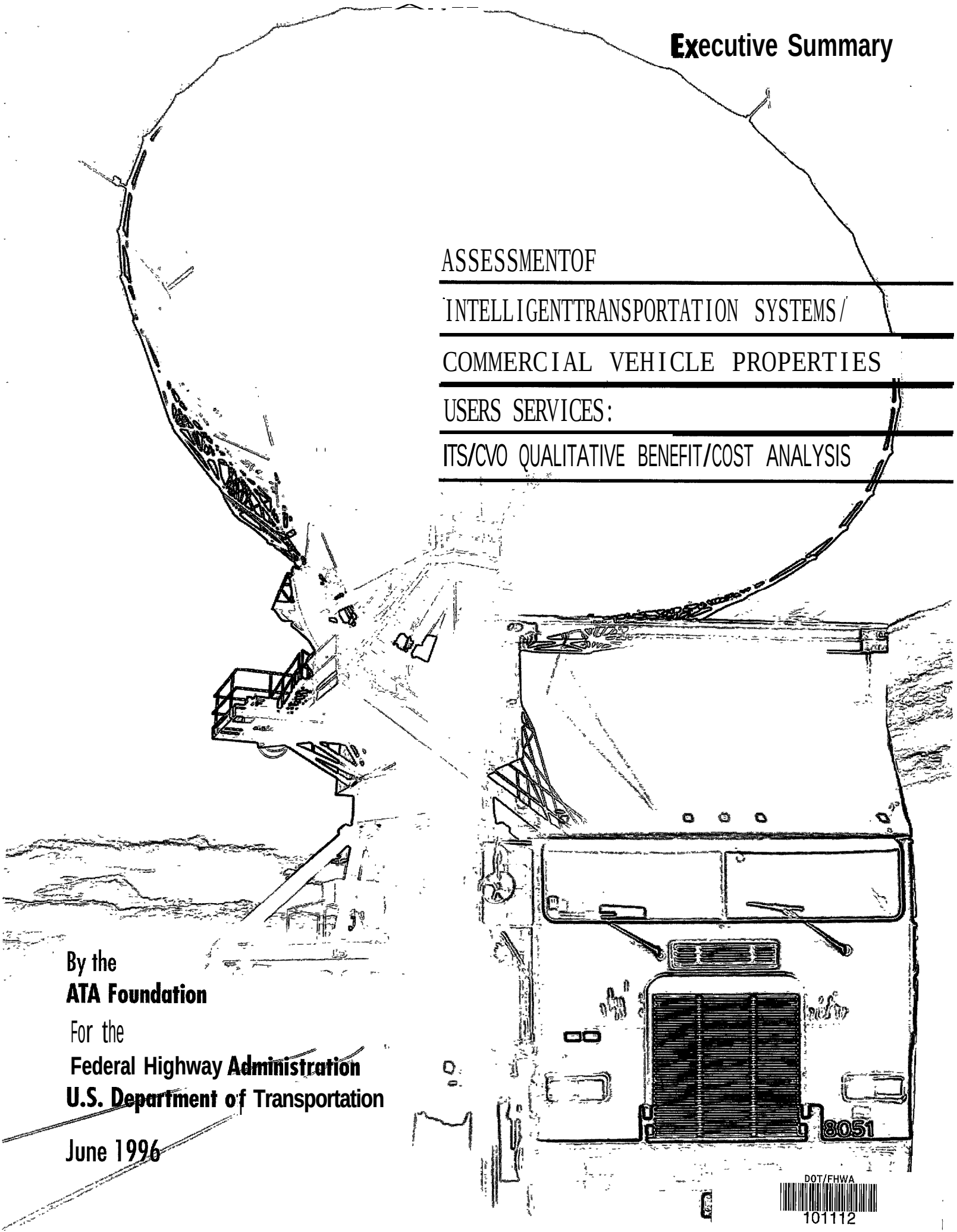
Executive Summary

ASSESSMENTOF INTELLIGENTTRANSPORTATION SYSTEMS/ COMMERCIAL VEHICLE PROPERTIES USERS SERVICES: ITS/CVO QUALITATIVE BENEFIT/COST ANALYSIS



By the
ATA Foundation
For the
Federal Highway Administration
U.S. Department of Transportation

June 1996

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ASSESSMENTOF INTELLIGENTTRANSPORTATION SYSTEMS/ COMMERCIALVEHICLE OPERATIONS USERSERVICES:

ITS / CVO Qualitative Benefit/Cost Analysis

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DTFH61-93-C-00088 Task F

For further information, contact the American Trucking Associations, 2200 Mill Road, Alexandria, Virginia 22314, telephone l-800-ATA-LINE (l-800-282-5463). Additional copies can be obtained at a cost of $25.00 per copy by writing to the above address.

Printed in the United States of America.

P R E F A C E

This executive summary presents the findings of a two-year effort led by the ATA Foundation to explore the impact of ITS technology on regulatory compliance costs for motor carriers. This study does not represent the policies and positions of the American Trucking Associations or its members, but is presented as an objective appraisal of the ITS/CVO User Services by the ATA Foundation.

This study was conducted by the ATA Foundation with support from the National Private Truck Council and Dr. Tom Maze of the Center for Transportation Research and Education at Iowa State University. It was guided by the 36-member ITS/CVO Technical Working Group (TWG) composed of motor carrier, industry, and government representatives. The study team was led by Robert D. Pritchard of the ATA Foundation.

The authors wish to express a special thank you to the members of the TWG for providing their invaluable insights; to the hundreds of motor carriers and technology vendors who took the time to provide us information; and to the many other industry experts who supported this effort.

