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FIELD TESTING OF ON-BOARD RECORDER, SMART CARD AND DIGITAL SIGNATURE TECHNOLOGIES

PHASE 1: PRELIMINARY STUDY

Prepared for
Transportation Development Centre
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by
Tecsult

March 2002

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by
Jean-François Gysel
Tecsult

March 2002

NOTICE

This report reflects the views of the authors and not necessarily those of the Transportation Development Centre of Transport Canada or the Steering Committee.

The Transportation Development Centre does not endorse products or manufacturers. Trade or manufacturers' names appear in this report only because they are essential to its objectives.

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Ce rapport est disponible aussi en français «*Essais en service des technologies d'enregistreur de bord, de carte à puce et de signature numérique – Phase 1 : Étude préliminaire*», TP 13893F.

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16. Abstract

This report presents the first phase of a project involving the field-testing of on-board recorder, smart card and digital signature technologies. Phase 1 consisted of research on available on-board recorder technologies and functionalities; identification of other similar on-going and planned research and development projects; development of a pilot project conceptual plan, including estimated budget and schedule; and development of a preliminary work plan for subsequent phases.

A technology review was carried out to assess current and recently completed projects in the field of on-board recorder systems for commercial vehicles and the use of these technologies in auditing compliance with applicable Acts and regulations.

The technologies were analysed by assessing firms active in the field of on-board systems. A detailed analysis chart was drawn up to help make a comparative assessment of the available technologies. The assessments revealed that equipment currently on the market contained many elements that had been tailored to specific customer requirements. Because very few of these requirements involved regulatory compliance auditing, few of the systems could carry out this function.

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16. Résumé

Le présent rapport représente la première phase d'un projet touchant l'essai en service des technologies d'enregistreur de bord, de carte à puce et de signature numérique. La phase 1 comportait une recherche sur les enregistreurs de bord existants et leurs fonctionnalités; un recensement des projets de recherche et de développement similaires, en cours ou projetés; l'élaboration d'un plan conceptuel en vue du projet pilote, y compris une estimation du budget et du calendrier; ainsi que la mise au point d'un plan de travail préliminaire pour les phases subséquentes.

Une revue de la technologie a été effectuée afin d'évaluer les projets actuellement en cours ou récemment menés à terme, dans le domaine des systèmes embarqués pour les véhicules commerciaux, et l'utilisation de ces technologies dans un cadre de vérification de la conformité aux lois et règlements pertinents.

L'analyse des technologies s'est effectuée par le biais d'une évaluation d'entreprises œuvrant dans le domaine des systèmes embarqués. Une grille d'analyse détaillée a été élaborée pour permettre une évaluation comparative des technologies disponibles. Il ressort de ces évaluations que les appareils actuellement sur le marché contiennent beaucoup d'éléments créés sur mesure pour les besoins précis des clients, et comme bien peu touchent à la vérification de la conformité aux lois, peu de systèmes permettent donc de réaliser cette fonction.

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SUMMARY

In June 2001, the Transportation Development Centre of Transport Canada contracted Tecsult to carry out Phase 1 of a research project entitled Field Testing of On-Board Recorder, Smart Card and Digital Signature Technologies. This first phase involved research on available on-board recorder technologies and functionalities; identification of other similar on-going and planned research and development projects; development of a pilot project conceptual plan, including estimated budget and schedule; and development of a preliminary work plan for subsequent phases.

Because the overall project included many tasks, it was divided into the following four phases:

Phase 1 – Preliminary Study, the focus of this report;

Phase 2 – Detailed Planning of Field Tests;

Phase 3 – Actual Field Testing, including data gathering and analysis;

Phase 4 – Conclusions and Recommendations regarding the field testing.

The overall project was envisaged to involve the following tasks:

- Conduct research on conventional systems for recording vehicle and driver parameters in the field of goods transportation;
- Through field testing, assess technical, operational and administrative procedures required to record pre-trip inspection reports electronically with digital signatures and to facilitate legal recognition of this practice;
- Assess the use of smart cards (or memory cards) to store drivers' hours of service and records of pre-trip inspections, and to check whether these data comply with the requirements and regulations of participating authorities;
- Draw up an outline of minimum requirements (and/or standards) to be established to enable motor carriers and authorities to use these technologies effectively and efficiently in provincial, national and international transport activities.

A technology review was conducted as part of Phase 1 of this project and used to assess current and recently completed projects in North America and Europe that involved on-board systems for commercial vehicles in general, and their use in auditing compliance with Acts and regulations in force in the motor carrier industry in particular.

The technologies were analysed by assessing selected firms active in the field of on-board systems. Some of these firms, whose profiles met the project objectives, were invited to attend and present their technology during a Project Steering Committee meeting. Interviews were held with carriers to obtain more information on certain aspects of the systems analysed. A detailed analysis chart was drawn up to help make a comparative assessment of the available technologies.

The assessments revealed that equipment currently on the market contained many elements that had been tailored to specific customer requirements. Because very few of these requirements involved regulatory compliance auditing, few of the systems could carry out these functions. This does not mean that the manufacturers cannot modify their systems to meet

these functionality requirements, but to do this, they would need to have sufficient, actual demand to justify the cost of customizing their equipment.

With respect to regulatory compliance, the majority of manufacturers surveyed were not fully aware of the regulations affecting the motor carrier industry. Although this shortcoming is directly attributable to the manufacturers themselves, it also highlights the importance of explaining the Canadian regulatory framework with regard to issues of regulatory compliance using on-board systems and the need for the Project Steering Committee to develop specific terms of reference for conducting the field tests (Phase 3 of the project).

As concerns the organization of the pilot project, the field test objectives were set out, particularly with regard to specific functionalities of the on-board systems and to necessary project tasks. Preliminary definitions of the criteria were drawn up and organizations to be approached regarding possible participation were identified. An interim plan for Phases 3 and 4 was also drawn up.

In addition, preliminary budget estimates for Phases 2, 3 and 4 of the project were prepared based on projected activities outlined in the the preceding sections of this report. The total cost of the pilot project would be approximately $500,000: $90,000 for Phase 2, $360,000 for Phase 3 and close to $50,000 for the final phase. These amounts include consultant fees and expenses, manufacturers' costs to adapt systems to meet project requirements, related telecommunications and technology costs and a budget of 15% for contingencies. The budget for the pilot project is based on the assumption that four system manufacturers and four separate carriers will participate, and that equipment will be installed on five commercial vehicles per fleet.

The proposed preliminary implementation schedule for completion of the overall project is as follows: seven months for Phase 2 (April to October 2002), 18 months for Phase 3 (January 2003 to June 2004) and four months for Phase 4 (September to December 2004).

According to Phase 1 recommendations, the Steering Committee should proceed with Phase 2 of the project as quickly as possible so that the field tests may begin as soon as possible in 2003. Accurate technical specifications to establish a common basis for inviting all manufacturers interested in taking part in the project and to allow them to modify their equipment in accordance with properly defined requirements. Continuous technology monitoring throughout the project is imperative – particularly in the event of possible changes in Europe and the United States regarding on-board systems for commercial vehicles – to remain on the cutting edge of current developments in the field and to modify project parameters as necessary.

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LIST OF ACRONYMS AND ABBREVIATIONS

ACQ	Quebec Trucking Association
CCMTA	Canadian Council of Motor Transport Administrators
COMETA	COMmercial vehicle Electronic and Telematic Architecture
CTA	Canadian Trucking Alliance
CVSA	Commercial Vehicle Safety Alliance
EDR	Event Data Recorder
EU	European Union
FHWA	Federal Highway Administration (United States)
FMCSA	Federal Motor Carrier Safety Administration (United States)
GPS	Global Positioning System
IIHS	Insurance Institute for Highway Safety
MTO	Ministry of Transportation of Ontario
MTQ	Quebec Department of Transport
NBDT	New Brunswick Department of Transportation
NHTSA	National Highway Traffic Safety Administration (United States)
NTSB	National Transportation Safety Board (United States)
OEM	Original Equipment Manufacturer
SAAQ	Quebec Automobile Insurance Corporation
TC	Transport Canada
TDC	Transportation Development Centre, Transport Canada
ULCC	Uniform Law Conference of Canada
U.S. DOT	United States Department of Transportation

1. INTRODUCTION

This report summarizes the work carried out and conclusions reached in Phase 1 of the Field Testing of On-Board Recorder, Smart Card and Digital Signature Technologies project. This introductory chapter presents background information on the Project, overall project objectives, specific Phase 1 objectives and an outline of this report.

1.1 BACKGROUND

When the Quebec Automobile Insurance Corporation (SAAQ) submitted its pilot project on the use of on-board computers to automate daily log keeping in 1999, Transport Canada (TC) expressed interest in participating in the project. The pilot project was launched under the supervision of a Steering Committee. Transport Canada was invited to join the Steering Committee and chose Sesto Vespa as its representative.

Once the project was launched, the Quebec Trucking Association (ACQ), the Quebec Department of Transport (MTQ) and the SAAQ asked Transport Canada to participate in the field testing of on-board recorder, smart card and digital signature technologies. The objectives of these field tests were to analyse on-board recorder and related technology to demonstrate their use in actual operating situations; to assess their ability to improve vehicle fleet management from the perspectives of safety, regulatory enforcement and transport operations; and to assess the costs and benefits of using them. The project was also aimed at analysing both the attitudes of interested parties toward these devices and the minimum requirements and/or standards for the seamless use of these technologies in national and international transportation activities.

The end result was the Field Testing of On-Board Recorder, Smart Card and Digital Signature Technologies project. Because it involves many tasks, the project was divided into the following four phases:

Phase 1 – Preliminary study; the focus of this report included a technology review, the development of the pilot project and the development of a preliminary plan, budget and schedule;

Phase 2 – Detailed planning of field tests;

Phase 3 – Actual field testing, including data gathering and analysis;

Phase 4 – Conclusions and recommendations regarding the field testing.

The overall project will be carried out over a period of approximately three years: about seven months for each of the first two phases, 18 months for the field tests and four months for the final conclusion phase.

