass without stopping. This is not expected to be a significant problem.

6.3 OPERATION

Exhibit 6.2 illustrates proposed border crossing processes for a non-stop passage of a vehicle using an automated system.

Exhibit 6.3 illustrated a conceptual physical and geometric layout for implementing an AVI system for non-stop border crossing. These configurations are conceptual and will vary considerably to suit the specific geometric constraints at each crossing.

Toll

As a vehicle approaches the toll plaza from the access road, advance and overhead message signs are used to direct traffic into proper toll lanes. AVI antennas are installed at location 1, immediately in advance of the toll booths. The vehicle and/or driver ID and the driver's toll payment method are read from the AVI tag by the AVI Reader #1.

If the tag card indicates a credit account, the Toll Computer will validate the account and automatically log the transaction and debit the charge to the account.

If the tag incorporates a plug-in value card, the toll charge will be deducted from the stored value and the remaining balance will display on the driver communication device. If insufficient funds remain, the driver will be notified through the display indication. The message will remain displayed for 10 to 15 minutes to provide verification of toll payment. The plug-in card will store all transactions.

Vehicles passing through the toll express lanes with non-funded value cards, invalid tags or overdue accounts, will be directed by the in-vehicle display to avoid the express lane and use a cash toll lane. If these vehicles, or vehicles without AVI tags, continue to use the express lane, they will be flagged by audible alarms and message sign signals to leave the toll booth area and to park at the enforcement/emergency area. A toll attendant will subsequently collect a toll from the driver at the enforcement/emergency area.

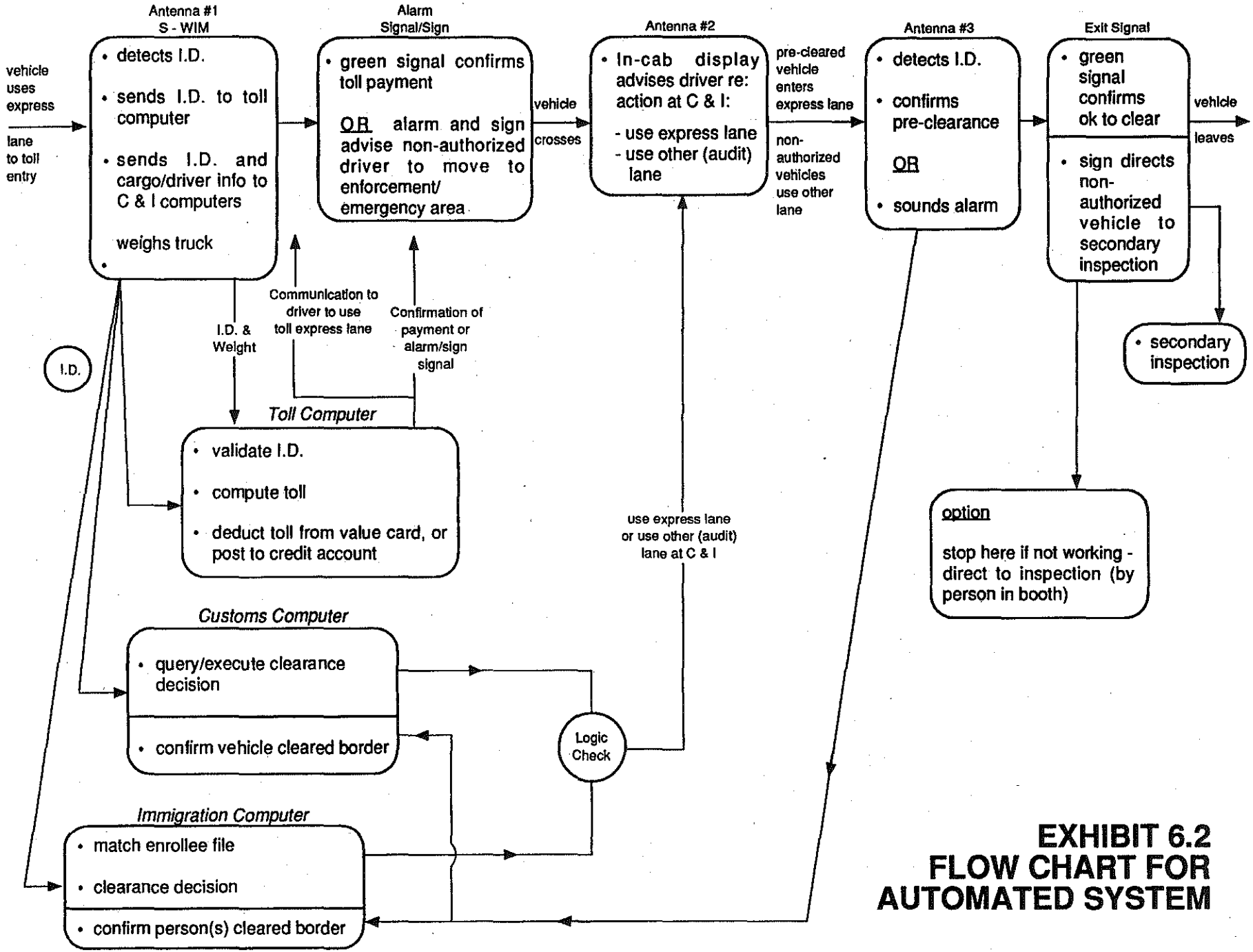
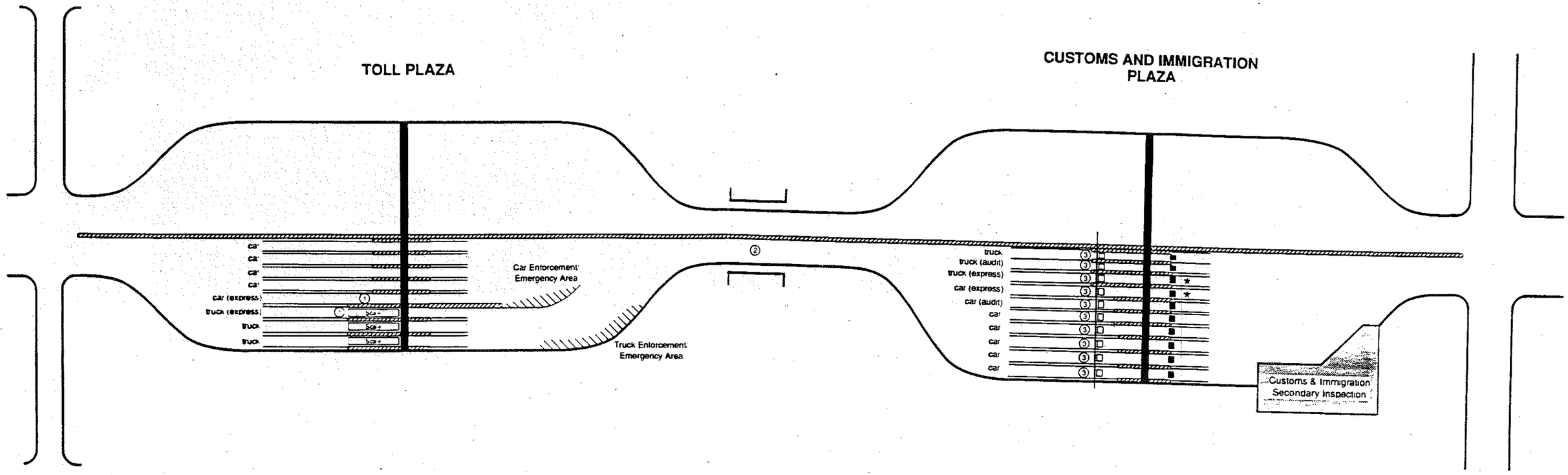


EXHIBIT 6.2
FLOW CHART FOR AUTOMATED SYSTEM



Legend

antenna ..... (#)
detector (passage)..... ■
detector (presence)..... □
message sign/signal/alarm ..... ★
express lane..... ▭

EXHIBIT 6.3
SCHEMATIC LAYOUT FOR AUTOMATED SYSTEM

As an alternative, automatic video licence plate readers may be used to photograph violating vehicles which can then be mailed a fine for violation of the toll. The licence plate number of any violating vehicles would be retained on the data base for further action in the event of additional violations.

Customs and Immigration

The AVI Reader #1 transmits data required for Customs and Immigration clearances from the tag(s) to the Plaza Computers which in turn queries the customs and immigration information systems for clearance processing. It is expected that 3 to 6 seconds will be required to query and receive a response from central customs computers in the U.S.A. and Canada. Immigration information will be readily accessible from the pre-clearance enrollment data base in the local immigration computer.

By the time an AVI-tagged vehicle reaches the antenna locations of the AVI Reader #2, C&I clearances will have been determined and will be available to the Plaza Computer and C&I Officers. The C&I clearance authorizations are transmitted from the Plaza Computer to the vehicle via the AVI Reader #2 and appended to the list of pre-cleared vehicles. The C&I clearance authorizations are checked when the vehicle reaches AVI Reader #3.