T A B L E 0 F C 0 N T E N T S

INTRODUCTION

Motor carriers currently compete in an environment of narrow operating margins and increasing service demands by customers, and do so with increased levels of safety. To realize efficiency, motor carriers have been aggressive innovators in applying advanced technologies. Motor carriers use technology to manage and optimize nearly every aspect of their operations and to transact business electronically.

The application of technology has redefined motor carrier operations and business relationships, and provides insights for government agencies to modify how they regulate the industry. The Intelligent Transportation Systems for Commercial Vehicle Operations (ITS/CVO) Program, led by the Federal Highway Administration (FHWA), is envisioned to enhance safety and road operating efficiency through institutional reform and technology applications. Acceptance of government-sponsored technology programs will, in part, be driven by motor carriers' perceptions of the impacts on their businesses and how the programs will affect the current and future regulatory environment.

Assessment of the Intelligent Transportation Systems/Commercial Vehicle Operations (ITS/CVO) User Services: Qualitative Benefit/Cost Analysis-is the culmination of a two-year effort led by the ATA Foundation, with the National Private Truck Council (NPTC) and Dr. Tom Maze of the Iowa State University Center for Transportation Research and Education, to explore the impact of the ITS/CVO User Services Program on regulatory compliance costs for motor carriers.

This effort was guided by the ITS/CVO Technical Working Group (TWG). The 36-member TWG is comprised of motor carriers from diverse segments of the industry, representatives from state agencies, and other interested parties. The TWG provided invaluable experience and insight to the research team through its review of all phases of this study. This study represents a beginning in the process of identifying and defining the economic impacts of the ITS/CVO User Services to motor carriers. An assessment of the impacts on state regulatory agencies will be presented by the National Governors' Association in a forthcoming report.

This executive summary describes the current level of technology used by U.S. motor carriers and provides assessments of the six proposed technology-based FHWA ITS/CVO User Services. Issues surrounding implementation of the User Services are also presented. The final report thoroughly details the analysis.

The six proposed User Services have been assessed in two ways: calculating motor carrier benefit/cost ratios, and estimating potential motor carrier participation. The assessments are based on the perceptions of 700 U.S. motor carriers responding to an ATA Foundation survey concerning labor requirements for complying with regulations, and on their current use of technology The assessments are limited by narrow assumptions, necessary in order to draw inferences about programs which do not currently exist and to advance understanding and facilitate discussion of the envisioned government application of technology.

This executive summary is divided into two parts. **Part I** is designed to briefly present the study's analytical framework and the survey results from 700 motor carriers and 180 technology vendors. **Part** II includes a summary presentation of the benefit/cost assessments for each of the ITS/CVO User Services and recommendations for additional research.

INTELLIGENT TRANSPORTATION SYSTEMS (ITS) FOR COMMERCIAL VEHICLE OPERATIONS (CVO)

The Intelligent Transportation Systems, authorized by the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), are based upon the application of technologies in such fields as data processing and communications to multimodal surface transportation needs. The ITS/CVO User Services are functional activities envisioned to improve the efficiency of state regulatory and enforcement agencies. It is also believed that motor carriers will benefit through improved safety and operational and administrative efficiency.

The ITS/CVO User Services were originally proposed in the FHWA National ITS Program Plan in May 1994. Since then, operational characteristics have been defined by the ATA Foundation's October 1994 study, *Measuring Benefits and Costs of ITS/CVO User* Services; and enhanced through programmatic development.

The following defines the envisioned purposes of ITS/CVO User Services.

Commercial Vehicle Administrative Processes--to automate regulatory functions and enhance data communications capabilities of state agencies in order to enable paperless transactions between motor carriers and agencies.

Electronic Clearance-to screen commercial vehicles for size/weight, safety, and credential compliance at mainline speeds.

Automated Roadside Safety Inspections — to improve screening and targeting of high-risk operators for inspection and to automate safety inspection activities in order to reduce inspection time and improve consistency. Two components are considered: (1) vehicle inspections and (2) hours-of-service reporting and verification.

On-Board Safety Monitoring--to provide warnings to drivers of developing unsafe conditions and to provide real-time monitoring of driver performance, vehicle systems, and loads. On-Board Safety Monitoring has two components: (1) collision avoidance and (2) monitoring of driver and vehicle performance. Only the second component is assessed within the framework of this study.

Hazardous Materials Incident Response — to provide responders to hazardous materials incidents rapid access to information concerning the shipment.

Freight Mobility--to provide real-time travel information to motor carriers in order to enhance routing and dispatching, and encourage intermodal information links.

- *Measuring Benefits and Costs of ITS/CVO* User Services - ATA Foundation, October 1994.

ASSESSMENT FRAMEWORK

The ITS/CVO User Services are assessed in two ways: (1) benefit/cost ratios and (2) estimating market potential. Development of these measures is summarized in the following section.

BENEFITS AND COSTS

Evaluating the benefits and costs of the ITS/CVO User Services to the motor carrier community requires comparing several evolving variables-motor carriers' regulatory compliance activities, available or developing technologies, and the likely components of the ITS/CVO User Services Program.

To understand the relationship among these disparate areas and activities, each has been broken down into its "functional activities." These areas of regulatory compliance are as simple as filling out a form, applying a sticker, stopping a vehicle, or filling out a driver log. This functional analysis allows for the comparison of the cost to motor carriers for technology products or services with the benefit as measured in reduced costs of compliance. The functional activity is the common denominator for this analysis.