The overall project consists of the following tasks:

- Conduct research on conventional systems for recording vehicle and driver parameters in the field of goods transportation;
- Through field testing, assess technical, operational and administrative procedures required to record pre-trip/post-trip inspection reports electronically with digital signatures and to facilitate legal recognition of this practice;

- Assess the use of smart cards (or memory cards) to store drivers' hours of service and pre-trip inspection history and to check whether these conform with the regulations and requirements of participating governments;
- Draw up an outline of minimum requirements (and/or standards) to be established to enable motor carriers and governments to use these technologies effectively, efficiently, and seamlessly in national and international transportation activities.

The overall project objectives are outlined in greater detail in section 1.2.

1.2 OVERALL PROJECT OBJECTIVES

The overall objective of the Field Testing of On-Board Recorder, Smart Card and Digital Signature Technologies project is to examine the use of on-board recorders and related complementary technologies (smart card and digital signature) in a range of possible applications related to commercial vehicle use. Although Phase 3 of the Project – actual pilot project field tests – can be carried out on the territory of a single government, the project has a North American scope and the results of the study will have international implications.

The equipment/technologies evaluation criteria will need to be defined and approved for project purposes. However, they will have to take into account the usefulness, user-friendliness and acceptability, of the proposed technologies as well as their efficiency and effectiveness, and their associated costs and benefits. The evaluation parameters will also have to take into account the points of view of drivers, carriers, police forces and authorities concerning the capabilities of on-board computers and related technologies to improve and facilitate compliance monitoring and application controls, transport activities and vehicle fleet management. All of these criteria should be specifically defined in Phase 2 of the project, which involves detailed planning of the field tests.

Viewed as a whole, this project should help improve overall highway safety and particularly the safety of commercial vehicle drivers; increase motor carriers' profitability by boosting driver productivity and improving drivers' quality of life; reduce fuel consumption; and expand the community's scientific knowledge base.

It should be noted that financing for this project will have to come from several partners, including the federal and provincial governments, the motor carrier industry and volunteer firms. Throughout this project, opportunities for partnerships between researchers and various transportation organizations will be studied for suitability as they arise. The following are some of the organizations which should be invited to participate: Transport Canada, the SAAQ, the MTQ, the Ministry of Transportation of Ontario (MTO), the New Brunswick Department of Transportation (NBDT), the Canadian Trucking Alliance (CTA), the U.S. Federal Motor Carrier Safety Administration (FMCSA), and some private-sector firms.

The sole tasks involved in the Phase 1 assignment outlined in this report were the preliminary study in preparation for subsequent phases. Consequently, a preliminary work plan for later phases of the project was drawn up, as outlined in section 1.3.

1.3 SPECIFIC PHASE 1 OBJECTIVES

This report presents the first phase of the Field Testing of On-Board Recorder, Smart Card and Digital Signature Technologies project. This first phase essentially consists of developing a detailed preliminary study, including research on available on-board recorder technologies and functionalities; identification of other similar on-going and planned research and development projects; development of a pilot project conceptual plan, including estimated budget and schedule; and development of a preliminary work plan for subsequent phases.

Phase 1 of the project included research work to identify other similar projects that may be in progress elsewhere in North America and in which researchers have studied these types of on-board technologies for commercial vehicles. In addition, an inventory was compiled and a review conducted of on-board recorder technologies and peripheral equipment available on the market and promising emerging technologies.

The work carried out in this first phase also included the compilation of a list of potential ways in which on-board recorders could be used to help improve safety, effect application controls to ensure that applications are used appropriately, and provide support for transport and vehicle fleet management activities, including speed management, pre- and post-trip inspections with digital signatures and monitoring of compliance with hours-of-service regulations. Various product lines currently on the market were studied and evaluated using a detailed analysis sheet prepared by the consultant.

Preliminary research was also carried out to identify potential partners in the motor carrier industry, police forces and government organizations, who might be interested in participating in subsequent phases of the project.

Phase 1 activities were completed with the preparation of a preliminary work plan, which included a list of key tasks to be carried out in subsequent phases as well as associated budgets and schedules.

This first phase was carried out by TECSULT under the supervision of the Steering Committee, coordinated by the Transportation Development Centre (TDC) of Transport Canada. The Steering Committee is made up of representatives of Transport Canada (Road Safety), the MTQ, the MTO, the SAAQ, the ACQ and the private sector (Canadian and U.S. transportation). In addition, a member of the FMCSA, representing the U.S. government, participated on the Committee as an observer.

1.4 PLAN OF PHASE 1 REPORT

In addition to the introduction, this report has three chapters, each of which outlines one of the following topics:

- ***Technology review*** – This chapter includes an inventory of similar projects and an analysis of technologies that was conducted, in part, through a meeting with suppliers. This information was validated with a number of motor carriers and an analysis of how these technologies can be used for regulatory compliance monitoring was carried out. The chapter ends with a technology review summary.
- ***Preliminary project plan*** – This chapter outlines the field testing objectives and provides preliminary definitions of the equipment selection and evaluation criteria, which will be specified in Phase 2. It also presents a preliminary list of participating organizations,

detailed (although preliminary) logistics for Phase 2, general logistics for subsequent phases, and the recommended methodology for carrying out the pilot project. This chapter also presents the preliminary budget estimate for the project and the proposed implementation schedule.

- ***Conclusions and recommendations*** – This final chapter is a summary of the main conclusions and recommendations resulting from Phase 1 of the project.

2. TECHNOLOGY REVIEW

Specific research was undertaken to identify similar projects carried out in North America and Europe involving on-board recorder, smart card and digital signature technologies. A bibliographic search was then carried out as part of Phase 1 to draw up an inventory of existing technologies on the market relative to on-board recorders, smart cards and digital signatures for commercial vehicles. This work produced some relevant information, which is outlined in section 2.1.

2.1 INVENTORY OF SIMILAR PROJECTS

2.1.1 Situation in Canada

A few projects similar to the one concerned in this report are currently under way in Canada or have been recently completed. The following three projects are the most important ones that meet the criteria of this inventory:

1. A pilot project to test the use of electronic logbooks for driver hours of service monitoring, coordinated by the SAAQ;
2. A project to evaluate the need for independent firms to provide services to industry to record and analyse data provided by on-board computers. This project is sponsored jointly by the MTQ and the SAAQ;
3. A project involving several organizations – including the Quebec Office of Energy Efficiency, the federal Office of Energy Efficiency, the MTQ the Forest Engineering Research Institute of Canada, the Canada Safety Council, Bell Mobility, the ACQ, on-board system manufacturers, and motor carriers – which aims to measure the operational and financial impacts of using on-board systems in commercial vehicles to maximize the vehicle's energy efficiency and safety.

The objective of the first pilot project noted above was to determine how motor carrier firms could use on-board systems (on-board computers) installed in heavy vehicles to monitor their employees' driving hours and work hours. The project consisted of determining which obstacles were involved in using a combination of printed and direct read-out reports of on-board computer data for motor carrier firms and road enforcement authorities, and proposing corrective solutions, if necessary. This pilot project was carried out between March 2000 and January 2001. A final report is expected to be available in 2002.

In addition to demonstrating the logistical problems associated with conducting the pilot project (monitors not fully trained, refusals to cooperate, difficulty obtaining access to data, etc.), the project showed that on-board computers needed to be reprogrammed to enable them to indicate whether drivers were complying with hours-of-service regulations. To make roadside checks easier, it was also recommended that on-board computers be equipped with printers to produce trip sheets immediately for trips in progress.

The objective of the second project was to assess the potential benefits for small and medium-sized goods and passenger transportation firms of using the services of an outside firm to store and analyse data gathered by on-board computers. This project was divided into four phases and included a pilot project under actual operating conditions to assess the feasibility, efficiency and cost-effectiveness of on-board recorders and related technologies based on pre-established criteria.

The study is expected to determine the following: cost-effectiveness conditions that will enable firms to provide integrated on-board computer data gathering, storage and analysis services; optimum conditions that will enable carriers to acquire equipment and use such services; cost-effectiveness conditions for using such a system from the standpoint of potential fuel economies; and the impact of these types of services on small and medium-sized transportation firms in terms of improved compliance with legislation governing driving hours, speed limits and vehicle mechanical maintenance.

In evaluating the results of this study, the very special context of an outside firm managing the data rather than the context of carriers acquiring and using the management tools themselves would be taken into account.

The third project began in late November 2001 and focusses on the use of computer technology and on-board systems to improve the energy efficiency and productivity of motor carrier firms. The project objectives are to test how the systems are used to manage vehicle energy performance and reduce greenhouse gas emissions, and to manage methods and procedures aimed at reducing mileage, thereby optimizing loads and trips while improving road safety.

The project also aims to study how systems can be integrated for the purposes of electronic commerce, logistics management and the application of related systems for data monitoring, electronic document exchanges and digital signatures, all of which are especially useful for customs purposes. The project also provides for the development of training and information tools and products within a perspective of evolving technology.

2.1.2 Situation in the United States

Most information on compliance audits of hours-of-service regulations in North America comes mainly from the United States, where the first applications for on-board recorders and other on-board recorder systems were developed, sold and installed in commercial vehicles. The American firm Rockwell is also a pioneer in this area. In addition, regulations on the use of on-board recorders to collect driving time data came into effect in 1988. A review is therefore necessary at this time.

However, although hours-of-service compliance audits are conducted in the United States, few research projects focussing on on-board recording equipment for commercial vehicles have been carried out. One of these research projects began in 1997 when, at the request of the Insurance Institute for Highway Safety (IIHS), the U.S. government (Federal Highway Administration [FHWA]) conducted a major survey concerning the use of electronic on-board recorders. The IIHS objective was to persuade the U.S. DOT to make the use of on-board recorders mandatory for commercial vehicles.

To carry out this study, the FHWA worked jointly with professional associations and commercial organizations that were interested and qualified to represent carriers and the American trucking industry. Over 10,000 questionnaires were sent out with the help of these associations and a total of 1,200 replies were collected. Although the survey team was rather disappointed with the low response rate, the amount of collected data was statistically valid based on margins of error and standards used in similar surveys of carriers and the trucking industry in general.

The survey results revealed the following about on-board recorder technologies:

- Of the 1,200 replies received, only 3% of the carriers used electronic recorders as the principal means of compiling hours of service for regulatory compliance auditing purposes.