Driver Communication

The AVI Reader #2 reads AVI tags, and the Plaza Computer matches the vehicle ID to the list of C&I pre-cleared vehicles. If an AVI-tagged vehicle is C&I pre-cleared, the driver will be instructed audibly or visually through the in-vehicle display to proceed to the C&I express lane. The message will remain displayed for 10 to 15 minutes to provide verification of toll payment.

If an AVI-tagged vehicle is not C&I pre-cleared, the driver will be instructed audibly or visually through the in-vehicle display to proceed to the primary C&I inspection lanes.

C&I Express Lane

An AVI-tagged vehicle with C&I pre-clearance enters the C&I express lane. The AVI Reader #3 reads the vehicle tag(s). The data read by AVI Reader #3 is matched with data in the Plaza computer, and an authorized vehicle and driver will be cleared through Customs and Immigration. The driver is instructed audibly or visually by the in-vehicle display to leave the Customs and Immigration plaza. The C&I clearance authorization for the passage is stored in the Plaza Computer, and will remain on the in-vehicle display for 10 to 15 minutes for verification purposes.

If an unauthorized vehicle enters the express lane, an audible alarm and sign signal message will direct the vehicle to the secondary inspection area. For an AVI equipped vehicle which is not authorized to use the express lane, the in-vehicle display will direct the driver to the secondary inspection area.

Upon exiting the C&I express lane, the vehicle, the driver and its cargo are confirmed to have crossed the border. The vehicle information and its passage are recorded in the Plaza Computer and transmitted electronically to the shipper/importer or broker to complete the "paperwork" and payments for applicable duty and taxes.

6.4 TOLL CHARGES FOR COMMERCIAL VEHICLES

At the Ambassador Bridge and the Detroit-Windsor Tunnel, the existing practice is to charge commercial vehicles by actual weights according to a fee schedule. Commercial vehicles are weighed on a static scale and toll charges are determined accordingly. At the Blue Water Bridge, the toll charge on a commercial vehicle is based on the number of axles.

For non-stop passage of AVI-tagged commercial vehicles through the toll facility, the toll charge process needs to be automated. The following additional equipment is required to automate toll charges:

Ambassador Bridge and Detroit-Windsor Tunnel

For each designated truck express lane, two vehicle presence detection loops will be installed; one immediately upstream from the static scale, and the other one immediately downstream from the same static scale. For toll automation, a PC-based computer system is required with custom software and with interfaces to the loop detectors, the static scale, the AVI reader and the Plaza Computers.

This arrangement provides automatic registration of the gross weight of a commercial vehicle on the static scale and calculates the toll charge for the vehicle without need for toll attendant input or stoppage of the vehicle. The computer system computes the load profile of the vehicle as it passes over the static scale.

Blue Water Bridge

For each designated truck express lane, a treadle with four axle sensors and a vehicle presence detection loop will be installed at the "toll booth" area. A PC-based computer system with custom software is required for toll charge automation. This computer system will interface with the loop detector, the treadle, the AVI reader, and the Plaza Computers.

This arrangement provides automatic counting of the number of axles of a commercial vehicle and calculates the toll charge for the vehicle without the need for toll attendant input or stoppage of the vehicle.

7.0 INSTITUTIONAL PROCEDURES

7.0 INSTITUTIONAL PROCEDURES

Application of AVI technology requires the establishment of appropriate procedures by the implementing agencies (toll, customs, immigration) as well as by users (brokers, shippers, carriers).

7.1 TOLL

Crossing operators now have a variety of toll accounts for commercial carriers. With an electronic system, the vehicle would automatically be identified and the toll would be calculated and accounted for electronically. Current credit or pre-paid systems could be transitioned to AVI-based, and would be fully automated and computerized.

The minimum system for passenger vehicles could operate efficiently with pre-authorized credit card toll accounts. The driver would open an account with an initial payment (say $50). When the vehicle tag is detected with each passage, the toll account is automatically reduced until it reaches a pre-determined minimum ($10). At that time, the credit card pre-authorization allows the toll agency to "refill" the account value by a charge ($40) to the credit card. For a small fee, the driver may obtain an itemized transaction statement from the toll agency. Otherwise, the credit card statement would document the toll account "refill" dates and amounts.

The driver would maintain a separate toll account with each crossing. All crossings could identify the vehicle with a single AVI Tag "I.D." and access the applicable account for that vehicle. If desired, a "crossing clearinghouse" could be created to enable a single account to suffice for all three crossings.

Possible system enhancements could provide the added flexibility to move away from a centralized toll account for each vehicle to a system with a pre-paid toll account value carried on a plug-in card associated with the AVI tag. A card user would "load" value into the card at designated outlet(s) and pay for the value amount loaded. Separate value amounts would be carried for each toll facility to be used. With each vehicle passage,

the toll funds would be electronically deducted directly from the card. The account would be maintained on the card, relieving the toll agency of the need to maintain an account. Ideally, the card would be usable at all toll crossings.

Centralized or Distributed Toll Accounting

The minimum system would require a centralized toll accounting where records of all crossing transactions would be maintained by the toll operator for each vehicle account.

The possible (optional) use of more sophisticated cards would provide the flexibility to use a "distributed" method where the account information is maintained on a plug-in card. Some toll operators are considering a hybrid system with many numerous individual auto accounts on a distributed system and commercial vehicle accounts maintained centrally. Since commercial accounts will contain higher toll values, and individual trucking operators may have numerous vehicles enrolled on one account, a centralized system may be more appropriate.

7.2 IMMIGRATION PRE-CLEARANCE - PASSENGER VEHICLES

One existing model is the PACE project which has been implemented at the Blaine, British Columbia - Bellingham, Washington border crossing (see Section 3.6). Although it does not use AVI, the basic procedure would likely be similar. The specific regulations concerning user admissibility and whether a "no goods" allowed or a voluntary duty declaration approach would be used would be at the discretion of Customs and Immigration.

The enrollment procedure for immigration clearances would include driver registration, qualifications check, personal interview, and perhaps issuance of a photo I.D. card. An annual fee may be charged.

The AVI tag would identify the qualified individual for both the toll account and for Customs and Immigration. It is expected that the AVI tag would be issued by the toll

agency, with any charges for the tag included with the charges for opening the toll account.

With an enhanced tag, a plug-in card could also provide the I.D. for the immigration and customs pre-clearance file.

Drivers may be randomly selected to be directed to an audit lane for normal inspection by an officer. In that situation, driver I.D. information can be displayed on the officer's terminal for checking against a driver's licence or other I.D. which must be carried by all authorized drivers.

7.3 COMMERCIAL DRIVER IMMIGRATION PRE-CLEARANCE

Commercial vehicle drivers also would enroll in the immigration pre-clearance program, generally following the same procedure as for passenger vehicle drivers. However, it is expected that commercial drivers will be issued a separate driver I.D. tag or plug-in card, which could be displayed in any vehicle. This driver ID AVI tag would be separate from the vehicle AVI tag permanently mounted on the commercial truck or trailer. The roadside AVI reader and antenna system in the commercial vehicle lanes/booths will have the capability to separately read and distinguish the driver and vehicle AVI tags. Some AVI technologies are able to read multiple AVI tags concurrently, while others will need dual antennae or possibly dual RF modules for this purpose.

Enrolled drivers might also be required to carry a photo I.D. card.

7.4 CUSTOMS PRE-CLEARANCE

The existing pre-clearance procedures of both Canada and U.S. Customs provide an excellent base of users. Implementation of an automated system should encourage additional enrollment.

Data Entry

The major change required with AVI technology is the need for all shipment information to be processed, usually through a broker, and to be entered in the Customs computer system for review prior to the arrival of the truck at the crossing. Customs can then review the shipment in advance, and determine whether the vehicle is authorized for clearance, or requires manual processing. The procedure will track all data related to the shipment, including shipper, consignee, commodity, duty status, quantity, broker, carrier and vehicle I.D.

The crossing movement can then be confirmed, and duty payment reconciliation can be facilitated.

Pre-Arrival Notification

An essential requirement for full operation of an AVI system is some form of pre-arrival notification to customs. This could be provided via FAX. In the future, an EDI network to link customs, brokers, and ideally shippers, would allow all data entries to be transmitted directly from the shipper to the broker and to the Customs computer system, thereby relieving customs of the data entry requirement, and reducing time required between data transmission and vehicle arrival at the crossing. Road transport EDI is expected to be implemented in 1995 or 1996.

Some shippers may also have the capability for EDI transmission to the broker. In other cases, alternatives such as FAX transmission by the shipper or carrier to the broker, or delivery of the paper copy by the carrier to the broker may be necessary.