The functional analysis of regulations and technologies represents the framework for evaluating:

(1) what technologies can impact regulatory compliance activities;

(2) what are the functional attributes and the prices of the technologies or services;

(3) what are the functional attributes of the ITS/CVO User Services;

(4) what are the compliance costs for motor carriers; and,

(5) what are the benefits in terms of reduced costs of compliance.

The benefits are calculated by examining the labor costs of regulatory compliance for motor carriers using technology systems and those who do not. For example, costs for companies using EDI, on-board computers, and electronic logs are significantly lower for specific functions.The enabling technologies for the User Services are assumed to be the same as currently used motor carrier systems and the benefits (labor cost savings) are extrapolated to the envisioned functions of the User Services. With assumed costs, ratios are calculated.

This effort began with a systematic cataloging of the regulatory compliance processes for motor carriers and an extensive review of literature concerning motor carrier use of technology systems. The findings are encompassed in Technical Memorandum 1 - *A Framework fo Measure the Benefits and Cosfs of IVHS/CVO User* Services-and were presented to FHWA and TWG in June 1994.

Technical Memorandum *2-Measuring Benefits and Costs of Intelligent Transporfafion Systems (ITS)/Commercial Vehicle Operations (CVO) User* Services--advanced the study by detailing: (1) the functional attributes of commercially available technology products; (2) the envisioned operating characteristics of the six ITS/CVO User Services; and, (3) preliminary quantification of motor carrier costs of regulatory compliance based on in-depth interviews with 15 motor carriers. Comments provided by the FHWA and TWG in October 1994 finalized the research methodology and provided guidance for large-scale data collection and analysis.

The ATA Foundation sent questionnaires to approximately 7,000 motor carriers comprising the membership of the American Trucking Associations and NPTC and small carriers identified from the National Motor Carrier Directory (ten power units or less). Survey responses from 700 motor carriers (ten percent response rate) with 200 follow-up phone interviews, formed the basis for estimating the labor costs of regulatory compliance and how the use of technology systems may impact these costs. While the composition of the 7,000 motor carriers sent questionnaires and the respondent sample was heavily skewed towards larger motor carriers, extrapolation of survey results to the universe of motor carriers was allowed by segmenting the survey sample according to fleet size and developing compliance cost estimates for each of the segments.

The ATA Foundation also identified and surveyed several hundred technology vendors. Product information was obtained from 180 vendors. An analysis of product functionality and pricing allowed development of simple price estimates for ITS/CVO enabling technologies that represents likely motor carrier costs of participation.

ESTIMATING MARKET POTENTIAL

The size of the potential market for motor carrier participation in the User Services is expressed in terms of power units. Lower bound estimates were derived by extrapolating survey results by industry segment to the number of power units operated by motor carriers in corresponding segments of the 7,000 motor carriers sent questionnaires. Upper bound estimates are based on extrapolation to the total number of medium and heavy commercial power units by segment, registered in the United States as reported in the U.S. *Department of Commerce 1992 Census of Transportation -Truck Invenfory and Use Survey (T/US).* To estimate market potential for Hazardous Materials (HazMat) Incident Response, the basis was adjusted to reflect the number of vehicles regularly hauling HazMat in quantities large enough to require a placard.

The factors used for extrapolation are:

Commercial Vehicle Administrative Processes-percent of sample power units operated by motor carriers that indicated (1) current Electronic Data Interchange (EDI) capability and (2) willingness to use EDI for regulatory administrative compliance transactions.

Electronic Clearance-percent of sample power units operated by motor carriers indicating that roadside compliance checks reduced their fleets' operating efficiency.

Automated Safety Inspections- *Vehicle Inspections-is* expected to improve efficiency of inspectors and would impact all motor carriers subject to vehicle inspections;

Hours-of-Service Reporting and Verification- percent of sample power units operated by motor carriers currently using on-board computers or electronic logbooks.

On-Board Safety Monitoring-percent of sample power units operated by motor carriers currently using on-board computers.

Hazardous Materials Incident Response- percent of sample power units operated by HazMat carriers indicating (1) current EDI capability and (2) willingness to use EDI for administrative compliance transactions.

Freight Mobility-this User Service will likely involve enhancing motor carrier routing and dispatching functions by providing real-time travel information. Therefore, market potential is based on the percent of sample power units operated by motor carders who currently use computer-aided dispatch and routing systems.

LIMITATIONS OF ASSESSMENTS

Narrow assumptions have been made to facilitate discussion and policy development for programs currently being tested. In addition to specific analytical qualifications, the following assumptions and restrictions limit the assessments:

- The assessments are based on possible operating parameters for programs not currently in place.
- Each User Service is assessed independently and not within the framework of an integrated ITS/CVO program.
- Benefits are narrowly defined as reductions in labor costs of demonstrating regulatory compliance with no inclusion of impacts on operational efficiency or safety.
- Estimates of market potential are based on current technology applications and perceptions of operating efficiency by motor carriers and are presented in very broad ranges.
- No assumptions are made concerning motor carrier participation in the financing of ITS infrastructure (i.e., highway taxes or payment of transaction fees).
- Motor carrier costs of compliance and the potential benefits of technology are based on the current regulatory environment.
- Motor carrier perceptions of their costs and the impacts of outside factors on their operations (i.e., roadside compliance checks) are assumed reasonable.
- Where the User Services are not related to a current technology application or where regulations do not affect current motor carrier behavior, benefit/cost ratios are not calculated (i.e., the collision avoidance component of On-Board Safety Monitoring or Freight Mobility).

MOTOR CARRIER COSTS OF REGULATORY COMPLIANCE-POTENTIAL BENEFITS OF ITS/CVO USER SERVICES

The two basic areas of motor carrier regulatory activities-compliance with administrative regulations (i.e., credentials, tax payments, etc.) and demonstrating compliance with safety regulations (including size/weight)-encompass both deskside and roadside activities. For many different functional activities the labor costs of regulatory compliance are measurable.