- Of this 3%, the vast majority were private-sector fleets. Thus, over 98% of the owners and/or operators who replied to the survey used logbooks to record their hours of service (paper logs).
- The study also showed a proportional relationship between fleet size and the use of electronic recorders: the smaller the fleet, the less common the use of electronic recorders.
- The study was unable to demonstrate with certainty that electronic on-board recorders could be cost-effective for small fleets of trucks.
- The study also showed that on-board recorders were effective for monitoring hours of service, provided the carrier, or its management team, was also fully committed to monitoring hours of service.

The National Transportation Safety Board (NTSB), a U.S. government organization responsible for investigating major accidents for all modes of transportation, has also been studying the potential uses of on-board recorders for some time now. In some of its earlier reports, the NTSB refers to on-board recorders as a potential means to improve safety in the trucking industry, particularly in the area of hours of service compliance. The NTSB issued a Safety Recommendation in 1990 (SR H-90-28) to require mandatory use of hours-of-service recorders in commercial motor vehicles. The NTSB also issued a recommendation to the National Highway Traffic Safety Administration (NHTSA) in 1997 (H-97-18): "Develop and implement, in conjunction with the domestic and international manufacturers, a plan to gather better information on crash pulses and other crash parameters in actual crashes, utilizing current or augmented sensing and recording devices." (August 2001 Final Report of the NHTSA Event Data Recorder Working Group). Consequently, the NHTSA is currently conducting the Event Data Recorder (EDR) Program, a data gathering program using on-board systems, to facilitate the gathering and use of collision avoidance and crashworthiness data using on-board recorders. The program is being carried out by a task force, including representatives of government, universities and Original Equipment Manufacturers (OEM), which has been holding regular meetings since 1998. The meetings have resulted in the drafting of recommendations relative to technological developments, data required (type, gathering, backup, etc.) by stakeholders, legal aspects and privacy of these data, the use of EDRs, and the target clientele. This program also includes a pilot project that will help demonstrate potential uses for this equipment. The NHSTA is also planning to initiate research and development projects in 2002 on the application of EDRs in commercial vehicles.

Over the past few years the United States Department of Transportation (U.S. DOT) has published in the *Federal Register* (Docket 2350) proposed regulatory amendments aimed at substantially changing the hours-of-service and compliance monitoring in the trucking industry. These proposed amendments would require, among other things, some sectors of the industry, especially long-distance carriers, to use on-board recorders. The proposed amendments are currently only in the preliminary discussion and comment stage and no final regulatory proposals have yet been issued. It is still not known when these proposed regulations will come into effect or what will happen to the section concerning on-board computers.

The FMCSA recently initiated several projects to achieve its set objective of halving the number of deaths and injuries in road accidents involving trucks and buses by 2010. One of these projects will analyse the potential benefits that could be offered by on-board systems to achieving this safety objective. The aim of this project is to define technical, financial and operational requirements that would enable on-board systems to help meet both road safety and motor carrier management requirements. The study should lead to a pilot project, possibly

resulting in recommendations for the development of new standards for the use of on-board systems. It should be noted that using these systems to monitor hours of service is not one of the objectives of this particular study because this aspect has already been assessed for the purposes of the proposed amendments to the HOS by the U.S. DOT.

Another project worthy of mention concerns Werner Enterprises, one of the five biggest commercial trucking firms in the United States, with over 10,000 employees, about 7,500 trucks (tractors) and close to 20,000 trailers. Werner used Qualcomm on-board systems to compile hours of service and replace traditional logbooks (Werner Paperless Log System). In 1998 the FHWA announced a voluntary program under which a motor carrier using global positioning system (GPS) technology and related safety management computer systems could enter into an agreement with the FHWA to use the system in a pilot demonstration project to record and monitor drivers' hours of service in lieu of complying with the handwritten driver log requirements or the conventional on-board recording requirements. In June, 1998, Werner Enterprises of Omaha, Nebraska, became the first motor carrier to enter into such an agreement with the FHWA. The next month, over 5,000 Werner drivers were operating without the paperwork burden associated with paper log books. Werner is the only motor carrier that has been approved by the FHWA to participate.

The FHWA believes this project will demonstrate that the motor carrier industry can use GPS technology to improve compliance with the hours-of-service regulations in a manner which promotes safety and operational efficiency while reducing paperwork requirements.

2.1.3 Situation in Europe

The situation in Europe is different from that in North America. For a long time, the Europeans have been requiring the use of on-board recorders by companies operating commercial vehicles. The European Union (EU) made tachographs mandatory in the 1980s. The following are the key elements of those regulations:

- All tachographs shall be designed and manufactured according to standards in force in the EU;
- Drivers shall at all times carry reports of the two previous work days for national trips and the seven previous work days for international trips, as well as enough blank reports to complete the trip in progress. Completed reports shall be given to the employer within 21 days of the end of the trip;
- Written notes shall be carried on board the vehicle if the driver was not on duty the day before;
- Drivers shall notify employers of any damage to the recording equipment incurred during a trip;
- Employers shall ensure that vehicle tachographs are sealed and properly calibrated, which means that the devices shall be checked every two years and recalibrated every six years at a recognized transport centre.

Police forces use tachograph reports to perform roadside checks of drivers' hours of service. Government-assigned inspectors also check this information during company audits in which they study the company's three previous months of operations. According to the information

collected from French trucking industry representatives, very few European drivers use logbooks for hours-of-service compliance purposes.

In 1998, new European regulations redefined the legal framework following the introduction of digital tachographs. These regulations paved the way to introducing on-board recorders as a replacement for traditional mechanical tachographs by 2001. The new regulations also mention digital tachographs, but the new systems are actually on-board recorders.

Some manufacturers of on-board equipment are currently working with EU representatives to set up equipment certification procedures. At the end of the consultative process, it is expected that five or six equipment manufacturers will be certified – most of them major industrial conglomerates such as Thomson and Siemens. These on-board systems will be installed on vehicles as basic equipment (OEM), but will also be sold as optional equipment that may be installed on older vehicle fleets. In all cases, the equipment to be sold and/or used in Europe, whether it is basic or optional equipment for heavy vehicles, will have to be certified in accordance with the new EU standards. Once these systems have been installed, it is expected that police will conduct roadside checks of motor carriers in the same way as they currently check with tachographs.

Like North Americans, Europeans are also expressing a growing interest in issues related to hours-of-service violations by commercial vehicle drivers. However, as in North America, applications are difficult to install even if data recording for hours-of-service compliance audits is mandatory.

In parallel with these trends, the EU is currently funding a major research and development project called COMmercial vehicle Electronic and Telematic Architecture (COMETA), which was set up to respond to concerns raised about the proliferation of on-board recorder systems that are available or being developed for commercial vehicles. The objective of the COMETA project is to define and design modules covering various functionalities associated with on-board systems so that flexible, effective interfaces may be created within an overall telecommunications and telematics system. Although the COMETA project is more concerned with intelligent transportation systems (ITS) than with regulations, the resulting overall architecture of the systems will clearly have a direct impact on the issues of hours of service and of on-board recorders and digital signatures.

The literature survey did not identify publications or research projects dealing with the merits or rationale for regulating the use of on-board recorders for hours-of-service audits in Europe. This regulatory requirement has now been in force in Europe for nearly 20 years and no one has yet assessed its benefits and disadvantages.

2.2 INVENTORY AND ANALYSIS OF TECHNOLOGIES

While conducting a literature survey of current and completed research projects relative to on-board recorder, smart card and digital signature technologies for commercial vehicles, the consultant also carried out, as part of Phase 1, a basic literature search for information on on-board system technologies. This inventory was compiled initially with the help of the library staff at Transport Canada's Transportation Development Centre (TDC).

The basic TDC literature search was carried out via the Internet using available search engines. A reference document was compiled from data obtained using a brief description of the project and English or French key words directly or indirectly related to on-board systems. The

preliminary list of companies, products and technologies was then completed by using information and specific knowledge of the market provided by members of the project Steering Committee and the Tecsult Project Team.

A total of 324 hits were checked and validated, and the collected information was broken down as follows:

- On-board computer manufacturing firms 65 entries
- Specialized software design and distribution firms 72 entries
- Communications firms 149 entries
- Maintenance system firms 38 entries

The research was carried out in two stages. First, the Internet was used to obtain an overview of the web sites of these firms, to check the technical specifications of their equipment and, in particular, to determine how these technologies could fall within the context of project objectives. Complementary information was then collected directly from commercial motor carrier operators who were known to use on-board technology. To round out this basic search, meetings were held with the suppliers and some of their customers, as described in section 2.3 of this report.

The search revealed that the available information emphasized product marketing and promotion more than technical data or the value of product/technology applications. Indeed, product manufacturers and distributors were fairly vague about the technical content of their products and usually published only general information.

It also appeared that the of distribution firms and manufacturers of systems using on-board technologies had not been listed in a way to enable a satisfactory, realistic classification of their products. For example, some firms were distributors of Global Positioning System (GPS) services and also sold truck fleet management services, but did not offer any equipment or technology for gathering information on trucks or drivers. It would therefore be appropriate to set up a system for standardizing the collected data. This classification could prove very useful for the users of these technologies, who unfortunately are often compelled to make decisions based on partial or incomplete information.

2.3 MEETINGS WITH SUPPLIERS

To complete the existing database, validate the collected information, and above all exchange information with manufacturers to answer specific questions about equipment capabilities, it was agreed that meetings would be held with several of the suppliers. The objective was to enable firms that had been invited to give short presentations on their products and to hold direct discussions between their representatives and the project Steering Committee.

To that end, it was necessary to use the compiled database to select firms so as to limit the number of interviews to be held and ensure that the full range of available and promising technologies on the market was covered. Other objectives of the selection process were to obtain a good geographic sampling of firms to be invited (Canada, the United States and Europe) and to vary the types of firms (by size, market penetration and development status of their products).

The consultant then drew up an evaluation sheet to provide both the Steering Committee and the invited suppliers with a common work tool. The evaluation sheet helped standardize the interviews and ensure that relevant questions directly related to specific project objectives were asked.

2.3.1 Process for selecting firms

The consultant's method of selecting firms was based on the following four key principles:

- The need to draw up a fairly large inventory of functionalities applicable to on-board systems for commercial vehicles;
- The need to meet with manufacturers and system integrators and obtain references from customers using their products;
- The need to gain a better understanding of – and to determine how – data capture applications installed in vehicles function, how this information is used in vehicles, and how data is transferred to integrated management computers in the case of supply chain systems;
- The need to see systems in operation and collect actual data in demonstrations of existing applications.