With a more elaborate system, the manifest could be read directly from the truck AVI tag as the truck approaches the toll plaza.

The essential change will be that the truck will not be required to stop at the border. To accomplish that, pre-processing of manifests will be necessary.

7.5 CUSTOMS BROKERS

The Role of Brokers

Customs brokers provide the vital link in most commercial transactions, by providing a basis for payment of duty. With the U.S. Customs BCS program, brokers are responsible for the data entry to the customs computer.

As the minimum AVI technology application is envisioned, brokers would provide the link with customs, and would input the cargo manifest and vehicle ID to the customs computer system prior to vehicle arrival. In some cases, shippers may initiate the data entry and transmit via EDI (when available) to the broker. In some cases, FAX or telephone links from shipper or carrier to the broker in advance, will allow the broker to prepare the customs data entry.

Broker Office Hours

Broker facilities and services must be available when needed to ensure that truck movements can utilize the AVI system. Comments received during the study indicated that brokers are usually available during normal business hours. Availability during evenings and weekends is difficult at times, and at a premium rate.

An AVI system may ease these concerns by providing a means for shippers to send the required information to brokers for input to customs during normal business hours, thereby allowing the flexibility for the truck to arrive at the crossing at any time.

7.6 SHIPPERS

In order to take full advantage of the AVI technology for non-stop automated truck crossings at the border, shippers must have the capability to provide the cargo manifest and vehicle ID to the broker and customs.

The most efficient method would be for the shipper to prepare the manifest with vehicle ID in an EDI compatible format, and to transmit it to the broker and customs. Since the shipper routinely prepares the manifest initially, this will ensure that it is only prepared once during the entire sequence of the border crossing. Single handling would reduce the potential for error which could occur with existing procedures.

In the ideal situation, the shipper would also have EDI capability to electronically transmit the manifest (with truck ID) to the broker for passage on to customs prior to vehicle arrival at the border.

7.6.1 - Pre-Arrival Notification

At the present time, EDI is not operational for the road transport mode. Pre-arrival notification can be accomplished by FAX transmission of cargo manifest data from shipper to the broker at the crossing. The broker would then arrange for entry of the cargo manifest to the customs computer system. The data (and a customs clearance decision) will then be resident in the local customs computer when the truck is detected approaching the crossing.

7.6.2 - Electronic Data Interchange (EDI)

A fully automated system can work most efficiently when a working EDI system is in place, at a minimum between brokers and customs, and ideally with shippers as well, as noted above. Considerable work on EDI has been in progress for some time in both the U.S. and Canada, although it is not clear that a workable EDI system can be implemented immediately. Canada Customs may not have EDI available for the trucking sector until at 1995 or 1996.

It is envisioned that EDI would work as follows:

- Shipper prepares cargo manifest. The manifest currently identifies shipper, consignee, commodity, duty status, quantity, and broker. With AVI, the manifest would also include carrier and specific vehicle ID.

- The manifest, which is prepared in the first instance by the shipper, would become the single data entry to cover the entire border crossing transaction, and would provide all information required for all parties involved.

- With EDI, the manifest would be transmitted directly to the broker and on to the Customs computer while the truck is travelling to the border crossing.

7.6.3 - Cargo Manifest on a Plug-In Card

With a more sophisticated tag combined with plug-in cards, the cargo manifest information could be carried with the vehicle. For those vehicles, an EDI link from shipper to broker to Customs would not be needed, although it would facilitate transaction reconciliation after crossing (i.e. duty payment), and monitoring of truck crossing.

When the shipper prepares the computerized cargo manifest, it could also be programmed to the plug-in module which would be provided to the driver.

The AVI tag would have the capability to transmit the card so that when the vehicle passes by the AVI readers at the border crossing, the manifest and the vehicle ID can be read from the AVI tag.

If AVI antenna #1 is placed on the approaches to the toll plaza, the manifest information can be transmitted to the local customs computer, and then on to the central customs computer for a clearance decision while the vehicle is passing through the toll plaza approaching the C & I inspection area.

This should provide sufficient time for a clearance decision to be made, and then transmitted to activate the in-vehicle communications instructions at AVI Antenna #2 as the vehicle is on the crossing.

In this scenario, the broker must also be involved to guarantee the shipment in terms of duty payment. Therefore, an EDI link may also be necessary, unless the broker

identification is also provided on the plug-in card and the broker is adequately notified of the transaction.

This method may be of interest to some shippers and carriers.

7.7 CARRIERS

Carriers will be responsible for several actions to facilitate the use of AVI technology, including:

- Procurement, installation, operation and maintenance of in-vehicle AVI tags.
- Establishment of appropriate toll accounts, or a procedure to maintain adequate toll value on a plug-in card in the case of an enhanced tag system.
- A procedure to ensure that qualified drivers are enrolled in both U.S. and Canadian immigration pre-clearance programs.
- Provision of the drivers immigration pre-clearance AVI tag (or plug-in card).
- Close liaison with drivers, shippers, brokers and customs to establish an appropriate communications link such as FAX initially and EDI in the future and to ensure that the cargo manifest and truck ID is transmitted to customs prior to vehicle arrival at the crossing.
- For an enhanced tag system, close liaison with shippers and brokers to ensure that plug-in cards are conveniently available to drivers and that the cargo manifest data is programmed on the card to be carried in the vehicle.

8.0 COSTS AND BENEFITS

8.0 COSTS AND BENEFITS

The costs and benefits associated with strategies to expedite international border crossings are discussed in this chapter.

8.1 POTENTIAL MARKET FOR AVI TAGS

8.1.1 - Automobile Traffic

As noted previously, 18.9 million automobile trips annually are made on the three crossings combined. Data is available for the tunnel which indicates the trip frequency. For every 100 tunnel "customers" interviewed after entering Canada from the tunnel, the trip frequency was found to be as shown in Exhibit 8.1.

Similar data is not available for the bridges. However, it is expected that infrequent tourist trips would occur more often than at the tunnel, because the bridge access routes connect directly to the freeway network and by-pass downtown areas of Detroit and Windsor. The estimates shown in Exhibit 8.1 are based on the assumption that the proportion of quarterly or less frequent trips are double at the bridge relative to the tunnel. Furthermore, it is possible that daily trips will be less relative to weekly or monthly trips. Exhibit 8.1 indicates an estimated range for these three categories.

EXHIBIT 8.1
NUMBER OF AUTOMOBILE CUSTOMERS

Frequency of Crossing	Number of Customers (per 100 Customers at Tunnel)	Estimated Number of Customers (per 100 Customers at Bridges)
Daily	28	16 - 22
Weekly	33	29 - 26
Monthly	21	19 - 16
Quarterly	4	8
Less Frequently	14	28

Using the number of annual trips for each frequency category (i.e. 230 trips per year by each daily customer, 50 trips per year by each weekly customer etc.), and the annual automobile volumes on each crossing, it is possible to estimate the number of unique customers who would use the crossing once or more each year. The detailed calculations are shown on Exhibit 8.2.

Exhibit 8.3 indicates the number of customers in each frequency category for the three crossings combined. The number of customers has been discounted to 68% of the customers calculated in Exhibit 8.2 since the statistics on user frequency reflect a typical weekday at the tunnel. It is estimated that the weekday traffic volumes (5 days) represent 68% of total weekly traffic, based on count data available at the Blue Water Bridge. Although there are likely to be potential AVI customers among weekend users, the estimates are based on known weekday data.

Also shown in Exhibit 8.3 is an estimate of the proportion of customers in each category who may choose to enroll in an AVI tag system.

EXHIBIT 8.3
ESTIMATE OF POTENTIAL AUTOMOBILE AVI ENROLLMENT
(All Crossings)

Frequency of Crossing at Tunnel	Number of Crossing Customers	Potential Enrollment	
		%	Number
Daily	19,800 - 21,500	60 - 80%	11,900 - 17,200
Weekly	25,300 - 30,900	30 - 50%	7,600 - 15,500
Monthly	15,700 - 20,000	25%	3,900 - 5,000
Quarterly	6,100 - 7,100	-	-
Less Frequently	20,500 - 24,500	-	
			23,400 - 37,700

A total of 23,000 to 37,000 automobile customers can be expected to enroll.