Costs are calculated for a single power unit (tractor semitrailer or straight truck) and include only labor costs.The costs of regulatory compliance are expected to vary from one motor carrier to another depending on carrier range of operations, types of loads carried, industry segment, and, as fleet size increases, the resulting internal efficiencies derived from automation of functions and specialization of personnel. It is this last factor-size-which has an overwhelming impact on compliance costs as measured in terms of labor; this is seen in all of the regulatory activities except driver time related to preparing trip sheets and logs which are fairly constant across carrier size.

The costs of compliance activities estimated based on driver time (i.e., stops for compliance checks or filling out logs and trip reports) are assumed to apply only to motor carriers who pay drivers based on time worked. Within the framework of this analysis, motor carriers whose driver settlements are not time-based (i.e., drivers paid by miles driven or as a percent of revenue) are assumed not to incur these costs.

Figure 1 summarizes the estimated labor costs of regulatory compliance by fleet size for the survey respondents and extrapolated to the industry using the relative proportions of medium and heavy commercial vehicles registered in the U.S. by fleet size.

LEVEL OF TECHNOLOGY APPLICATION IN MOTOR CARRIER OPERATIONS

Motor carriers from all industry segments are applying technology to enhance their operational performance and fleet safety. The application of computer and communications technologies are based on a motor carrier's benefit/cost assessment for functional activities. For example, optimizing routing and dispatching would drive the purchase of mobile communications and mapping software; optimizing engine performance would drive the purchase of real-time performance measuring via a satellite system.

FIGURE 1 Average Annual Labor Costs of Regulatory Compliance per Vehicle

BASED ON THE SURVEY RESPONSE OF 700 MOTOR CARRIERS

	Survey Respondents			Weighted Industry Average[3]
	Small Fleets	Medium Fleets	Large Fleets	
ADMINISTRATIVE ACTIVITIES:				
Licenses, Registrations, Permitting	$329	$132	$64	$197
Mileage/Fuel Tax Reporting, Audits	$579	$165	$72	$339
Installing Credentials on Vehicles	$10	$10	$9	$10
Total	$918	$307	$145	$546
DEMONSTRATING SAFETY COMPLIANCE—DESKSIDE:				
Audit Logs, Summarize, Data Entry	$587	$316	$159	$360
Reviewing Driver Records, Qualifications	$354	$197	$92	$216
Annual Safety Inspection of Vehicle	$22	$17	$14	$15
Total	$963	$530	$265	$591
DEMONSTRATING SAFETY COMPLIANCE—ROADSIDE:				
On-Road Safety Monitoring	$572	$183	$60	NA[2]
Driver Time at Roadside Compliance Checks[1]	$71	$81	$42	NA[2]
Driver Time on Trip Sheets/Logs[1]	$2,443	$2,577	$2,567	NA[2]
Total	$3,086	$2,841	$2,669	NA[2]
HAZARDOUS MATERIAL INCIDENT RESPONSE:	$270	$74	$20	NA[2]

Large Fleet = 100+ power units
Medium Fleet = 11 to 99 power units
Small Fleet = 1 to 10 power units

(1) Assumed only for motor carriers whose driver settlements are time-based.

(2) No industry average was calculated because survey responses only applied to those carriers whose driver settlements are time-based, or if the functional activity is limited to specific industry segments.

(3) Weighted by the relative number of commercial vehicles in small, medium, and large interstate and intrastate fleets as reported in the U.S. Department of Commerce 1992 Truck Inventory and Use Survey.

FIGURE 2 Motor Carrier Use of Advanced Technology
BASED ON THE SURVEY RESPONSE OF 700 MOTOR CARRIERS

	Survey Respondents			Weighted
	Small Fleets	Medium Fleets	Large Fleets	Industry Average[1]
COMMUNICATIONS:				
Mobile Communications	46%	42%	63%	46%
Electronic Data Interchange	8%	27%	65%	11%
Automatic Vehicle Location	1%	5%	23%	2%
COMPUTERS:				
Log Scanner/Auditing Systems	7%	35%	50%	10%
On-Board Computers/ Hand-Held Computers	7%	27%	57%	10%
Electronic Logs	1%	5%	19%	2%
SOFTWARE:				
Computer-Aided Dispatch/ Routing Systems	15%	46%	74%	19%

Large Fleet = 100+ power units
Medium Fleet = 11 to 99 power units
Small Fleet = 1 to 10 power units

(1) Weighted by the relative number of small, medium, and large fleets operating in the United States.

Figure 2 details the current level of technology application among the motor carriers responding to the ATA Foundation survey by fleet size and extrapolated to the industry using published estimates of the number of small, medium, and large fleets operating in the United States.

TECHNOLOGY PRODUCTS AND SERVICES—POTENTIAL COSTS OF ITS/CVO USER SERVICES

The potential costs to motor carriers for participating in the ITS/CVO User Services includes two areas: (1) financing of government ITS/CVO infrastructure from road use and other taxes and (2) cost of specific technology required to participate in a functional activity. While the funding of ITS/CVO infrastructure is of great concern to motor carriers, the focus of this analysis is restricted to only the motor carrier purchases.

The expected purchase price is based on an assessment of existing technologies in the marketplace with respect to the anticipated technological requirements of the User Services. The vendors in the technology marketplace produce a wide variety of products—hardware, software, and services—in an effort to enhance communications and computing capacities. These have been reviewed and are detailed in **Figure 3**.