As mentioned in section 2.2, a large number of firms are listed on the Internet as motor carrier equipment suppliers. For selection purposes, an initial list of firms had to be compiled from the total. Out of the 324 previously validated hits, a total of 244 firms was selected. Table 2.1 provides a breakdown of the firms.

Table 2.1 – Preliminary Selection of Firms to Be Invited to Meetings

Type of business	Number selected
On-board computers	73
On-board software programs	98
Smart cards	43
Digital signature	10
On-board electronic weighing equipment	20
Total	**244 firms**

Many of the firms included in this number were entered in more than one category, creating a surplus of information. To correct this situation, a second selection was made to shorten the original list to fewer than 200 firms. It was then necessary to carry out a more detailed analysis of each selected firm to assess the relevance of their activities and products. The information available on the Internet was clearly of variable quality and in many cases incomplete, which made it necessary to conduct a third selection in which only firms providing information of satisfactory quality and quantity were selected.

Finally, a series of cross and cluster analyses of these data was carried out, based on the consultant's specific knowledge of these technologies and their applications, to identify about

20 firms with profiles that met project requirements satisfactorily. The selected firms had one or more of the following basic characteristics:

- A variety of activities or geographic areas of operations, such as Europe and/or North America (Canada and/or the United States);
- A current and historical share of the on-board computer, smart card and digital signature market;
- Research and development, including prospects for development and innovation and/or potential for emerging technologies;
- Potential for integrated systems;
- Presence in specific activity areas;
- Potential for using communications systems.

Early in the assignment, the Steering Committee proposed that the number of firms with which meetings would be held be limited to about 10 for practical reasons; however, it was impossible to cover all of the technologies and related applications with such a small sample. The final number of selected firms was therefore established at 16. A letter of invitation was sent to each of the firms and they were later contacted by telephone. Those that were contacted are listed in Table 2.2. Of these 16 firms, 11 replied to the invitation.

2.3.2 Technology evaluation

The consultant prepared a questionnaire and appended it to the letters of invitation sent to all of the contacted firms. Most of the firms filled out the evaluation sheet, although in some cases (e.g., specialized telecommunications firms) this was not possible. The questionnaire results were used to draw up an evaluation sheet summarizing the main characteristics of the products.

The evaluation sheet is divided into the following nine major topics:

- ***Types of systems*** – This section covers data-gathering methods, data storage and printing, data integrity, event reconstruction potential and digital signature aspects.
- ***Communications systems*** – This section includes collected information on system operating platforms, communication technology used and unit cost of communications.
- ***Supplier and inventory*** – This section covers the number of units in service; the manufacturer's geographic location, market share, and research and development activities; manufacturing and management standards used; and customer service.
- ***Set-up problems and obstacles***
- ***Available languages***
- ***Costs and benefits***

Table 2.2 – List of Firms Contacted

Firm	Headquarters
AVC SYSTEMS (Elcon Mobility)	Germany and London, Ontario
CADEC CORPORATION	New Hampshire, United States
CANCOM (QUALCOMM)	Mississauga, Ontario
CENTRODYNE	Montreal, Quebec
DATACOM	Laval, Quebec
EATON FLEET ADVISOR	North Carolina, United States
INFOSAT Telecommunications	Coquitlam, British Columbia
ROADTRONIC	Mascouche, Quebec
SIGEM	Ottawa, Ontario
SIGNAFLEX	Victoriaville, Quebec
TERION	Florida, United States
TETRA TECHNOLOGIES	Montreal, Quebec
TMI COMMUNICATIONS	Gloucester, Ontario
TRIPMASTER CORPORATION	Texas, United States
VDO (ARGO)	Virginia, United States
XATA CORPORATION	Minnesota, United States

- ***Training***
- ***On-board system functionality*** – This is the key section of the evaluation sheet, at least in terms of the current project's requirements. It covers operating permits, vehicle files and characteristics, driver qualifications, dangerous goods, daily inspections, hours of service, customs procedures, speed management, fuel management and other functions that could give the system added value.
- ***Participation in a demonstration project*** – The evaluation sheet was completed in accordance with data collected from the 11 firms with which the project Steering Committee held meetings. A summary of the analysis is shown in Table 2.3.

It should be noted that most of the information on the evaluation sheet was provided by the manufacturers themselves, thus introducing a degree of bias into the collected answers. To counter this lack of objectivity, the consultant proposed that meetings be held with the operators of the systems (motor carriers) to confirm or invalidate the information provided by the suppliers. This activity was not included in the original Phase 1 work plan, but proved significant for confirming the results and filling in information gaps, where necessary. The meetings and their results are outlined in section 2.4.

2.4 VALIDATIONS CARRIED OUT WITH OPERATORS

To validate the information collected in the meetings with the manufacturers, the consultant contacted all of the suppliers who had attended the meetings and asked them to provide the contact information for some of their best customers. This initiative was carried out with the utmost transparency. The suppliers were asked to contact one or more of their customers personally and inform them that they would be contacted by the consultant to verify some of the functional aspects of the system they were using. Once again, for the sake of objectivity, the choice of customer and the option of referring or not referring a customer were left to the suppliers' discretion.

After these requests were made to all of the suppliers, a list of seven operators was drawn up and they were all contacted (see Table 2.4).

Table 2.3 – Summary Chart: Analysis of Operational Functionalities of On-Board Equipment

TABLE 2.3 - SUMMARY CHART: ANALYSIS OF OPERATIONAL FUNCTIONALITY OF ON-BOARD EQUIPMENT

	Types of systems							Communications systems			Supplier and inventory									On-board system functionality														
Company	Data gathering without communications interface	Data gathering with communications interface	Information storage	Printing of information	Data integrity	Reconstruction of events	Electronic signature	Operating platform	Communications technology	Communications unit costs	Units in service (05-01)	Research and development	Manufacturing and management standards	Customer service	Set-up problems and obstacles	Available languages	Costs and benefits	Training	Operating permit	Vehicle file	Driver qualifications	Vehicle characteristics	Dangerous goods	Daily check	Hours of service	Customs procedures	Speed management	Safety management	Fuel management	Other functions and added value	Participation in a demonstration project			
1	yes	yes	yes	yes	yes	yes	no	Win	yes	n/d	no[1]	yes	yes[2]	n/d	n/d	En/Fr	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	yes	n/d	yes	n/d	n/d	no	yes			
2	yes	yes	yes	yes	n/d	no	yes	Palm	yes	yes	10	yes	n/d	n/d	many	En/Fr	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	n/d	yes			
3	yes	yes	yes	yes	yes	yes	no	Win NT	yes	yes	400	yes	n/d	yes	few	En/Fr	yes	yes	yes	no	no	no	no	yes	no	no	yes	yes	yes[3]	no	yes			
4	yes	yes	yes	yes	yes	yes	yes	Win CE	yes	yes	79	yes	yes	yes	few	En	yes	yes	no	yes	yes	yes	no	yes	yes	no	yes	yes	yes	no	yes			
5	no	yes	yes	no	yes	no	no	n/a	yes	yes	yes	yes	n/a	yes	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a				
6	yes	yes	yes	yes	yes	yes	yes	Win	yes	yes	56K	yes	yes	yes	few	En	yes	yes	yes	yes	yes	no	no	yes	yes	no	yes	yes	yes	no	yes			
7	yes	yes	yes	yes	yes	yes	n/d	Win	yes	yes	20K[4]	yes	n/d	yes	few	En/Fr	yes	yes	yes	yes	yes	yes	n/a	yes	yes	n/a	yes	yes	yes	yes	yes			
8	yes	yes	yes	yes	yes	yes	yes	Win	yes	yes	85	yes	yes	yes	few	En/Fr	yes	yes	yes	yes	yes	yes	no	yes	yes	no	yes	yes	yes	yes	yes			
9	yes	yes	yes	yes	yes	no	no	Win	yes	yes	300	yes	n/d	yes	few	En/Fr	yes	yes	no	no	no	no	no	no	no	no	no	no	no	no	yes			
10	yes	yes	yes	yes	yes	yes	no	Win	yes	yes	1500	yes	yes	yes	few	En/Fr	yes	yes	yes	yes	yes	yes	yes	yes	yes[5]	no	yes	yes	yes	no	yes			
11	yes	yes	yes	yes	n/d	n/d	yes	Win	yes	yes	n/d	yes	yes	yes	averag	En/Fr	yes	yes	no	yes	no	yes	no	no	no	no	yes	yes	yes	yes	yes			

n/d not determined
n/a not applicable

(1) 200 units being tested
(2) Beta
(3) Except for fuel taxes
(4) In Canada + 380,000 in the United States
(5) Requires reprogramming

Data associated with the safety aspects of regulatory control management

Key to On-Board System Functionalities

Operator's permit	Includes cab cards, registration number (CTQ, CVOR, U.S. DOT, etc), type of permit (bulk, intraprovincial or interprovincial), restrictions and special permits (non-standard, single trip, project permit or annual permit).
Vehicle file	Includes Preventive Maintenance Program (PMP), mechanical inspection and Commercial Vehicle Safety Alliance (CVSA) registry data on major and minor infractions.
Driver qualifications	Includes driver's licence, regulatory training, comments and driver's file.
Vehicle characteristics	Includes total weight, weight per axle and recordings of last weighing on a trip.
Dangerous goods	Includes classification of dangerous goods on board, and documentation and certificates.
Daily inspections	Pre- and post-trip safety inspections.
Hours of service management	Hours in and out of service, within 160-km perimeter; many drivers; driving cycles; North American harmonization (Canada and U.S.); waiting times (customers, customs, other) and exceptions (e.g., reduction of rest time).
Customs procedures management	Customs Self-Assessment Program (CSA System), bonded carriers, Prearrival Review System (PARS) and Inland Prearrival Review system (INPARS).
Speed management	Indicates speed limits and exceptions.
Safety management	Seal number, door-opening information (tractor and trailer), wearing of seatbelts and mechanical breakdown warning systems.
Fuel management	Fuel taxes and breakdown by province or state, idling, performance measures and braking indications.
Other functions and added value	Drowsiness warning system, collision and obstacle warning system, detour warning system, overturn warning system and integrated e-mail system.