EXHIBIT 8.2
FOR EVERY 100 CUSTOMERS WHO USE THE CROSSING

Customer Trip Frequency	# of Trips per Year per Customer	# of Customers (per 100 Customers)	Total Trips (per 100 Customers)	% of Total Trips	All Customers at Crossing # of Annual Auto Trips (2 Way)	All Customers at Crossing # of Customers
1) Detroit-Windsor Tunnel						
Daily	230	28	6,440	76.9%	2,768,000	12,000
Weekly	50	33	1,650	19.7%	710,000	14,200
Monthly	12	21	252	3.0%	108,000	9,000
Quarterly	4	4	16	0.2%	7,200	1,800
Other	1	14	14	0.2%	7,200	7,200
			8,372		3,600,000	44,200
2) Ambassador and Blue Water Bridges						
Daily	230	16 - 22[1]	3,680 - 5,060	67.9 - 76.6%	3,975,000 - 4,480,000	17,200 - 19,500
Weekly	50	29 - 26[1]	1,450 - 1,300	26.7 - 19.7%	1,565,000 - 1,150,000	31,200 - 23,000
Monthly	12	19 - 16[1]	228 - 192	4.2 - 2.4%	246,000 - 168,000	20,500 - 14,100
Quarterly	4	8	32	0.6 - 0.5%	35,000 - 29,000	8,750 - 7,250
Other	1	28	28	0.5 - 0.4%	29,000 - 23,000	29,000 - 23,000
			5,428 - 6,610		5,850,000 - 5,850,000	106,650 - 86,850
				TOTAL		**150,850 - 131,050**

(1) Ranges shown to account for possible lower proportion of customers who cross daily in comparison to Tunnel.

8.1.2 - Truck Traffic

A total of 2.7 million truck trips are made each year on the three crossings combined. In the absence of data on the frequency of crossings, an estimate of the range can be made based on the following assumptions:

- 30% of truck trips are daily crossings
- 30% of truck trips are weekly crossings
- 30% of truck trips are monthly crossings
- 10% of truck trips are once per year

Based on these assumptions there would be 15,150 truck "customers" using the three crossings. If the potential enrollment percentage for trucks was as shown below, there could be 7,600 trucks enrolled in an AVI system.

Trip Frequency	Number of Truck Customers	Potential AVI Enrollment	
		%	Number
Daily	4,600	80%	3,680
Weekly	4,600	60%	2,760
Monthly	4,600	25%	1,150
Less Frequently	1,350	-	
	15,150		7,590

8.2 FRAMEWORK FOR COST ESTIMATES

For the implementation of an AVI system, there are four major categories of cost items. These categories are hardware, software, installation and engineering services.

Hardware costs include AVI Readers, AVI antennas, Plaza Computer, in-road sensors, in-booth alarm signals or monitors, external message signs and signals for the two toll express lanes and the two C&I express lanes at each crossing.

Software costs include packaged software license fees, software development for AVI integration, software development for toll, customs and immigration applications, and software development for toll accounting. Software development cost also includes testing and commissioning of software.

A number of standard and custom software packages would be used in the development of the system. These packages augment the development of other applications software for toll, customs, immigration and accounting. These packages include RDBMS (Relational Database Management System), software tools, toll collection, communications management, network management and Operating System. The use of packaged software reduces the overall system development time and cost.

Installation costs include labour and materials for electrical and civil works.

Engineering services include site preparation, documentation, training and project management.

8.2.1 - Plaza Computers

Independent Process Computers

The proposed Plaza Computer installation at each site consists of a dual-processor communications control computer (CCC) system and independent process computer systems for toll, Customs and Immigration applications. The CCC system controls and co-ordinates communications between the Plaza Computer and AVI Readers and controls and routes communications and information to/from vehicles from/to either toll, customs or immigration application process computers.

Individual application process computers may be designed with dual-processor configuration for redundancy. The level and degree of redundancy can be determined during system analysis and design phases of implementation. Redundancy can range from stand-by, manual switch-over, hot stand-by, fault-tolerant and non-stop computer operations.

Toll, customs and immigration applications run in their own process computers within the proposed Plaza Computer installation. Access to data and information for individual applications is controlled by multi-level password and application-specific security within their operating environments. Additional security may be provided using magnetic card readers or palm readers at additional cost.

The hardware cost of a Plaza Computer installation for each site includes two (2) colour work stations and two (2) printers (one laser and one matrix printer) for each application process computer. In addition, a console terminal and matrix printer are included for the communications control computer.

Optional Single Computer Configuration

A second computer system option can also be considered. Toll, customs (local) and immigration applications could all run in a single Plaza computer. A non-stop, dual processor computer system would be the ultimate choice for mission critical applications. This type of computer system is specified in all Defence and Banking applications.

8.2.2 - System Cost Estimates

The following estimates are based on 6 sites at the three border crossings. Each direction of border crossing is considered a site. Each site has two express lanes (one for passenger vehicle and the other one for commercial vehicle) at toll and two express lanes at C&I.

Automatic video licence plate detection and recording may be desirable for the express lanes at toll and C&I. Systems are now available on the market at a cost ranging from C$25,000 to C$50,000 per lane.

A total of eight lanes at each crossing would be included.

		Toll		C&I
Hardware				
Plaza Computer Equipment	C$	107,200	C$	214,200
Warranty on Equipment	C$	12,900		25,700
Booth Computer Equipment	C$	11,950		31,900
Warranty on Equipment	C$	1,300		3,500
AVI Equipment	C$	22,160		100,000
Treadles, Loops	C$	9,100		0
In-booth Alarms, Signs		10,200		23,700
TOTAL HARDWARE	C$	174,850	C$	399,000
Software				
Plaza and Booth Equipment	C$	60,000	C$	120,000
Installation				
Computer, AVI, etc.	C$	30,900	C$	61,500
Video Enforcement				
Image Processing	C$	0	C$	200,000
Engineering Services	C$	8,400	C$	16,650
TOTAL PER SITE	**C$**	**277,150**	**C$**	**797,500**
TOTAL PER SYSTEM (6 sites)	**C$**	**1,645,000**	**C$**	**4,785,000**
OVERALL TOTAL		**C$6,430,000**		

8.2.3 - In-Vehicle Units

The Advantage I-75 tender indicates that a basic vehicle transponder tag with minimum driver communication display capability will cost approximately C$94 (U.S.$75). This cost has been used for this analysis, although other recent tag cost quotations have indicated that there are prospects for substantially lower tag costs.

The potential enrollment of autos and trucks in an AVI tag system was discussed above. It is estimated that 23,000 to 37,000 automobiles and approximately 7,500 trucks may be equipped.

Based on an average figure of 30,000 automobiles plus 7,500 trucks, the total cost to users for in-vehicle tags would be approximately C$3,500,000.

8.2.4 - Project Management

Implementation of an AVI system will include several project management activities which can be expected to add the following costs:

• System design and engineering	C$	400,000
• System implementation management	C$	500,000
• Marketing and public information program	C$	300,000
• Project evaluation plan	C$	250,000
Sub Total	C$	1,450,000

If allocated to Toll and C&I in proportion to the costs shown on page 8-7, the total cost would increase by C$370,000 to **C$2,015,000 for toll**, and by C$1,080,000 to **C$5,865,000 for C&I**, as shown in Exhibit 8.14.

8.2.5 - Project Cost Summary

The total system costs are summarized in Exhibit 8.4.

EXHIBIT 8.4
ESTIMATED PROJECT COST - ADVANCED TECHNOLOGY SYSTEM

System Design and Engineering	C$ 400,000
System Implementation Management	C$ 500,000
Equipment Procurement and Installation	C$ 6,430,000
Marketing and Public Information Program	C$ 300,000
Project Evaluation Plan	C$ 250,000
Total Project Implementation Cost	C$ 7,880,000
User Costs for Vehicle Transponders	C$ 3,500,000

8.2.6 - Administration Costs

An administrative function must be established to provide the AVI tags to vehicle owners. It is expected that all AVI tags will be used for electronic toll collection, while automated C&I clearance may not be used by all vehicles, or not for all trips. Therefore, it is likely that AVI tag distribution will be handled by the toll operators. Tag costs may be included in the initial account charge to users. Operating costs will be offset by the expected benefits which are outlined below.

Toll operators will also be responsible for maintaining toll account transactions and balances. This should reduce or eliminate administrative costs for printing/manufacturing, distributing, collecting and counting toll tickets or tokens which are currently in use.

Customs costs should be streamlined by reduced staffing required to process AVI users, and third party entry of cargo manifest data.

Immigration will incur additional administrative costs for processing immigration pre-clearance applications. However, these costs should be offset by the annual fees which

will likely be imposed, and by reduced staffing to process pre-clearance participants each time they cross the border.

8.3 FRAMEWORK FOR BENEFIT ASSESSMENT

Coarse estimates for the benefits related to an automated border crossing system are presented in the following paragraphs. The first step is to identify the expected benefit categories. Next, an approximation of benefit values for various categories is derived based upon estimates developed in several different ways. Finally, the results are generalized to provide an aggregate range for the benefits. By their very nature, some of the expected benefits are very difficult to quantify; therefore, the results should be interpreted as merely indicative of potential benefits.

8.3.1 - Definition of Benefits

Benefits related to automation of border crossings are judged to accrue to three groups – the users, the facility operators (toll entities in this case), and the Customs and Immigration (C&I) services.