PRICING AND ENABLING TECHNOLOGIES FOR THE ITS/CVO USER SERVICES

Since the majority of functional activities of the ITS/CVO User Services are not currently operational, the challenge of estimating costs lies in determining appropriate assumptions related to enabling technology and pricing. The actual sale price for a technology product is determined by myriad factors—number of units purchased, add-on features to basic systems, the specific functional characteristics, etc. This analysis does not attempt to estimate these factors, but rather maintains a simple price estimate that represents a likely average price across industry segments and company size. The cost of enabling technology systems is assumed to be spread over three years to reflect conservative estimates of useful life for the systems. The pricing assumptions for the ITS/CVO User Services are presented in **Figure 4** (see next page).

FIGURE 3 Technology Products and Services Distribution of 180 Surveyed Vendors by Technology Group

Technology	Number of Vendors
COMMUNICATIONS:	
Mobile Communications	17
Electronic Data Interchange	15
Automatic Vehicle Location	15
Automatic Equipment/ Vehicle Identification	6
COMPUTERS:	
On-Board Computers	7
Hand-Held Computers	12
Hours-of-Service Related Products	4
SOFTWARE:	
Vehicle Maintenance Software	8
Routing and Dispatching	14
Mapping Software	13
Other Software Providers	36
OTHER TECHNOLOGY:	6
Vehicle Diagnostics	16
Weigh-in-Motion/Automatic Vehicle Classification/ On-Board Scales/Traffic Management	11
TOTAL	180

FIGURE 4 Pricing and Enabling Technology Assumptions

ITS/CVO User Service	Pricing/Enabling Technology[1]
Commercial Vehicle Administrative Processes	$500 Per Carrier per Year: Cost of PC-based EDI software ($1,500 per carrier capitalized over three years) and transaction fees.
Electronic Clearance	$11 per Vehicle per Year: Cost of Type I, read-only transponder ($33 per transponder capitalized over three years).
Automated Roadside Safety Inspections	Vehicle Inspection— None: All costs borne by enforcement agencies. Hours-of-Service Reporting and Verification— $465 per Vehicle per Year: Cost of hand-held data terminal ($1,395 per unit capitalized over three years).
On-Board Safety Monitoring	$232 - $633 per Vehicle per Year: Range based on cost of on-board devices for vehicle systems/load monitoring (add-on devices to mobile communications systems—$695 per unit) and the cost of on-board computer systems ($1,900 per unit). All costs are capitalized over three years.
Hazardous Materials Incident Response	$500 per Carrier per Year: Cost of PC-based EDI software ($1,500 per carrier capitalized over three years).
Freight Mobility	Undetermined for User Service Application.

(1) Based on product information obtained from 180 vendors of technology products.

PART II

ITS/CVO USER SERVICES BENEFIT/COST ASSESSMENTS

The benefit/cost assessments of the ITS/CVO User Services are based on the impacts of current technology on motor carrier operations and are extrapolated to the proposed User Services not yet deployed. The User Services hold promise for improving the efficiency of regulatory and enforcement agencies, but the success of the program will depend on the voluntary participation by motor carriers. In choosing whether or not to participate in government applications of technology, motor carriers will carefully scrutinize the benefits, costs, and policy implications of the ITS/CVO User Services.

The following summarize the assessments.

Commercial Vehicle Administrative Processes (CVAP)

CVAP shows great promise for reducing motor carriers' administrative compliance costs. Reductions in administrative compliance labor costs-which include licensing, permitting, registration, fuel tax reporting, and the installation of operating credentials on vehicles-are expected to be in the range of nine to 18 percent. Motor carrier costs to participate are expected to be low.

Within the framework of this study, the greatest promise is for medium- and large-sized companies (primarily regional and national in range of operation). These companies are expected to realize reductions in administrative compliance costs outweighing participation costs by at least four to one. For small carriers, benefits are assumed to be at least equal their cost of participating, as detailed in **Figure 5.**

Motor carrier participation in this User Service can be expected to be broad. Willingness to conduct regulatory transactions electronically via EDI was expressed by 32, 61, and 79 percent of small, medium, and large carriers, respectively. Market potential is estimated to be in the range of 425,000 to 2.0 million power units; ranging from 11 to 54 percent of the medium and heavy truck population.

Benefits to motor carriers can only be realized if the state agencies streamline regulatory compliance activities and enable paperless transactions between motor carriers and agencies. Enhancements to agency information systems will help improve agency efficiency, reduce government costs, and then aid motor carriers.

FIGURE 5 Commercial Vehicle Administrative Processes Assessment
Motor Carrier Benefits, Costs, and Market Potential

	Fleet Size		
	Small 1-10 Units	Medium 11-99 Units	Large >99 Units
BENEFITS AND COSTS:			
Average annual labor cost for administrative compliance functions per vehicle	$918.00	$306.00	$145.00
Average percent savings due to technology (EDI)	9%[1]	18%	15%
BENEFITS—Estimated annual savings in labor costs for administrative compliance functions per vehicle	$83.00[1]	$55.00	$22.00
COSTS—Cost of PC-based EDI software ($1,500 per carrier), capitalized over three years and prorated over average respondent fleet size by segment	$83.00	$13.15	$1.11
Calculated benefit/cost ratio	1.0:1[1]	4.2:1	19.8:1
MARKET POTENTIAL:			
Percent of vehicles operated by EDI-capable survey respondents	9%	34%	84%
Percent of vehicles operated by survey respondents willing to use EDI for regulatory transactions	36%	69%	85%
Market potential (number of medium and heavy trucks)	2,000 to 762,000	32,000 to 649,000	391,000 to 606,000

(1) Insufficient numbers of EDI-capable small carriers appear in the survey results to estimate the impact of technology on compliance costs. Given the results from medium and large fleets, small fleets are assumed to show benefit/cost ratios of at least 1.0:1.