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Table 2.4 – List of Operators Contacted

Equipment Supplier	Operator (referred client)	Person Contacted
CABIT SYSTEMS (TMI)	VTL Transportation	Operations Manager
CADEC	Gordon Foods	Project Manager
DATACOM	Provigo	Transportation Manager
ELCON (AVC SYSTEMS)	Daimler Chrysler Mobility	Mobility Division Manager
QUALCOMM	Kriska Transportation	President
ROADTRONIC	Metro Richelieu	Transportation Superintendent
TETRA TECHNOLOGIES	Air Liquide	National Transportation Manager

Generally speaking, the information provided by the manufacturers could be deemed fairly correct overall. Despite slight overstatements in the suppliers' sales pitches to the effect that their systems were always better than those of the competition, the evaluated systems seemed to satisfactorily perform the functions for which they were designed.

One aspect worth noting, however, concerned the range of functionality requirements that were met and the lack of regulatory compliance monitoring provided by this equipment. All of the equipment examined in this evaluation seemed to contain many elements that had been customized to meet specific customer requirements. Since very few of these requirements involved regulatory compliance auditing, very few of the systems could carry out those functions. This does not mean that the manufacturers cannot modify their systems to meet these functionality requirements, but to do this, they would need sufficient, actual demand to justify the cost of modifying their equipment.

This is an important distinction because it explains why the evaluated systems placed so little emphasis on some of the functionalities required for the purposes of this project. Moreover, it is still unclear whether these functionality requirements can be met because the manufacturers have yet to receive any specific requests to do so. At first glance, we are led to believe that this obstacle will be relatively easy to overcome and that the manufacturers could modify their systems to meet some of the project's functionality requirements without major problems. However, until these modifications are made, this contention can only remain an optimistic assumption.

2.5 USE OF TECHNOLOGY TO AUDIT REGULATORY COMPLIANCE

2.5.1 Regulatory requirements

Canadian legislation regulating the operation of commercial vehicles falls under two jurisdictions: federal legislation applying to extra-provincial transportation and provincial regulations governing intra-provincial transportation.

2.5.1.1 Canadian federal legislation

The applicable federal legislation is the *Motor Vehicle Transport Act, 1987* and its Regulations, such as the *Commercial Vehicle Drivers Hours of Service Regulations, 1994*. The *Extra-Provincial Truck Undertaking Licencing Regulations* are also part of the 1987 Act. Federal legislation also includes the *Transportation of Dangerous Goods Act* and a series of related Regulations.

2.5.1.2 Canadian provincial legislation

In 1998, the Province of Quebec passed Bill 430, *An Act respecting owners and operators of heavy vehicles*, to establish the legal framework for motor carrier transportation in Quebec. The SAAQ, the MTQ and the Quebec Transportation Commission jointly developed this new framework. The Quebec government, through the SAAQ, the MTQ and other organizations, also publishes a number of guides, such as the following: *Obligations of Heavy Vehicle Users*, *Guide de vérification avant départ* [Pre-Trip Checklist Guide], *Guide de vérification mécanique* [Mechanical Checklist Guide] and the *Guide to the Regulation Respecting Special Permits*.

Another Act that may have a direct impact on the final recommendations to be drafted as part of the field tests targeted by this study is Bill 161 entitled *An Act to establish a legal framework for information technology*, passed by the National Assembly in June 2001.

There is also a harmonization agreement between Quebec and Ontario concerning weight and dimension limits for commercial vehicles.

In Ontario, *Commercial Vehicle News* is a publication with information on new Acts and Regulations affecting trucks and buses. The Ontario government has also recently set up the Carrier Safety Rating System, which it uses to award performance ratings to motor carriers in order to improve road safety. To that end, Ontario has also developed an automatic weigh-in-motion project using the Automatic Vehicle Identification ONtario (AVION) system, in which the use of electronic transponders plays a primary role and gives motor carriers the right to bypass some roadside inspections if they have satisfactory safety records.

2.5.1.3 American legislation

In the United States, the use of on-board systems is governed by section 395.15, *Automatic on board recording devices*, of the U.S. DOT FMCSA Regulations.

2.5.2 Digital signatures

As part of the initial phase of this study of on-board computer, smart card and digital signature technologies, an analysis was carried out to determine the types of legislation concerning digital signature technologies that are currently in force in Canada at the federal and provincial levels. In June 1999, the Uniform Law Conference of Canada (ULCC), an organization set up by federal and provincial governments to promote the harmonization of Canada's laws, submitted a document in that regard entitled the *Uniform Electronic Commerce Act.* This document is not legally binding per se, but is instead a reference tool for various levels of government and an adapted version of the *United Nations Model Law on Electronic Commerce* to meet specific Canadian context requirements.

The *United Nations Model Law on Electronic Commerce* has three parts: the first sets out the basic principles of electronic transactions (legal recognition of electronic documents and digital signatures); the second deals with special rules governing electronic contracts (training, effect, and date and place of coming into force); and the third sets out special provisions for goods transportation. The second part of this law also allows the government to establish its own regulations regarding digital signature reliability standards.

Several provinces as well as the federal government have already drafted or are in the process of drafting their own statutes on this matter, based on the above-mentioned two documents. The current situation in this area for each level of government in Canada is outlined in sections 2.5.2.1 and 2.5.2.2.

2.5.2.1 Federal government

The federal *Personal Information Protection and Electronic Documents Act* provides measures for the protection of information in the private sector while offering the opportunity to maintain business relations with the federal government electronically. It clarifies aspects relative to the receivability of electronic documents and recognizes the use of electronic methods in cases where paper methods are acceptable for recording and disseminating information or carrying out transactions. In some cases and according to stipulated requirements, this Act authorizes the use of digital signatures on documents submitted to the federal government.

A digital signature is defined under this Act as "a signature that consists of one or more letters, characters, numbers or other symbols in digital form incorporated in, attached to or associated with an electronic document." The concept of a secure electronic signature is also defined in this Act, which allows the government to issue regulations allowing technologies or processes to be used to ensure the integrity or reliability of electronic transmissions. To date, however, the federal government has not yet adopted any regulations to that effect.

2.5.2.2 Provincial governments

The Quebec government has passed a bill entitled *An Act to establish a legal framework for information technology* (Bill 161) to provide a legal safety net for all communications, regardless of medium, and to harmonize systems and technical standards for communication via electronic documents. This Bill also recognizes the potential for using various personal identification methods, including digital signatures. No specific regulatory amendments associated with this Act have been made public.

In Ontario, the provincial government has passed an Act (*Electronic Commerce Act, 2000*) promoting the use of information technologies in commercial operations that eliminates legal uncertainties and legislative obstacles that have an impact on electronic communications. This Act confirms the legal recognition and legality of electronic documents and signatures, and includes a section applying specifically to the transportation of goods. Under this Act, the Ontario government may prescribe regulations with regard to the reliability of digital signatures, digital signature methods and standards for information technologies and equivalent technologies pertaining to seals for digital signatures. To date, the Ontario government has not made public any proposed regulations to that effect.

In British Columbia, legal recognition and the validity of electronic documents and signatures are provided for in the 1999 *Land Title Amendment Act*. However, this Act applies only to titles

on real property. In addition, the B.C. government recently tabled a Bill confirming the legal validity of electronic documents and digital signatures. This Bill also includes specific regulations applicable to the transportation of goods. It appears this Bill is about to be passed, but thus far the British Columbia government has not made any proposed regulations public.

Saskatchewan has an Act confirming the legal recognition of electronic documents and signatures, which is based essentially on sections of the ULCC's *Uniform Electronic Commerce Act*. Like other provinces, the Saskatchewan government has not made public any proposed regulations. It is a similar situation in Manitoba, Nova Scotia and the Yukon.

In New Brunswick, the government is currently preparing to table a Bill on electronic operations, which has been submitted for public consultation, but has not yet been tabled in the Legislative Assembly.

No legislation validating digital signatures has been passed in Alberta, Newfoundland or Prince Edward Island.

To conclude, for most provinces the national trend in digital signature technologies is toward adoption of uniform legislation based primarily on the ULCC's *Uniform Electronic Commerce Act*. One notable exception is Quebec, where Bill 161 was suspended for several months following a request to significantly overhaul the Bill before its final reading.

The conclusion of this analysis is that rapid changes in electronic commerce technology in Canada have gone well beyond the legal framework under which they were supposed to fall. Although several Acts are already in force in some provinces across the country, they only set out general principles that have no practical application because there are still no specific implementing regulations associated with these Acts.

2.5.3 Regulatory compliance auditing

Validating whether a technology can be used to audit compliance with applicable Acts and Regulations is very clearly a central element of the pilot project on on-board recorder, smart card and digital signature technologies. Although the suppliers of on-board systems with whom meetings were held in Phase 1 of this project all said they could meet the proposed specific set of requirements addressing operational and regulatory compliance functions, none of them, however, could clearly demonstrate that their system could effectively provide all of the said functionalities.

This is actually not surprising because the list of desired functionalities prepared by the consultant was indeed fairly extensive. Furthermore, as explained in section 2.4, there is another more important reason existing systems do not provide the functionalities that would provide for comprehensive regulatory compliance verification: they are not fundamentally designed to provide for these types of compliance audit functions in the first place.

It was also clear from the meetings with suppliers that most of them seemed to know very little about the specific regulatory requirements that may be potentially addressed by these on-board systems. The current generality of the Canadian regulatory framework with regard to issues of regulatory compliance using on-board systems may have a direct impact on the absence of a relationship between the functionalities of current systems and their use for regulatory compliance purposes. However, carriers and manufacturers also know full well that the use of electronic logbooks is now permitted in the United States. Nonetheless, it seems that carriers'

current demand for these types of on-board systems is not based on discharging specific regulatory requirements.

From another perspective, it is now possible to identify options and types of technology that could help operators ensure regulatory compliance by using on-board systems. Systems with on-board data capture and processing capability, including printing of the logbook directly from the truck, are all feasible in the short term. The systems proposed by major manufacturers such as Elcon, Cancom and Tripmaster, as well as those developed by smaller manufacturers such as Roadtronic, have clearly demonstrated that these technologies can be adapted to meet the regulatory compliance management needs of commercial vehicle operators.