The benefits can be categorized as follows:

- Benefits for users
  - time savings
    - direct, (toll, C&I processing)
    - indirect (queue time)
  - cost savings
  - convenience (avoidance of finding/carrying cash or ticket for toll, rolling down window, stopping, interviews (C&I), inclement weather, etc.)
  - commercial fleet operations
    - driver training re border crossing procedures
    - accounting (expense reports, paperwork, petty cash)
    - reduced errors/omissions in documentation, paperwork)

- other benefits

- Benefits for toll operators
  - collection cost savings
  - increased capacity (reduced expansion cost for same demand volume)
  - toll processing savings (reduced ticket printing, cash counting, commercial accounting, reduced toll revenue shrinkage/loss; debit toll account revenue float)
  - improved management information for staffing, scheduling, planning, performance evaluation, and other decisions
  - improved customer service quality/public relations

- Benefits for Customs and Immigration
  - increased third party user data entry
  - automation of records and systems
  - reduced inspector hours
  - improved management information for staffing, scheduling, planning, performance evaluation, and other decisions
  - improved customer service quality/public relations

8.3.1.1 - User Benefits

Time savings: Border crossers who are eligible to participate in an automated crossing program are expected to save time for each crossing. Time savings will result directly from faster service time at toll booths and at C&I inspection booths. In order to achieve a meaningful time savings, both toll and C&I lanes must be automated. In addition to the direct service time savings, indirect time savings will accrue to passenger vehicles and commercial vehicles from reduced time waiting in queue to get to the toll and C&I processing booths. These are discussed below and summarized in Exhibits 8.7, 8.8 and 8.10.

Currently, direct toll service time (that is the time required to process an individual toll transaction) is approximately 9 seconds per passenger vehicle and from 35 to 55 seconds per commercial vehicle; the range for commercial vehicles is due to weighing trucks at some facilities and not at others as well as differing procedures to process commercial accounts. Electronic toll collection can be accomplished in 3 to 4 seconds for both autos and trucks, with or without weight measurements.

The significant time savings result from the combination of direct time saved plus the indirect time savings related to waiting in line to reach the toll or C&I booths. The indirect time is much more variable and more difficult to estimate. No records are presently maintained regarding average queue time or queue backup lengths. Vehicle arrivals at the border follow a cyclical pattern daily but exhibit broad stochastic swings over short time periods. Budget constraints dictate prudent use of staff resources for manning, generally around the "average" historical conditions. Therefore long queues can develop during certain intervals when traffic arrivals are well above the norm. Good weather, sporting events, conventions, retail sales, and weekends/holidays may cause traffic spikes and resulting surges in queue times. Finally, since truck and auto service lanes are separate at most of the border facilities, variations in the relative demands may create unusual queues of one or the other at different times.

Cost savings: Automating border crossing will yield cost savings for some commercial vehicles in addition to the time savings discussed above. Auto border crossers may also realize various forms of cost savings but these are expected to be of minor significance and not considered in the benefit analysis. Some motor carriers direct their drivers to a nearby terminal before proceeding to the border crossing, to check paper work, make sure that broker paperwork has been processed, and generally to reduce the likelihood of problems and delay at the border.

Automating the border crossing via electronic filing of paperwork and processing qualified carriers electronically at express lane C&I border inspection booths should enable some carriers to eliminate stops at nearby terminals. Those carriers who are able to eliminate intermediate stops will realize additional time and operating cost savings.

Convenience: Electronic payment of tolls and processing through C&I booths will provide added convenience to participants. While a quantitative value for convenience is difficult to quantify, nonetheless, not worrying about carrying cash or retrieving it from wallets or purses for tolls; not rolling down windows in cold or hot weather; not stopping; not being interviewed (C&I); and not being exposed to inclement weather provide value to the users. Evidence that consumers value convenience is demonstrated by the fact that over 20,000 tollway users in Dallas were willing to pay a 5% to 10% toll surcharge for electronic toll processing even when they gained no time savings or other direct benefits.

Commercial fleet operations: Commercial fleets spend considerable time in training and indoctrination of drivers regarding procedures, paperwork preparation, and related matters to avoid delays at border crossings. These costs can be mitigated somewhat by filing customs documents electronically.

An automated border crossing process would be fully integrated with Advantage I-75 and AVION programs to foster seamless, paperless, non-stop truck operation throughout a trip in the I-75/Hwy. 401 corridors.

Also, electronic pre-filing coupled with automating more of the crossing inspection and release processing, should enable commercial fleets to reduce errors and omissions in documentation paperwork and thereby reduce delays associated with improper documentation at the border.

Electronic toll processing and automated debit or billing will relieve some accounting steps for commercial operators who now process driver expense reports, manually reconcile crossing receipts with invoices, and handle related paperwork and petty cash transactions for toll payments.

Other benefits: This category, while most difficult to quantify, is estimated to be large in magnitude. One segment of this benefit is the potential reduction in truck schedule allowances currently incorporated for uncertainty in border crossing time. In our interviews with carriers and shippers, many reported that they build in an allowance of

one hour or more for border crossing. The schedule allowance is added due to uncertainty. If electronic pre-entry and automated border processing can stabilize the actual border crossing times many of these carriers and shippers can control their schedules more tightly and realize productivity gains in their operations.

8.3.1.2 - Toll Operator Benefits

The estimated benefits for toll operators fall into five categories:

Collection cost savings: Electronic toll collection will speed up toll processing and in the process will enable reduction in collector labour hours. The savings will evolve in two ways. First, an express electronic toll lane can process about 900 to 1,200 vehicles per hour compared to about 400 per hour by current manual collection methods. Therefore, even if the express lane is manned, a single booth attendant is able to process three times as many vehicles per hour. Stated another way, the electronic lane attendant can do the work of three manual collection attendants (presuming there are enough vehicles enrolled for electronic toll). Additionally, over time, the express electronic lane will not need to be manned at all, yielding yet further labour savings.

The above observations are even more dramatic for commercial vehicles which now take 35 seconds to 55 seconds for toll processing. An electronic express toll lane can easily handle five to ten times as many trucks per hour.

Increased capacity: Effectively, an electronic express lane increases the capacity of the facility by processing vehicles more quickly. In the absence of this electronic technology capacity option, traditional approaches to gain more capacity would rely on physical plaza expansion which is extremely capital intensive. Electronic toll collection, therefore, is an instrument to reduce capacity expansion costs for an equivalent demand volume.

Traffic increases can be expected because of the influence of a number of factors including free trade, NAFTA, the proposed Windsor casino, and general economic recovery. Electronic lanes will allow toll operators to accommodate growth more economically.

Toll processing savings: Present toll collection methods include cash counting, printing and sales of multiple ticket books for volume users, commercial account invoicing, and collection audit processes. Electronic toll collection reduces or eliminates these costs by substituting electronic, computer readable media for many of the steps. For example, electronic toll collection could replace commuter tickets; electronic tolls eliminate cash counting as the toll funds are collected and reconciled directly by computer and then deposited via electronic funds transfers; commercial accounts similarly can be invoiced by computer from electronic toll records.

Another positive feature of electronic toll collection is reduction of cash handling. This translates into reduced revenue loss/shrinkage for the toll agency. Finally, electronic debit toll accounts provide a revenue float for the toll agency.

Improved management information: Electronic toll collection in combination with the automation steps planned by toll operators will provide significantly improved statistics for a variety of management uses. These include traffic and revenue information, staff scheduling, performance evaluation, planning, and other decisions. Collectively these improved information resources will aid operating managers with timely inputs for operating, financial, planning, and control decisions as well as support their information dissemination activities more effectively.

Improved customer service: Customer service quality is improved with electronic toll collection in at least two ways. First, toll customers gain directly from reduced queue and service times. Secondly, electronic toll collection provides consumers another option with considerable convenience quality; therefore, users can choose which option best fits their individual needs. Finally, since there are competing facilities for the border crossing, electronic toll collection offers a competitive marketing and public relations tool for attracting and/or retaining business.

8.3.1.3 - Benefits for Customs/Immigration

The estimated benefits for Customs and Immigration (C&I) services are somewhat similar to those for toll operators; they fall into five categories:

Increased third-party (user) data entry: The proposed border automation procedures rely upon third-party (shipper, broker, importer) electronic pre-entry filing of customs and immigration clearance data. Third-party data entry is well established in U.S. Customs clearance processing for ocean, air and rail shipments; the proposed border crossing automation procedures will further extend that strategy. For Canadian Customs, the proposed automation will reduce current Customs data entry efforts by shifting it to third-parties, allowing Customs to redirect those resources.

This process improvement requires a well-established EDI capability, which will facilitate tracking of goods shipments and reconciliation of duty payments.

Automation of records and systems: The proposed border automation steps reinforce and continue C&I strategies to automate their processes for maximum productivity and efficiency.