Electronic Clearance (EC)

The labor costs of roadside compliance checks to motor carriers were estimated based on survey respondent perceptions of the number and average duration (including waiting time) of size/weight, safety, and credential inspections they underwent in 1994. For motor carriers whose driver settlements are time-based, average annual per vehicle cost of driver time at roadside compliance checks is estimated to be $71, $81, and $42 for small, medium, and large fleets, respectively. These stops are assumed to hold no cost for carriers whose driver settlements are not time-based.

The potential benefit of EC to motor carriers as measured within the framework of this analysis, is the reduced cost of driver time resulting from fewer stops for roadside compliance checks. This analysis assumes that EC will decrease the amount of time spent undergoing roadside compliance checks by 50 percent to 100 percent. This measure of benefit may be considered only directly applicable to motor carriers who pay their drivers based on time worked. For the carriers whose driver settlements are not time-based, this analysis concludes that no benefit in terms of reduced cost of driver time is derived from EC.

The calculated range of benefit/cost ratios for only motor carriers who pay their drivers based on time worked are: 3.3:1 to 6.51 for small carriers; 3.7:1 to 7.4:1 for medium-sized carriers; and 1.9:1 to 3.8:1 for large carriers, as detailed in **Figure 6.**

The proportion of power units operated by survey respondents who indicated that roadside compliance checks decrease their fleets' operating efficiency is 33,40, and 47 percent for small, medium, and large carriers, respectively. Market potential is estimated to range from 264,000 to 1.4 million power units, representing from seven to 38 percent of the U.S. medium and heavy truck population. This estimate is not restricted to carriers who pay drivers by time because the potential benefit extends to enhanced operational efficiency.

Several concerns about EC were voiced by members of the trucking industry; many are captured in the American Trucking Associations' December 1994 comments to the FHWA on the intelligent Transportation Systems (ITS) National Program Plan and also have been presented by several motor carrier members of the TWG.These include:

- Not all carriers will realize benefit in reducing the number of roadside checks.
  Many motor carriers do not pay their drivers based on hours worked.These carriers therefore generally do not recognize driver time spent at roadside compliance checks as a business cost. In addition, 58 percent of the survey respondents perceived roadside compliance checks as either improving or having no effect on their fleets' operating efficiency.
- EC is premised on clearing trucks past a fixed point.
  Automated fixed-site weigh stations and inspection facilities may not be the best way to capture noncompliant motor carriers and may not be compatible with emerging safety compliance strategies.
- The scope of EC deployment and financing is undefined.
  Concerns exist that funding the automation of fixed-site weigh stations and inspection facilities may not be the best use of highway funds. Additionally, some motor carriers view the payment of transaction or "clearance" fees as a method augmenting state revenues at motor carrier expense.

FIGURE 6 Electronic Clearance Assessment
Motor Carrier Benefits, Costs, And Market Potential

	Fleet Size		
	Small 1-10 Units	Medium 11-99 Units	Large >99 Units
BENEFITS AND COSTS:			
Average hours per year per vehicle undergoing roadside compliance checks[1]	4.9	5.7	2.9
Average annual cost of driver time at roadside compliance checks per vehicle @ $14.49 per hour	$0.00[2] $71.00[3]	$0.00[2] $81.00[3]	$0.00[2] $42.00[3]
Assumed percent savings in driver time at roadside compliance checks per vehicle due to Electronic Clearance	50-100%	50-100%	50-100%
BENEFITS–Estimated annual savings per vehicle	$0.00[2] $36.00 to $71.00[3]	$0.00[2] $41.00 to $81.00[3]	$0.00[2] $21.00 to $42.00[3]
COSTS–Cost of Type I, read-only transponder ($33 per transponder), capitalized over three years	$11.00	$11.00	$11.00
Calculated range of benefit/cost ratios	No Benefit[2] 3.3:1 to 6.5:1[3]	No Benefit[2] 3.7:1 to 7.4:1[3]	No Benefit[2] 1.9:1 to 3.8:1[3]
MARKET POTENTIAL:			
Percent of vehicles operated by survey respondents who perceive that roadside compliance checks decrease fleet efficiency	33%	40%	74%
Market potential (number of medium and heavy trucks)	8,000 to 696,000	37,000 to 373,000	219,000 to 336,000

(1) This estimate is not based on timed observations, but is based on motor carrier reported number and average duration of stops.

(2) Estimated for motor carriers whose driver settlements are not time-based.

(3) Estimated for motor carriers who pay drivers based on hours worked.

Automated Roadside Safety Inspections (ARSI)

ARSI is evaluated for two components: (I) inspection of vehicles and (2) hours-of-service reporting and verification.

The primary purpose of this User Service is to increase the efficiency of enforcement personnel in conducting roadside inspections, thus allowing them to inspect a higher volume of vehicles. Market potential is not an appropriate measure for the vehicle inspection component of ARSI because all motor carriers are subject to safety inspections.

Providing the means for drivers to present log data electronically to enforcement officials could also reduce the amount of time required to undergo a roadside safety inspection. In addition, the use of electronic logs or trip recorders reduce the amount of time a driver spends completing logs and trip reports by as much as 25 percent.