Technologies that may be used to ensure regulatory compliance will also have to be able to process information associated with the regular management of trucking firms, including, of course, fuel management, travel time and dispatching. Among the paradigms to be taken into consideration, those of cost-effectiveness and return on investment are fundamental for all stakeholders. For the time being, users of on-board systems are looking primarily for cost-effectiveness and efficiency, and the evaluated systems help meet these financial and operational objectives.

Regardless of the type of on-board system that will be used for the purposes of the pilot project, these systems must be modified somewhat to meet regulatory requirements. It will be very important in subsequent phases to work closely with carriers involved in the pilot project to make sure that these systems are properly managed in accordance with regulatory requirements. But before the pilot project is launched, it will be necessary to properly define specific regulations (hours of service, pre-trip inspections, speed, etc.) that will have to be taken into consideration in the field tests and to specify aspects of the selected regulations that should be studied.

Current U.S. regulations allow the use of on-board systems to audit hours of service. Under section 395.15 of the U.S. regulations, electronic methods instead of traditional logbooks may be used to record drivers' hours of service. These same regulations also set out all of the information required and associated administrative rules. It should be noted, however, that very few American carriers thus far have taken advantage of these provisions. The U.S. DOT currently estimates that 5% of truck fleets use on-board recorders for regulatory compliance purposes.

As previously mentioned, the U.S. DOT has published several proposed regulations in recent years concerning major changes to hours of service. These proposed regulations are still under discussion and have not yet been finalized. However, one of these proposed regulatory changes concerns the requirement that some carriers have on-board systems to carry out regulatory audits of hours of service once vehicles have returned to their home terminals.

As for the European regulatory framework, the effective dates of European regulations concerning on-board systems are expected to be changed because it appears these regulations will not be introduced before 2002.

2.6 TECHNOLOGY REVIEW SUMMARY

The extensive technology review carried out in Phase 1 of this Project and described in detail in section 2 of this report may be summarized as follows:

- The technology analysis carried out as part of this study involved the checking of 324 hits on the Internet, out of which 244 firms were selected. A more specific analysis was carried out to select only 16 firms whose profiles satisfactorily met project requirements. All of these firms were invited to attend a meeting with the project Steering Committee and interviews with carriers were held to further define some aspects of the analysed systems. The evaluations revealed that the analysed equipment contained many elements customized to meet customer requirements. Since very few of these requirements pertained to regulatory compliance audits, very few systems were able to carry out these functions. This does not mean that the manufacturers cannot modify their systems to meet these functionality requirements, but to do this, they would need to have sufficient, actual demand to justify the cost of modifying their equipment.
- Where regulatory compliance is concerned, most of the manufacturers said they could meet regulatory requirements without any difficulty. However, their lack of specific knowledge of these legal requirements was a problem. The manufacturers themselves are directly responsible for this shortcoming, but it clearly highlights the importance of having a Canadian regulatory framework with specific provisions on matters of regulatory compliance using on-board systems and the need for the Steering Committee of this project to develop specific terms of reference for carrying out the field tests (Phase 3 of the project).
- Some on-board systems installed in heavy vehicles can perform other functions: for example, in-motion weighing by means of wireless telecommunications systems. These additional functionalities can offer significant advantages in terms of lower fuel consumption.
- In Canada, some projects in this area are currently in progress or have been recently completed. The following are the most important ones: a pilot project coordinated by the SAAQ to test the use of electronic logbooks for driver hours of service monitoring; a project jointly sponsored by the MTQ and the SAAQ to evaluate the need for independent firms to provide services to industry to record and analyse data provided by on-board computers; and a project sponsored by various federal, provincial, and industry groups to measure the financial and operational impacts of using on-board systems in commercial vehicles to optimize the energy efficiency of these vehicles.
- Generally speaking, although hours-of-service compliance audits have been carried out in North America for over 50 years, few research projects have been conducted on the use of on-board recording equipment in commercial vehicles to carry out these audits.
- In the United States, a research project on electronic on-board recorders was begun in 1997 with the objective of examining the use of these systems as an electronic logbook for commercial vehicles. In addition, the NTSB, which has also been studying potential uses for on-board recorders for some time, is proposing that this type of device be used as a potential means to improve safety in the trucking industry. The FMCSA recently initiated several projects to achieve its set objective of halving the number of deaths and injuries in road accidents involving trucks or buses by 2010. One of these projects will study the potential benefits that on-board systems may provide to help achieve this objective.

- The most comprehensive American research project on this topic was carried out in 1997 by the FHWA/University of Michigan, at the request of the IIHS, to assess the possibility of making the use of electronic recorders on board trucks mandatory. The survey results demonstrated that these technologies were actually used by less than 3% of carriers and that it would be difficult for on-board electronic recorders to be cost-effective for small firms. The study also demonstrated that these systems were effective as long as the operators themselves were fully committed to monitoring their hours of service.
- A recent proposed amendment to the hours-of-service regulations of commercial vehicle drivers is currently being studied by the U.S. DOT. The proposed amendment includes the requirement that certain industry sectors, particularly long-distance carriers, use on-board recorders as electronic logbooks. The proposed amendment is only in the preliminary discussion stage and no final rule has yet been issued, which means it is still not known when these proposed amendments will come into effect or what will happen to the section concerning on-board computers.
- In Europe, the use of tachographs has been mandatory since the 1980s and all tachographs must now be designed and manufactured according to EU standards. Hours-of-service audits are carried out mainly with these devices rather than traditional logbooks. However, despite the Europeans' growing interest in issues associated with hours-of-service violations and the requirement that data be recorded for regulatory compliance audit purposes, very few practical solutions have yet been found.
- New regulations concerning digital tachographs came into force in Europe in 1998. Since then, some on-board equipment manufacturers have been working jointly with EU representatives to set up equipment certification procedures. In the UK, the legislation, introducing digital tachographs, Regulation 2135/98, replaces the previous tachograph regulation 3821/85. Legislation requires agreement of the Technical Annexes which was expected in September 2001 or February 2002. Two years following publication of the Annexes all vehicles will have to be fitted with digital tachographs; 21 months after publication all drivers must be issued with their personal cards.
- The EU is currently funding a major research and development project set up in response to concerns associated with the proliferation of on-board systems on the market. The objective of this study called COMETA is to define various functionalities associated with these systems to create flexible, effective interfaces within an overall telecommunications and telematics system.
- Aside from the COMETA Project, there are no research projects dealing with the merits or rationale for regulating the use of on-board recorders to audit hours of service, although this regulatory requirement has been in force in Europe for nearly 20 years.

3. PRELIMINARY PROJECT PLAN

3.1 FIELD TEST OBJECTIVES

The objective of the overall project is to analyse on-board recorder and related technologies to demonstrate their use in actual operations, to assess their ability to improve vehicle fleet management from the standpoints of safety, regulatory enforcement and transport operations, and to assess the cost and benefits of their use. There are also plans in this project to study both the attitude of stakeholders toward these devices and the minimum requirements for applying these technologies in the areas of national and international transportation. One of the project's objectives is to examine specific functionalities of on-board systems to validate their potential use for auditing compliance with regulatory requirements. To that end, the functionalities concerned must be accurately defined in the form of functional technical specifications and existing systems must be modified by manufacturers so that these functionalities may be applied. Only after these activities are carried out can their potential use as a regulatory compliance audit tool be studied.

In light of the September 2001 events in the United States, it would be worthwhile to study the way in which on-board recorders and smart cards could help boost transportation safety and security using the data that can be stored with these technologies. Provision should be made for a specific security component and specific evaluation criteria for this concern should be defined in this project.

The subsequent Phase 2 of the project is intended to more accurately determine the activities required for successful completion of the field test and development of associated conclusions and recommendations. One of the key success factors is to prepare an accurate, comprehensive evaluation sheet to ensure that the on-board systems are evaluated on a scientifically objective and technically valid basis. The consultant prepared preliminary definitions of the evaluation criteria on which the Steering Committee should focus in Phase 2. These are outlined in section 3.2. Phase 2 will also be an opportunity for the Steering Committee to initiate negotiations with potential project partners to obtain funding for field test-related expenses, as outlined in section 3.3 of this document. Only when existing systems have been modified to meet the Steering Committee's specific requirements and the evaluation tools have been developed can the field test be launched to meet its objectives.

3.2 PRELIMINARY DEFINITION OF SELECTION AND EVALUATION CRITERIA

Equipment to be evaluated in the field test (Phase 3) should be selected according to specific criteria. The key parameters to be examined are the following:

- Mandatory and optional functionalities of each proposed system;
- Ease with which additional functions can be added (expansion possibilities);
- System user-friendliness;
- System reliability;
- Security of data handled by the system;
- System acquisition and operating costs;

- Potential benefits and return on investment for operators.

To establish a common basis for evaluating the equipment during the pilot project, some standardization of the data is necessary. The following are some of the essential parameters to be standardized:

- Automatic vehicle-data capture;
- Inputting of data by the driver;
- Transmission of collected information;
- Generation of reports (type, format and content);
- Interoperability and modularity of the systems.

The parameters to be examined in the field tests and included in the evaluation sheet will include a minimum of the following:

- Auditing of regulatory compliance data, including:
  - Driving and work hours;
  - Speed management;
  - Mechanical inspections;
  - Driver identification;
  - Vehicle weight and dimensions.
- Integration of the technology into regular operations, including:
  - Mechanical maintenance;
  - Vehicle dispatching;
  - Route management;
  - Driver management.

The types of audits to be carried out in the pilot project are those carried out in the normal context of carrier activities, namely the following:

- On-road data audits (roadside checks);
- Off-line audits of operations (inspections in home terminals);
- Audits carried out during inspections at home terminals.

Note that if the on-board systems are able to improve the regulatory compliance of motor carriers, this improvement may be quantified by a reduction in the number of failures to comply and the number of highway accidents and incidents.

As part of this evaluation, it will also be necessary to make sure that all stakeholders accept the technology, namely the following:

- Operators;
- Drivers;
- Enforcement officers.

It is therefore recommended that the European experience be examined in detail in subsequent project phases to identify problems encountered by the EU when implementing its new standards for on-board recorders and to benefit from its positive and negative experiences.