Reduced inspector hours: Automating border crossing and release processing for low risk travellers will enable reduction in inspector labour hours. The savings will evolve in two ways. First, an express electronic lane can process over 900 vehicles per hour compared to about 120 autos per hour and about 60 trucks per hour by current manual methods. Therefore, even if the express lane were manned, a single inspector is able to process an order of magnitude more vehicles per hour. Stated another way, the electronic lane inspector can process the equivalent of several, perhaps six, inspectors using current manual inspection and release procedures (presuming there are enough vehicles and people enrolled for electronic border clearance).

Additionally, if the system is designed properly, it should not be necessary to man the express electronic lane at all. Transition to unmanned operation may evolve in steps over time, but will yield further labour savings.

With resources being frozen, or even reduced, increased traffic demands can be serviced with existing staff complements. Furthermore, available manpower can be focussed on better control of border entry since the frequent, low risk travellers can be processed electronically.

Improved management information: Automating border crossings for selected travellers and commercial operators via automated identification technology can provide highly useful management information resources. Most importantly, automation provides a tool to assess emerging strategies and options for meeting border crossing demands under stringent budgetary constraints. Carefully designed experiments, and assessment of behaviour responses to traveller and commercial border release programs can assist in refining policies, strategies, and operations.

Improved customer service: The Ambassador Bridge and Detroit Tunnel border crossings lie in the midst of a large, metropolitan, urbanized area. Interaction between residents on the Canadian side of the border and Michigan residents on the other side is extensive and routine — for a broad variety of work, social, commerce, education, entertainment and cultural activities. Area residents expect relatively free cross border travel. Automating border crossings selectively for low risk travellers will assist in accommodating ever-increasing crossing demand with improved service quality at the same time that it assists C&I to effectively deploy available resources.

Border crossing automation will generally improve service quality at the border. These improvements are important to commercial operators as well as the region's businesses and manufacturing concerns and the substantial commerce and trade between Canada and the United States.

8.3.2 - Estimates of Benefits

Using the benefit categories described above, several different estimating techniques have been used to get a preliminary fix on the scale of potential benefits. These estimates are

quite crude; they should be interpreted only as first approximations pending more definitive work.

Several methods used to estimate the value of the benefit categories are discussed in the following section.

Exhibit 8.5 shows the makeup of the crossing volume for each of the three border crossing facilities at Detroit-Windsor and Port Huron-Sarnia. The total crossing volume in 1992 was estimated at 21.6 million vehicles per year, of which 18.9 million are autos and 2.7 million are trucks. Passenger vehicles are reasonably evenly distributed among the Blue Water Bridge, the Detroit-Windsor Tunnel and the Ambassador Bridge. Trucks crossings are far more heavily concentrated on the Ambassador Bridge (60%) and the Blue Water Bridge (30%); about 10% of truck crossings use the Detroit Windsor Tunnel.

EXHIBIT 8.5
BORDER CROSSING TRIP VOLUMES (MILLIONS/YEAR)

Facility	Cars	Trucks	Total
Ambassador Bridge	6.5	1.6	8.1
Blue Water Bridge	5.2	0.8	6.0
Detroit-Windsor Tunnel	7.2	0.3	7.5
Total	18.9	2.7	21.6

Traveller User Benefits - Frequent Border Crossers

A first estimate of traveller benefits was based on the proportion of frequent border crossers and their estimated enrollment to participate in an automated border crossing program.

Survey data for the Detroit-Windsor Tunnel indicates about 82% of auto crossers make at least 12 trips per year; further, 64% of passenger vehicles had a single occupant. This group (frequent crossers who drive alone), would be the easiest to pre-clear and automate for crossings. A smaller proportion of the total auto crossings on the Ambassador and

the Blue Water Bridges are estimated to be frequent users and solo drivers. These routes connect directly with major highways in Ontario and Michigan and a larger share of their auto volumes are visitors and other long-distance travellers.

Exhibit 8.6 shows estimated auto crossing volumes by user frequency, the estimated annual trips made by each user category, and the expected percent enrollment in an automated border crossing program. Based on the projected enrollment, an annual volume of 3.9 million or 20% of all auto border crossing trips are forecast under the automated system.

The benefit value for these trips can be inferred from experience with the "PACE" pre-cleared crossing project between British Columbia and the State of Washington. PACE participants paid an annual fee of U.S.$25 and C$10 respectively to participate. If we assume an annual average of 50 trips (e.g., approximately one per week), the fee paid to participate in PACE works out to C$0.60 one way. Using C$0.60 per trip, and the estimated 3.9 million one-way trips across the Detroit and St. Clair Rivers, we deduce a benefit value of C$2,350,000 per year.

EXHIBIT 8.6
ESTIMATED ENROLLED TRIPS BY FREQUENT AUTO CROSSERS

Frequent Crosser Categories	% at Tunnel	% Est. for Border	Est. Annual Trips (mill)	% Est. Enroll-ment	Est. Enrolled Trips (mill)
Solo Drivers	52.5	38.0	7.2	40	2.83
Family	13.1	16.7	3.2	20	0.64
Business	12.3	13.7	2.6	15	0.39
Other & w/Duty)	4.1	7.6	1.4	0	0
Subtotal			14.4		3.91
Occasional	18.0	24.0	4.5		0

Approached from a different view, the C$2,350,000 estimated benefit works out to be the equivalent of about 4 minutes saved for a commuter whose value of time is approximately C$9.00 per vehicle hour; solo drivers are estimated to be the largest share of participants in an automated crossing program.

Toll and C&I Primary Service Time Savings

Automated border crossings for cars and trucks will reduce the primary service times at both the toll booths and the C&I inspection booths. Current service times are shown in Exhibit 8.7. The automated crossing program will reduce service times to approximately three seconds at the express toll lanes and at the express C&I booths. Service time savings per trip for auto travellers enrolled in the automated system will be about 36 seconds; for trucks, the average primary service time savings will be about 90 seconds.

EXHIBIT 8.7
CURRENT PRIMARY SERVICE TIMES AND AUTOMATED SAVINGS

Facility	Auto Toll & C&I Times (secs)	Truck Toll & C&I Times (secs)	Est. Auto Time Savings (secs)	Est. Truck Time Savings (secs)
Blue Water Bridge	9+34	34+68	36	90
Detroit-Windsor Tunnel	9+33	36+54		
Ambassador Bridge	9+29	53+57		

The aggregate primary service time savings will be directly proportional to the number of trips enrolled in the automated crossing program. The maximum benefit is the avoidance of queue delays by use of the automated lanes. Exhibit 8.8 shows the estimated range of savings based on auto traveller value of time of C$9.00 per hour and truck time valued at C$38 per hour. With 10% participation of autos and trucks, the savings per year would be C$410,000; for 20% or 30% enrollment it would be C$760,000 million or C$1,170,000 per year respectively.

EXHIBIT 8.8
ESTIMATED ANNUAL PRIMARY SERVICE TIME SAVINGS

Mode	Estimated Annual Primary Service Savings (C$ thousands/year) Per Cent Enrollment		
	10%	20%	30%
Auto	C$135	C$270	C$410
Truck	C$250	C$510	C$760
Total	C$390	C$780	C$1,170

In Section 8.1, the potential enrollment was identified to range from 23,000 to 37,000 automobiles and approximately 7,500 trucks. As shown in Exhibit 8.9, a median value of 30,000 autos would represent approximately 20% of all auto trips which is consistent with the estimate described previously. The 7,500 trucks would represent as many as 37% of all truck trips. However, information on truck trip characteristics is limited. A reasonably conservative estimate of annual primary service savings using 32% of truck trips would be:

Auto	(20%)	C$ 270,000
Trucks	(32%)	C$ 1,250,000
Total		C$ 1,520,000

EXHIBIT 8.9
POTENTIAL AVI PARTICIPATION

	Auto	Truck
Annual Trips	18,900,000	2,700,000
#AVI Vehicles	30,000	7,500
#AVI Trips		
Daily (x230)	3,333,500	846,400
Weekly (x50)	575,000	138,000
Monthly (x12)	56,400	13,800
% AVI Trips	3,966,400	998,200
	(21%)	(37%)

Estimated Primary Queue Processing Delay Savings

Queue delays waiting for toll and C&I processing develop when vehicle arrival rates exceed the service processing capacity at the toll or C&I booths. The number of available, open service booths is a critical factor affecting formation and magnitude of queues. The 1990 A.T. Kearney Study reported an estimated 170,000 hours of annual queue delay for primary truck processing on the Ambassador and Blue Water Bridges; no data were available for the Detroit-Windsor Tunnel. The delay was estimated to cost U.S.$11.7 million based on truck costs of U.S.$30 per hour. Auto primary delays were not calculated directly in the Kearney report.