For only those firms paying drivers based on time, the benefit/cost ratios for automating driver hours-of-service reporting and verification via on-board computers or electronic logs are estimated to range from 1 .I :I to 1.4:1, depending on industry segment. For motor carriers whose driver settlements are not time-based, no benefit is assumed within the analytical framework of this assessment, as described in **Figure 7.**

Based on the percent of power units operated by survey respondents who use on-board computers or electronic logs, the estimated market potential for this aspect of automating safety inspections is estimated to range from 80,000 to 885,000 power units; ranging from two to 24 percent of the medium and heavy truck population.

As with Electronic Clearance, driver time spent on regulatory compliance activities is not considered a cost for the motor carriers who do not pay drivers based on time worked. Therefore, the benefits as defined in reducing driver time undergoing roadside inspections or in completing logs are restricted to a narrow portion of the industry.

FIGURE 7 Automated Roadside Safety Inspections, Hours-of-Service Recording and Verification Assessment Motor Carrier Benefits, Costs, and Market Potential

	Fleet Size		
	Small 1-10 Units	Medium 11-99 Units	Large >99 Units
BENEFITS AND COSTS:			
Average annual cost of driver time for roadside safety inspections per vehicle @ $14.49 per hour	$0.00[1] $30.00[2]	$0.00[1] $28.00[2]	$0.00[1] $11.00[2]
Average annual cost of driver time completing logbooks per vehicle @ $14.49 per hour	$0.00[1] $2,443[2]	$0.00[1] $2,577[2]	$0.00[1] $2,567[2]
Average percent savings in driver time due to technology (electronic logbooks)	25%	25%	25%
BENEFITS–Estimated annual savings per vehicle	$0.00[1] $618[2]	$0.00[1] $651[2]	$0.00[1] $645[2]
COSTS–Cost of technology (hand-held computer)	$465	$465	$465
Calculated benefit/cost ratios	No Benefit[1] 1..3:1[2]	No Benefit[1] 1.4:1[2]	No Benefit[1] 1.4:1[2]
MARKET POTENTIAL:			
Percent of vehicles operated by survey respondents who use on-board computers or electronic logs	11%	29%	54%
Market potential (number of medium and heavy trucks)	2,600 to 229,000	27,000 to 273,000	50,400 to 383,000

(1) Estimated for motor carriers whose driver settlements are not time-based.

(2) Estimated for motor carriers who pay drivers based on hours worked.

On-Board Safety Monitoring (OBSM)

OBSM has two components: (1) collision avoidance and (2) on-road safety monitoring of drivers and vehicles. The framework of this study-evaluation of impacts of technology on the labor costs of motor carrier regulatory activities-allows for the evaluation of only the second component. Collision avoidance is not assessed because: (1) the activity does not strictly involve regulatory compliance and (2) the exposure of collision avoidance technologies in the marketplace is limited and the impact on current activities cannot be assessed.

The monitoring of drivers and vehicles is assessed based on savings in labor for on-the-road direct observation of drivers and vehicles by using on-board computers or trip recorders instead.The monitoring of drivers and vehicles is only one of many functions performed by on-board computer systems or trip recorders. The benefit of reducing labor costs associated with on-road safety monitoring is small compared to the cost of on-board computers or trip recorders, resulting in calculated benefit/cost ratios ranging from less than 0.1 :I to 0.5:1, as described in **Figure 8.**

Motor carriers will not likely purchase an on-board monitoring device solely to automate direct observation of drivers and vehicles, but would include this benefit with other operational benefits derived from its use. For example, other benefits could include increased equipment utilization, reduced fuel consumption, improved maintenance programs, etc. In other words, the decision to invest in such on-board sensing and recording devices will be based primarily on the motor carriers' assessment of operational and safety benefits.

Estimated market potential is not based on positive benefit/cost ratios as calculated within this narrow framework, but is based on those carriers who currently use on-board computers or trip recorders for monitoring driver/vehicle performance. Market potential is estimated to range from 202,000 to 866,000 power units, representing a range from five to 23 percent of the medium and heavy truck population.This estimate should be viewed carefully, as it may more realistically express the potential for on-board computers as a tool of fleet management than potential motor carrier participation in OBSM.

Motor carriers have expressed concern about monitoring or recording devices becoming mandated equipment on their vehicles. As well, drivers have shown limited acceptance of on-board monitoring devices, citing the devices represent an invasion of privacy in their workplace.

FIGURE 8 Automated Monitoring of Driver and Vehicle Operations Assessment Motor Carrier Benefits, Costs, and Market Potential

	Fleet Size		
	Small 1-10 Units	Medium 11-99 Units	Large >99 Units
BENEFITS AND COSTS:			
Average annual labor cost for observing driver and vehicle performance on the road per vehicle	$572	$183	$60.00
Average percent savings due to technology (on-board sensing device–OBSD)	20%	20%	20%
BENEFITS–Estimated annual savings in labor costs for observing driver and vehicle performance on the road per vehicle	$114	$37.00	$12.00
COSTS–Likely cost of technology per vehicle[1]	$232 to $633	$232 to $633	$$232 to $633
Calculated benefit/cost ratios	0.18:1 to 0.49:1	0.06:1 to 0.16:1	0.02:1 to 0.05:1
MARKET POTENTIAL:			
Percent of vehicles operated by survey respondents using mobile communications systems which would support real-time OBSD	3%	11%	41%
Percent of vehicles operated by survey respondents who use on-board computers	10%	30%	52%
Market potential (number of medium and heavy trucks)	1,000 to 213,000	10,000 to 283,000	191,000 to 370,000

(1) Range based on cost of on-board devices for vehicle systems/load monitoring (add-on devices to mobile communications systems–$695 per unit) and the cost of on-board computer systems ($1,900 per unit). All costs are capitalized over three years.

Hazardous Materials Incident Response (HMIR)

HMIR is assessed within the framework of reducing motor carriers' administrative costs for hazardous materials incident response programs through automation. Reduced remedial costs are not considered.