3.3 PRELIMINARY IDENTIFICATION OF PARTICIPATING ORGANIZATIONS

The field test to be carried out in Phase 3 will involve many participants, either to conduct the actual field work or to provide sufficient funding for activities related to this research. By way of preliminary information, it would be preferable to include the following partners in the pilot project:

- ***Manufacturers of on-board systems*** – Some manufacturers have expressed interest in participating in a pilot project headed up by the federal and provincial governments. All of the manufacturers with whom meetings were held as part of Phase 1 of this study and who are listed in section 2 expressed interest in participating. It is clear that the issue of modifications to be made to each system to meet project objectives should be settled before the field tests are set up.

  The following approach is therefore recommended. The cost of modifying systems that may be marketed later should probably be borne by the manufacturers themselves; however, any specific request that is carried out as part of the pilot project and does not result in any marketing opportunities following the field tests should be negotiated with these manufacturers so that the organizations financing the project can absorb at least a portion of the costs. Some of these firms may also have access to research and development funds or tax credits administered by the federal and provincial revenue departments that would minimize their costs of participating in the project.

  It would also be necessary to ensure that manufacturers of on-board systems participating in the pilot project have some experience in marketing their products to more than one carrier. Given that the pilot project objective is to test certain specific functionalities for regulatory compliance purposes on existing equipment and not on equipment being developed or marketed, it is definitely an important requirement that the manufacturers invited to participate in the field tests already have a diversified client base (a minimum of four carriers) and at least 100 or so on-board systems already in service with these carriers.

- ***Carriers*** – Once the manufacturers who will participate in the pilot project have been selected, it will then be necessary to invite motor carriers to also participate in the field tests. Various methods may be considered for recruiting participating trucking firms, but it might be worthwhile to ask the selected manufacturers to have some of their customers take part in the project. However, it would be necessary to make sure that the range of selected firms is representative of the activity areas of various existing trucking fleets currently in the market. For example, private- and public-sector fleets should be involved as well as international trucking fleets. Ideally, if each manufacturer participating in the pilot project could equip a few vehicles in four or five separate trucking fleets, the project should in principle cover a satisfactory range of activities. It should be noted that some of the carriers contacted in Phase 1 of the project also expressed interest in participating in this type of pilot project. In the case of Ontario, MTO representatives specified that only carriers with excellent MTO safety ratings should be asked to participate in the pilot project, the reason being that this potential participation could be an incentive for these carriers.

- ***Government agencies*** – The pilot project should involve government agencies from various levels of government. If the field-testing objective continues to focus on international operations, it is important that government agencies representing Canadian provinces, American states and federal departments of transportation be involved. Agencies carrying out regulatory compliance monitoring in some Canadian provinces should also be involved, such as the SAAQ. At this stage of the project, the SAAQ and the transportation departments of Quebec and Ontario are already active participants. The list of participants could also be expanded depending on requirements.
- ***Other potential partners*** – There are other potential partners who will perhaps not contribute financially to this type of pilot project, but whose cooperation could bring considerable expertise and technical support to the project. For example, the following groups would be excellent partners: truck and trailer manufacturers, OEMs, associations representing stakeholders with a direct interest in this type of project (Canadian Council of Motor Transport Administrators, Commercial Vehicle Safety Alliance, trucking associations, owner-operators, insurance companies and unions representing trucking industry employees), and road safety groups or associations.

3.4 PRELIMINARY TASKS FOR PHASE 2

Phase 2 of the Field Testing of On-Board Recorder, Smart Card and Digital Signature Technologies project is a turning point for the pilot project in that it involves the planning activities for Phases 3 and 4. The project's success depends on sound planning of the required activities, an adequate financing plan and an organization made up of solid partnerships. It would be unwise to launch the field test (Phase 3) without first making every necessary effort in Phase 2 to ensure its success and without first drawing up appropriate contractual agreements with manufacturers and operators.

It is therefore recommended that Phase 2 of the project be organized on the basis of the following five main activities:

1. **Define the specific objectives, scope and functional requirements of the project**, which will serve as a framework for subsequent activities. This includes project launch and coordinating activities, including the organizing of the field tests and project management.

   During this activity, a detailed and complete evaluation sheet will be prepared starting from criteria previously outlined to make it possible to evaluate the equipment on a common basis during the field test and to ensure some degree of standardization of the collected data.

2. **Prepare technical specifications** to help manufacturers tailor their products to satisfy pilot project requirements and objectives. This aspect is vitally important for the success of the field tests and will make it possible not only to compare the systems on the same basis and criteria, but also to standardize the results obtained for a comprehensive review.

   During this activity, functional and technical specifications for the on-board systems will be used for the purposes of the field test preparations to verify, among others, achievement of the desired regulatory functions. These specifications will help interested manufacturers understand the actual pilot project issues and prepare prototypes on a common basis. The specifications will cover on-board computers, smart cards and digital signatures, and data

manipulation. This activity will include individual and group discussions with various project stakeholders.

3. **Organize partnerships** with manufacturers, operators or carriers who will use these systems, with government organizations that will monitor and finance the project, and with other organizations that will be closely or remotely involved in this project.

   During this activity, various potential suppliers and carriers interested in participating in the project will be contacted. An effort will be made to expand the range of participating firms as much as possible, whether in terms of size, geographic distribution or type of operation.

4. **Carry out technology and legal monitoring** to closely follow changes in technology and regulations, particularly in Europe where major changes are expected in early 2002. This technology and legal monitoring will continue throughout Phase 2 of the project, and even in the subsequent field-testing phase, so that the Steering Committee can stay on top of on-going developments in the field and so that additional considerations may be input into major decisions throughout the project. Also, if new stakeholders become involved during the course of the project or if manufacturers bring new products onto the market, they could be invited to participate in the project or at least their input could be included in the project.

   It will also be important to keep in continuous communication with various stakeholders through technical visits or other means. It is therefore recommended that links be established with European authorities to take advantage of work done by the Europeans in this area. The Phase 2 Steering Committee may consider it appropriate to organize a technical mission to meet authorities responsible for regulating on-board systems for the EU (headquartered in Brussels), particularly with German, Dutch and French organizations that are very technologically advanced in this area. The benefits of such a mission at this stage of the project and the light that it would shed on the preparation of the technical specifications would undoubtedly outweigh the low cost associated with such an activity.

5. **Implementation Plan** – Project activity sheets outlining the tasks and responsibilities associated with each activity will be drawn up for pilot project management and monitoring purposes. They will provide detailed outlines of each activity, its specific objectives and the expected results. The implementation plan will include a financing plan and a list of participating government agencies. The results of all Phase 2 activities will then be summarized in a progress report.

3.5 PRELIMINARY TASKS FOR PHASES 3 AND 4

Initial ideas as to what should be undertaken in Phases 3 and 4, subsequent to the activities carried out in Phase 2, are outlined in the following paragraphs. The subsequent phases of the pilot project consist of Phase 3, the actual field tests, and Phase 4, the project conclusions and recommendations. The main activities to anticipate are the following:

Phase 3 – Field Tests

- Suppliers will develop prototypes according to the functional and technical specifications drawn up in Phase 2 and install the equipment in carriers' operations;

- A training program will be prepared and courses organized and given to participants, including the management team, drivers and persons in charge of regulatory compliance monitoring;
- A large quantity of data will be generated and manipulated for the purposes of the pilot project and specific activities involving aspects of data management and telecommunications will be carried out;
- Aspects of monitoring and management will be the consultant's most important activities during the field tests in order to keep the project within the guidelines to be established and ensure the validity of the results as they are produced.

Phase 4 – Conclusions and Recommendations

- This phase will start with a complete compilation of the data collected during Phase 3, after which the data will be formatted into summary tables.
- A communications plan will be drawn up and a data presentation framework established.
- This phase will end with the drafting of the final project report.

3.6 RECOMMENDED MANAGEMENT METHODOLOGY

The recommended management methodology for carrying out the field tests includes preparation of a series of detailed activity sheets for each major element of the project. These activity sheets will then be numbered in a logical sequence and may be used to monitor and manage the project. Each sheet will outline the objectives, inputs and content of the activity concerned, interactions required between various stakeholders and the results of the activity, and include the name of a supervisor. These sheets will be sufficiently detailed so that work may begin promptly and allows close monitoring to be carried out to ensure that activities run smoothly in terms of budget, scheduling and deliverables.

Figure 3.1 shows a sample activity sheet that could be developed for the purposes of this project.

Activity 3.3 – Training Program	
Objective	Develop a training program for various field test participants to inform them of the pilot project objectives and methods, and their specific roles and tasks.
Inputs	▪ Field test implementation plan ▪ List of participating manufacturers and carriers ▪ Technical specifications for on-board systems ▪ Prototypes of systems used for field test purposes
Content	▪ Preparation of a course plan based on objectives to be achieved ▪ Definition of objectives and roles for each target clientele ▪ Development of required training activities ▪ Preparation of an on-site demonstration session ▪ Preparation of the list of participants and a course schedule
Interaction	▪ Project Steering Committee to approve the program ▪ Carriers and suppliers to approve the schedule
Deliverables	Work plan for carrying out training activities, including course content, list of participants and schedules.
Supervisor	To be decided

Figure 3.1 – Sample Activity Sheet

3.7 PRELIMINARY BUDGET

A preliminary budget estimate has been prepared for Phases 2, 3 and 4 of the Field Testing of On-Board Recorder, Smart Card and Digital Signature Technologies project based on the projected activities outlined in this report.

The total cost of the project would be approximately $500,000: about $90,000 for Phase 2, $360,000 for Phase 3 and close to $50,000 for the final phase. These amounts include consultant fees and expenses, manufacturers' costs to adapt systems to meet project requirements, related telecommunications and technology costs and a budget amount of 15% for contingencies. The project budget is based on the assumption that four system manufacturers and four separate motor carriers will participate, and that equipment will be installed on five commercial vehicles per truck fleet. This preliminary budget had been drawn up for planning purposes only.

An amount of $15,000 per manufacturer, or $60,000 in all, has been budgeted to cover the costs of modifying equipment to include required additional functionalities that may not currently be available to clients. The suppliers and telecommunications firms may also be prepared to pay their own expenses as a contribution to the pilot project, thus reducing the total cost of the project accordingly.