Since 1988-89 when the Kearney data were compiled, significant capital and operating improvements have been implemented for border crossings. Observations and operator inputs confirm that primary queue delays are much less frequent and intense now than earlier.

An estimate of current annual truck primary queue delays was derived from a series of simulations of truck arrival volumes by hour and the C&I primary service rates on the Ambassador and Blue Water Bridges. These exercises provide only general indicators of queue delays, since booth staffing assumptions comprise a very critical input. Based on multiple runs, current truck queue delays (on the bridges only) are estimated to be on the order of 45,000 to 64,000 vehicle hours per year.

The automated border crossing program with dedicated express toll and C&I service lanes would be expected to reduce the current delay by about 25% to 50% depending on the level of truck enrollment in the program. At C$38 per truck hour, the resulting queue delay savings would appear to range between C$420,000 and C$1,180,000 per year. A median value would suggest annual savings of C$800,000.

Auto queue delays were crudely estimated based on the auto volumes at the three facilities, the percent enrollment in the automated program, and an assumed savings of two minutes per participating auto border trip. The results suggest an annual queue

savings of approximately C$1,3,00,000 for autos. Exhibit 8.10 summarizes the calculations.

EXHIBIT 8.10
ESTIMATED AUTO PRIMARY QUEUE DELAY SAVINGS

Facility	Auto Trips per Year (mill)	% Enroll-ment	Annual Enrolled Trips (mill)	Auto-Hours Saved (1000's)	Est. Annual Savings (C$1,000)
Blue Water	5.2	15	0.78	26.0	C$240
Detroit-Windsor Tunnel	7.2	30	2.16	72.0	C$650
Ambassador Bridge	6.6	20	1.30	43.3	C$410
Total	18.9	22	4.24	141.3	C$1,300

Estimated Carrier Productivity Gains

Trucking firms may realize operating efficiency improvements as a result of an automated border crossing program. Some firms may be able to obtain more equipment turns; other firms which pull into local terminals now before proceeding to the border crossing may be able to eliminate the terminal stops in conjunction with electronic pre-filing and the automated crossing program.

The ability to eliminate terminal stops will be related to the type of trucking operation. Auto-related carriers would not tend to be in that group and are not estimated to receive any savings. Truckload (TL) carriers would be the most likely to be able to benefit from elimination of terminal stops; Less-Than-Truckload (LTL) carriers would be somewhere in between. Exhibit 8.11 presents a preliminary estimate of the savings which might accrue due to fewer intermediate terminal stops. Each eliminated terminal stop is assumed to save 30 minutes and truck time is valued at C$38 per hour. The aggregate savings is estimated at C$353,000 per year.

EXHIBIT 8.11
CARRIER OPERATING SAVINGS WITH REDUCED TERMINAL STOPS

Type	Est. Trips per Year (mill)	% Enrollment	% Terminal Stops Elim.	Est. Terminal Stops Elim.	Est. Annual Savings (C$1,000)
LTL	1.44	15	2	4,300	
TL	0.80	25	7	14,300	
Auto	0.29	50	0	0	
Other	0.17	N/A	0	0	
Total	2.7			18,600	C$353

General operating productivity for all truck carriers should flow from reduction in border crossing times. Truck operating revenue for Detroit/Windsor area border crossings aggregates to an estimated C$4.4 billion per year based on the number of estimated less-than-truck-load (LTL), truckload, auto-related, and other truck trips.[1] Using the operating revenue as an approximate proxy surrogate for operating costs, the impact of carrier operating efficiency gains due to reduced border delays can be gauged. A one-hundredth of one percent efficiency gain translates to about C$440,000 savings per year.

Carrier productivity gains will not be limited solely to border time savings. Border time savings will be amplified by productivity gains for shipments by LTL carriers using container freight station inspection procedures which eliminate delays to freight when some manifest items - but not all - need to be inspected. LTL carriers also should benefit from increased trailer bulk ratios in this manner, thus effectively improving trailer utilization and profitability over current bulk limits dictated by border inspection cargo access requirements.

[1] Page 97,99, St. Clair and Detroit Rivers International Crossings Study - Final Report, June 1, 1990, A.T. Kearney.

Assuming only a one-hundredth of one percent (e.g., 0.01%) efficiency gain, the general operating productivity gains (benefit C$440,000) combined with the reduced terminal stops (benefit C$353,000) would produce a fleet operations benefit of C$793,000 annually (see Exhibit 8.12).

Estimated Border Trade Productivity Gain

Highway border trade across the Michigan - Ontario international border was estimated to be U.S.$56 billion in 1986 (see, A.T. Kearney 1990 Study, page 14). Part of that trade involves time-sensitive shipments for manufacturing, distribution, retail and related industries. Most large industries, such as the automotive industry which generates a large proportion of the cross-border movements, operate with an agile manufacturing philosophy which depends on just-in-time delivery to maintain close to zero inventory levels. Reduction in crossing delays at the border can have a marginal impact on the productivity and efficiency of the region's businesses. Even an extremely minor productivity/efficiency improvement against such a large trade volume base will generate impressive numbers. If improved border crossing systems yielded as little as one-hundredth of one percent impact, the annualized value would be U.S.$5.6 million or C$7.0 million.

Estimated Toll and C&I Labour Savings

Current Customs and Immigration staffing levels for both U.S. and Canadian operations are estimated to be on the order of 520 person years; of this total, on the order of one-half are believed to be devoted to primary inspections. Similarly, approximately 100 person years are estimated to be expended for toll collection per year across the three facilities.

Express processing will require fewer person years for toll collection and C&I primary inspections. Fewer staff will be required because automated processing enables higher volumes to be handled per lane. In addition, it may be assumed that the express lanes will not need to be manned in future years. However, manning levels can not necessarily be reduced in direct proportion to the volumes handled electronically. Sufficient booth

capacities must still be provided to preclude large queues with fluctuations in auto and truck volumes from hour to hour.

If 20% of auto and truck traffic is enrolled to use the C&I express lane, it would be reasonable to assume at least 5% labour savings for C&I primary inspection. Enrollment for the express toll lane only is likely to be higher than for C&I where personal interviews, cargo pre-arrival notification or cargo data carried on a smart card will be a condition of use. Accordingly, approximately 9% labour savings are assumed for toll collection. This would yield an annual savings of approximately thirteen person years at C&I primary inspection and a savings of approximately nine person years at toll collection. Using an average value of C$37,500 per person year for C&I and for toll collection, and adding 40% to cover overhead and fringe benefits, the estimated aggregate annual savings are C$682,000 for C&I primary inspections and C$470,000 for toll collection.

Benefit Estimate Recap

The preceding paragraphs have outlined a preliminary estimate of potential savings related to an automated border crossing program which reduces traveller and truck crossing delays. At best, these estimates are approximations which serve to indicate the possible magnitude of associated benefits to the user community. The results are summarized in Exhibit 8.12 below.

EXHIBIT 8.12
SUMMARY OF ESTIMATED ANNUAL USER BENEFITS

Category	Estimated Annual Savings (C$1,000)		
	Cars	Trucks	Total
Service Time	C$270	C$1,250	C$1,520
Queue Delay	C$1,300	C$800	C$2,100
Fleet Operations		C$793	C$793
Customs & Immigration			C$680
Toll Operators			C$470
Other/Trade Productivity			C$7,000
Total	**C$1,570**	**C$2,843**	**C$12,563**

8.4 BENEFITS, COSTS AND FUNDING

8.4.1 - Passenger Car & Trucks

Benefits to passenger cars and trucks are shown in Exhibit 8.13, both as annual benefits and as accumulated over a 5 year period which would be the minimum life expectancy for the AVI vehicle tag.

The tag costs are shown in Exhibit 8.13 as both a one-time initial expense or as a cost over 5 years, assuming an annual interest rate of 6.25%. The accumulated benefits reflect an annual inflation rate of 2.5%, with no assumed benefit increase resulting from increasing traffic volumes.

EXHIBIT 8.13
BENEFIT/COST FOR PASSENGER CARS AND TRUCKS
(C$ 1,000'S)

	One Year Analysis			Five Year Analysis		
	Initial[1] Cost	Annual Benefit	Benefit/Cost Ratio	Cost	Accumulated Benefits	Benefit/Cost Ratio
Passenger Cars	$2,800	$1,570	0.56	$3,345	$8,254	2.5
Trucks	$700	$2,843	4.06	$840	$14,945	17.8
Total	**$3,500**	**$4,413**	**1.26**	**$4,190**	**$23,199**	**5.5**

1) Costs are based on C$94 per vehicle tag. The B/C ratio could be improved if tag costs were lower. Recent tag supply quotations indicate the prospect for substantially lower tag costs.

The benefits to trucks exceed the tag costs by 4 times in one year alone. For cars, the benefits would exceed the tag costs in less than 2 years.