A method of providing first responders with information on load contents grew from the conclusions of a 1993 National Research Council (NRC) report on transportation and hazardous materials in which it was determined that a centralized system for tracking hazardous materials shipments would be too unwieldy and costly. The NRC recommended that industries transporting hazardous materials build on existing management systems developed by railroads and motor carriers.

The functional characteristics of this User Service are currently being defined through two operational tests. Hazardous Materials Incident Response is assessed assuming that motor carriers would post existing response information to a well-publicized site in an electronic network. Emergency responders could then rapidly access information about the company, cargo, response instructions, emergency response phone numbers, etc. These data are currently maintained by hazardous materials transporters.

A comparison of costs for motor carriers that use EDI and those that do not indicate nine to **18** percent lower costs for administrative compliance functions. Accordingly, it is assumed that the motor carrier costs of hazardous materials incident response programs would be reduced by a similar percent using these types of technologies. The estimated benefit/cost ratios range from 0.3:1 to 2.5:1, as detailed in **Figure** 9. Within the framework of this assessment, this User Service holds promise for medium and large carriers. The cost of participating in this User Service outweighs the potential benefits for small carriers.

Market potential is estimated to range from 94,000 to 377,000 power units, representing approximately eight to 34 percent of trucks regularly transporting hazardous materials in quantities large enough to require a placard.

Though HMIR will enable improved motor carrier efficiency in administrating an incident response program, this User Service is designed to improve management of HazMat incidents to ensure the safety of the public and emergency responders.

FIGURE 9 Hazardous Materials Incident Response Assessment Motor Carrier Benefits, Costs, And Market Potential

	Fleet Size		
	Small 1-10 Units	Medium 11-99 Units	Large >99 Units
BENEFITS AND COSTS:			
Average annual administrative labor cost for hazardous materials incident response per vehicle	$270	$74.00	$20.00
Average percent savings due to technology	9%[1]	18%	15%
BENEFITS–Estimated annual savings in administrative labor costs for hazardous materials incident response per vehicle	$23.30[1]	$13.32	$3.00
COSTS–Cost of PC-based EDI software ($1,500 per carrier), capitalized over three years and prorated over average respondent fleet size by segment	$83.33	$12.50	$1.22
Calculated benefit/cost ratios	0.3:1[1]	1.1:1	2.5:1
MARKET POTENTIAL:			
Percent of vehicles operated by survey respondents who are EDI-capable HazMat carriers	6%	39%	77%
Percent of vehicles operated by HazMat carrier survey respondents who are willing to use EDI for regulatory transactions	33%	75%	73%
Market potential (number of trucks)	None Assumed	19,000 to 212,000	75,000 to 165,000

(1) Insufficient numbers of EDI-capable small carriers appear in the survey results to estimate the impact of technology on costs. Given the results from medium and large fleets, small fleets are assumed to show benefit/cost ratios of at least 1.0:1.

Freight Mobility (FM)

FM involves motor carrier use of many technologies to improve fleet operating efficiency and safety. The literature provides many examples of advanced computer and communications technologies improving carrier operational efficiency for vehicles, fleets, and business functions.The high ratio of benefits to costs are obvious from the rapid deployment of decision support systems, communications equipment, on-board computers, etc. These are borne out by the description of benefits provided by the motor carrier survey respondents.

The use of mobile communications can yield benefit/cost ratios ranging from 1.51 to 5.O:l. Computer-aided dispatch and routing systems also provide carriers benefits far outweighing costs.

The public sector role in Freight Mobility is still undefined, but will likely be based on enhancing operational efficiency and safety. Possible public sector applications may include real-time travel information to aid routing and dispatch functions. Computer-aided routing and dispatch systems (CAD) are used by 15,46, and 74 percent of small, medium, and large carrier survey respondents, respectively. Based on these figures, it is estimated that the routing/ dispatching of approximately 1.5 million medium and heavy commercial vehicles could potentially be affected through the use of real-time traffic information.

RECOMMENDATIONS FOR ADDITIONAL RESEARCH

This study effort detailed benefit/cost assessments of the ITS/CVO User Services within the framework of their impacts on motor carrier labor costs of compliance with current regulations. The operational and safety impacts of the User Services were not quantified through this effort, nor were the impacts to motor carriers of changes in the regulatory environment examined.

The ITS/CVO User Services are evolving; the dozens of operational tests and program developments will ultimately determine their form. These all assume that there are safety and operational benefits to motor carriers, but these have not been systematically determined nor quantified. For example, the vendor literature suggests that one-half of all vehicle collisions could be avoided if the driver had even a one-half second warning of the impending collision and high frequency radar could provide this warning. But, what is the context of benefits and costs in the motor carrier operation?

Anecdotal information is being used to drive many projects that will define the ITS/CVO program. Therefore, it is recommended that a systematic assessment be conducted to determine the safety and operational impacts from current and emerging ITS technologies for motor carriers to help guide the programs of the future and demonstrate the potential benefits to motor carriers.

From the perspective of motor carriers, regulatory efficiency is best realized through the elimination of regulation. Institutional issues analyses focus on improving existing regulatory structures and not on their reform. It is also recommended that institutional renovation be analyzed to accompany ITS/CVO deployment for motor carrier/government applications.

MEETINGS OF THE TECHNICAL WORKING GROUP

June 1994, Washington, DC

October 1994, San Diego, California

February 1995, Laguana Nigel, California

October 1995, Chicago, Illinois

February 1996, San Diego, California

ATA FOUNDATION WOULD LIKE TO THANK
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