Although preliminary, this budget envelope reflects the level of investment required to carry out this pilot project. If the Steering Committee plans to have five or six stakeholders finance this project, the required funds from each stakeholder would be approximately $75,000 to $90,000.

The following is a summary of the detailed budget presented in Table 3.2:

- Phase 2 Detailed planning of field tests $89,075
- Phase 3 Actual field testing, including data gathering and analysis $357,075
- Phase 4 Development of conclusions and recommendations $48,588

Project total (Phases 2 to 4) $494,738

Table 3.2 – Preliminary Budget

Phase 2 – Field Test Preparations	Fees	Expenses	TOTAL
Project launch	$1,500	$250	$1,750
Technology monitoring	$11,500	$3,500	$15,000
Definition of specifications	$18,000	$500	$18,500
Evaluation criteria	$4,000		$4,000
Selection of suppliers	$3,500	$750	$4,250
Selection of carriers	$3,500	$750	$4,250
Project management and control procedures	$12,500	$500	$13,000
Phase 2 report	$8,500	$950	$9,450
Management Committee and meetings	$5,000	$500	$5,500
Travel and accommodation	$2,500	$300	$2,800
15% for contingencies	$10,575		$10,575
Total	**$81,075**	**$8,000**	**$89,075**

Phase 3 – Field Test	Consultant	Suppliers	Operators	Tele-communi-cations	Equipment and software	Total
Product development	$10,000	$60,000				$70,000
Purchasing and installation	$5,000	$5,000	$5,000		$20,000	$35,000
Training for participants:						
Trucking firm managers	$5,000		$4,000			$9,000
Trucking firm drivers	$10,000		$10,000			$20,000
Enforcement officers	$5,000					$5,000
Data gathering and analysis system	$10,000					$10,000
Project management	$80,000			$40,000	$8,000	$128,000
Phase 3 report	$12,500					$12,500
Management Committee and meetings	$5,000	$500	$500			$6,000
Travel and accommodation	$15,000					$15,000
15% for contingencies	$23,625	$9,825	$2,925	$6,000	$4,200	$46,575
Total	**$181,125**	**$75,325**	**$22,425**	**$46,000**	**$32,200**	**$357,075**

Phase 4 –Conclusion and Recommendations	Fees	Expenses	Total
Data compilation and analysis	$12,500	$2,500	$15,000
Presentation of results	$4,500	$1,250	$5,750
Final report	$15,000	$750	$15,750
Management Committee and meetings	$2,500	$500	$3,000
Travel and accommodation	$1,250	$1,500	$2,750
15% for contingencies	$5,363	$975	$6,338
Total	**$41,113**	**$7,475**	**$48,588**

Project grand total	**$494,738**

3.8 PRELIMINARY PROJECT SCHEDULE

The projected schedule for completing this project is slightly longer than the one outlined in the project terms of reference. The information gathered in this first phase was used to more clearly determine the activities required to carry out the project and, in particular, to research similar tests conducted elsewhere.

For example, the U.S. DOT conducted two full years of testing before implementing Regulation 395.15 covering on-board recorder systems for commercial vehicles in the United States. A pilot project was conducted between 1986 and 1988 with the participation of major carriers, such as Frito-Lay.

Because some periods of the year, such as November and December, are peak business times for carriers, research and development projects at these times become secondary priorities for them, if not nuisances in some cases. The period from mid-July to the end of August is also a difficult period because carriers operate with a minimum of staff owing to summer vacations.

For these reasons, it is recommended that Phase 2 be extended to seven months, that Phase 3 be extended to 18 months and that Phase 4 be extended to four months to have some leeway to better manage problems arising in these periods and to take into account deadlines for approvals, document translation and the signing of contractual agreements.

The proposed preliminary project schedule is as follows:

- Phase 2 7 months, April to October 2002
- Phase 3 18 months, January 2003 to June 2004
- Phase 4 4 months, September to December 2004

4. CONCLUSIONS AND RECOMMENDATIONS

This section of the report on the Field Testing of On-Board Recorder, Smart Card and Digital Signature Technologies project presents the conclusions and recommendations from the analyses conducted in Phase 1. The Phase 1 objectives were to draft a preliminary outline of the overall project, conduct research concerning on-board technologies and other similar research projects, and develop a preliminary work plan for subsequent phases.

An analysis and evaluation of various product lines currently on the market was carried out using an evaluation sheet prepared by the consultant. It included a list of potential ways in which on-board recorders could be used to improve safety and provide supporting applications to enhance transport operations and vehicle fleet management activities, including speed management, on-board weighing, pre- and post-trip inspections with digital signatures and compliance monitoring of hours-of-service regulations.

A preliminary list was drawn up of possible partners in the motor carrier industry and among enforcement organizations and other government agencies who might participate and would be useful in subsequent project phases. In addition, a preliminary work plan, including a list of key tasks to be carried out in subsequent stages and associated budgets and schedules, was drawn up.

The following are the main conclusions of Phase 1:

- On-board recorder, smart card and digital signature technologies could be further developed. The current legal framework allows for the use of on-board systems, but their high cost does not encourage carriers to participate with suppliers in the development of these products. This generality is reflected in a significantly meagre, if not a near total lack of, knowledge of regulatory requirements on the part of on-board system manufacturers, who only design customized equipment based in very large part on the specific management and operating requirements of their customers. Consequently, many systems with fairly dissimilar functionalities and using different technologies and separate telecommunications procedures have appeared on the market.
- From an operational and regulatory point of view, Canada generally monitors and combines its efforts with those of the United States, which brought Regulation 395.15 into force for the technology nearly three years ago, while the Europeans have been using tachographs to audit drivers' hours of service for 20 years. The Europeans are also about to pass new legislation for the auditing of hours of service using digital tachographs, which, for all practical purposes, are on-board recorders.
- The rapid development of smart card technologies and manufacturers' interest in these types of on-board systems because of the immense potential market creates an ideal environment for carrying out the Field Testing of On-Board Recorder, Smart Card and Digital Signature Technologies project. The current context lends itself particularly well to in-depth research of the problems and issues currently being examined by Transport Canada and the Steering Committee and of the need to provide recommendations on regulatory compliance audit methods within a highway safety perspective. This conclusion is all the more relevant given that very few similar research and development projects in this area have been completed or are in progress.

- Because there are a few current or recently completed research and development projects in North America and Europe that are similar to this project and because the potential legal amendments relative to the use of on-board systems in commercial vehicles could influence the evaluations to be performed in the field tests, there is a continuous need for technology and legal monitoring throughout the subsequent phases of this project.
- Most of the technologies used for commercial vehicles by on-board system manufacturers have been around for some time and have been developed to a satisfactory level of maturity. Indeed, the manufacturers interviewed have proposed few new technological features in terms of data gathering and transmission. There is room for innovation in the use of these technologies to audit compliance with road transportation Acts and Regulations.
- The technological functionalities considered in Phase 1 should help carriers, drivers and highway enforcement officers provide enhanced security for drivers and passengers as well as vehicles and their cargoes. For example, geographic information system technologies available in wireless form can help warn carriers if vehicles have been diverted or help them locate stolen vehicles. Identification and verification techniques using smart cards could be used to compare drivers' identities with their driver's licence data. These types of security considerations should be included in the selection and evaluation criteria that will be used in subsequent project phases.
- Questions about the privacy of collected data will have to be studied in the subsequent phases of the project. These concern respect for the privacy of drivers, the potential use of these data for other purposes, or even liabilities associated with these data – as well as issues of data identification and authentification and the use of "intelligent" keys.
- Manufacturers are expressing interest in participating in a pilot project of this type and modifying their equipment to meet specific requirements, provided these requirements are realistic and clearly explained in functional and technical specifications. Based on this conclusion, there is a need to properly define the desired functionality requirements in Phase 2 of the project and to make sure that the manufacturers can meet these requirements. It is preferable to specify only some of the requirements to the manufacturers and to be very specific in terms of required data and desired results rather than to try to cover the full range of functionalities and possibly obtain only partial or misleading results. An alternative that could also be considered is a few mandatory functionalities combined with optional ones.
- The remainder of the project should be carried out in three phases. In Phase 2, the detailed planning of the field tests will be undertaken, including the following: definition of the specific objectives of the field tests, scope and functional requirements; preparation of technical specifications and evaluation criteria; setting up of partnerships and carrying out of related negotiations; technology and legal monitoring; and drafting of the project schedule. In Phase 3, the actual field tests will be carried out, and Phase 4 will involve the development of conclusions and recommendations.
- A seven-month period is estimated to be required for the detailed preparation of the field tests (Phase 2 of the project) and a minimum of 18 months should be allocated for the field tests themselves (Phase 3). The Phase 3 schedule will require some flexibility to ensure that the field tests do not interfere with the carriers' regular commercial activities. If Phase 2 begins in April 2002, the field tests (Phase 3) could be carried out between January 2003

and June 2004, and the project could be completed with submission of the final Phase 4 report in December 2004.

- The total cost of the subsequent phases (2 through 4) would be close to $500,000: about $90,000 for Phase 2, $360,000 for Phase 3 and nearly $50,000 for the final phase of the project. These amounts include consultant fees and expenses, manufacturers' costs to adapt systems to project requirements, related telecommunications and technology costs, and a budget amount of 15% for contingencies. These preliminary budget estimates are for carrying out the field tests on the assumption that four system manufacturers and four separate motor carriers will participate, and that equipment will be installed in five commercial vehicles per truck fleet.

Based on these conclusions, the following are recommended for the remainder of the project:

- The Steering Committee should proceed with Phase 2 of the project without delay so that the field tests may begin as soon as possible in 2003.
- Specific technical specifications should be prepared to establish a common basis for inviting all manufacturers interested in participating in the field tests and to help them modify their equipment to meet properly defined requirements.
- It would be timely to include a technical mission to Europe in the Project's Phase 2 work plan to take advantage of European efforts in the area of on-board recorders.
- Based on the conclusions of Phase 1, it would be worthwhile to organize a round table with key government agencies to determine their potential financial involvement and cost sharing arrangements in the project.
- It is important to ensure adequate technology monitoring throughout the project's life (Europe and United States) to keep abreast of recent developments in this area and to adjust planned project work, if deemed necessary.

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