Tags would be funded through purchase directly by vehicle owners at a total cost of C$3,500,000. This cost would vary depending on the number of vehicles enrolled, and if tag costs differed from the assumed cost of C$94.00 per tag.

8.4.2 - Toll Operators

Benefits to toll operators are shown both as annual benefits, and accumulated over 5 years in Exhibit 8.14. The system capital costs shown are the total system costs including cost for toll lanes and systems, and customs and immigration lanes and systems. Vehicle AVI tag costs are excluded.

8.4.3 - Government, Including Customs and Immigration

Benefits include economic/trade productivity gains which are of value to the citizens of both nations, as well as savings to customs and immigration agencies. Annual benefits and accumulated benefits over 5 years are shown in Exhibit 8.14.

The costs shown represent the total fixed capital cost of the system, excluding vehicle tag costs.

In one year, the benefits would equal the total system cost. Over 5 years, the benefit/cost ratio would exceed 4.5 to 1.

EXHIBIT 8.14
BENEFIT/COST FOR TOLL OPERATORS, GOVERNMENT, AND CUSTOMS AND IMMIGRATION
(C$1,000'S)

	One Year Analysis			Five Year Analysis		
	Initial Cost	**Annual Benefit**	**Benefit/Cost Ratio**	**Cost**	**Accumulated Benefits**	**Benefit/Cost Ratio**
Toll Operators	C$2,015	C$470	0.23	C$2,407	C$2,470	1.025
Government:						
- Customs & Immigration	C$5,865	C$680	1.31	C$7,002	C$3,575	5.77
- Economic/Trade Productivity Gains		C$7,000			C$36,800	
Overall	**C$7,880**	**C$8,150**	**1.03**	**C$9,409**	**C$42,845**	**4.55**

To complement the preceding five-year cost and benefit assessment, on-going maintenance expense for the automated border crossing system and the effects of traffic growth over the five-year operational period need to be addressed.

A supplemental sensitivity analysis was conducted to gauge the impacts of these maintenance and traffic factors. Annual electronic equipment and software maintenance expense was estimated at ten percent of the initial equipment and software capital cost, exclusive of warranty cost items. Warranties were assumed to cover first year expenses, so maintenance expense was accumulated for years two through five only. The estimated five-year, non-warranty maintenance costs aggregate to C$2,185,000.

Corridor traffic across the three border crossing facilities grew 45% between 1984 and 1992. This equates to an annual growth rate of about five percent. In the absence of electronic systems to help process crossing traffic, growth will require increasing expenditures by toll and C&I agencies to service the demand. Increased expenditures will be necessary for physical improvements and/or inspector resources to process greater traffic flows. The estimated savings to the toll and C&I agencies with expanded throughput capacity due to electronic lanes were derived by factoring the labour savings in Exhibit 8.12 in proportion to the estimated annual traffic growth. At five percent traffic growth per year, the savings would aggregate to approximately C$763,300 over five years.

Adding these costs and benefit savings to the overall five-year costs and benefits shown in Exhibit 8.14 would result in aggregate costs of C$11,595,000 and aggregate benefits of C$43,608,000. The resulting overall benefit/cost ratio of 3.76 remains significantly positive.

8.4.4 - Funding Considerations

There are a variety of possible approaches to cost sharing and funding for the proposed systems. One option would be a cost sharing formula that involved contributions from all participating agencies, including the toll operators, customs and immigration services and the federal and provincial/state governments. For the toll operator, the system would replace the need for expenditures for stand-alone automated toll systems which are being considered at the crossings. For customs and immigration services, the system provides a means of processing existing traffic and future traffic increases in light of the dwindling resources available for staffing. For governments, the improved efficiency represents economic and trade productivity gains which have immense benefits to both nations.

Funding for the system could also be generated by a charge to users. There are several examples of automated toll operations for toll roads where AVI-equipped vehicles have been charged preferential (lower) tolls as an incentive to enroll, while non-enrolled vehicles have been charged increased tolls.

A toll surcharge of as little as 25¢ per vehicle would generate sufficient revenue in one year alone to pay all of the system capital costs. Exhibit 8.15 indicates the potential revenue generated if all non-AVI equipped vehicles were subjected to a 25¢ toll surcharge for passenger cars and either 25¢ or 50¢ for trucks for only one year.

EXHIBIT 8.15
ANNUAL USER FEE REVENUES
(C$ 1,000'S)

Annual Traffic Volume (Non-AVI Vehicles)			Option 1		Option 2	
			Toll Surcharge Per Crossing	Annual Revenue	Toll Surcharge Per Crossing	Annual Revenue
Passenger Cars	(80%)	15,120,000	25¢	C$7,560	25¢	C$7,560
Trucks	(68%)	1,835,000	50¢	C$918	25¢	C$459
Total Annual Revenue				**C$8,478**		**C$8,019**

The toll surcharge to recover the total capital costs of C$7,880,000 could be eliminated after one year.

Any such toll surcharge should be specifically earmarked to be used only to cover capital, operating and maintenance costs for the system, and to be reduced when the capital costs are paid off to a surcharge that could cover annual operating and maintenance costs.

A third implementation option would require funding established by the supplier as part of a contract for installation and 5 years of system maintenance. The financing could be repaid by various methods, or combinations of methods, such as:

- contributions by each participating agency, in proportion to its share of costs;
- partial contribution to the costs by each agency, with the balance paid from an earmarked toll surcharge; and
- the entire cost paid from an earmarked toll surcharge.

A combination of the above, or other funding options are possible, including the establishment of an IVHS revolving loan fund to finance automated border crossing projects at various locations.

8.5 GOVERNMENT FUNDING OPTIONS

Funding for part or all of the system costs may be available from Federal, State and Provincial government departments other than directly from Customs and Immigration. Exhibit 8.16 illustrates the effect of a range of government (non-C&I) funding on the benefit/cost ratio for customs and immigration and for governments who would be the "beneficiaries" of the "Economic/Trade Productivity Gains" benefits shown in Exhibit 8.14.

EXHIBIT 8.16
EFFECT OF GOVERNMENT FUNDING ON BENEFIT/COST

Government Funding				Benefit/Cost Ratio For Five Year Analysis			
Canadian Governments		U.S. Governments		Canadian		U.S.	
%	C$ [1] (1000's)	%	C$ [1] (1000's	C+I	Government[2]	C+I	Government[2]
0	0	0	0	0.51	∞	0.51	∞
20%	790	20%	790	0.70	23.3	0.70	23.3
40%	1,575	40%	1,575	1.10	11.7	1.10	11.7
40%	1,575	60%	2,365	1.10	11.7	2.64	7.8
40%	1,575	80%	3,150[3]	1.10	11.7	∞	5.8
40%	1,575	100%	3,940[3]	1.10	11.7	∞	4.7

(1) Based on Overall Cost of C$7,880 (Exhibit 8.14) shared equally by Canadian and U.S. Government. (U.S. Government contribution shown in C$ for consistency with other $ values in report, and to avoid effects of fluctuating exchange rates.)

(2)
- Benefit: C+I benefit of C$3,575,000; (Government) Economic/Trade Productivity Gains of C$36,800,000 from Exhibit 8.14.
- Cost: Cost to C+I of C$7,002. Government (non-C+I) funding would shift costs from C+I to other government agencies. (Funding assumed to reduce initial cost to C+I.)

(3) U.S. C+I initial cost is C$2,933. U.S. Government funding of 74.5% would cover all C+I costs.

The central notion of Exhibit 8.16 is that the Government funding would go first to reduce C+I costs, in recognition of the benefits to the Governments in general. If funding is available in excess of the C+I costs, consideration could be given to a subsidy to toll operators.

Initial indications are that the higher proportions of government (non-C+I) funding may only be available in the U.S.

9.0 IMPLEMENTATION

9.0 IMPLEMENTATION

9.1 CONSENSUS

At the New Technology Committee meeting of June 21, 1993, all participants were in agreement that the proposed automation of the border crossing was a positive initiative that should proceed.

9.2 PROJECT FUNDING

This report sets out a general description of the system and a preliminary cost estimate. The estimated benefits clearly outweigh the estimated costs.

The next step is to determine the appropriate funding mechanism for the project. Since a wide range of stakeholders will benefit from the initiative, the costs could be shared by many agencies. The initiative strongly supports the economic and trade interests of both nations, and it represents a key element in the movement to implement intelligent vehicle-highway systems in both Canada and the United States.

9.3 SYSTEM REQUIREMENTS DOCUMENT

In light of the unanimous endorsement of the initiative by the New Technology Committee, the chairman was asked to arrange for the preparation of a System Requirements Document (SRD) as the next step toward implementation. An addendum scope of work for preparation of the SRD has been developed, and funding is now in place for the consultants to proceed. The SRD work program is underway. It is intended to develop more explicit user requirements documentation and examine alternative organizational formats for procuring and implementing the proposed border crossing systems.