



Advantage I-75 Mainline Automated Clearance System

Final Report

Part 1 of 5: Executive Summary

Prepared for

The Advantage I-75 Evaluation Task Force

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Executive Summary

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EXECUTIVE SUMMARY

The Advantage I-75 Mainline Automated Clearance System Project (MACS) demonstrates and evaluates the feasibility of electronic clearance at weigh stations along the Interstate Highway 75 corridor. The test involves participants from government and industry. Government participants include the states of Michigan, Ohio, Kentucky, Tennessee, Georgia, Florida, the Province of Ontario, Canada, the Federal Highway Administration (FHWA), and Transport Canada. Industry participants included the American Trucking Associations, the National Private Truck Council, the Ontario Trucking Association, state trucking associations along the corridor, and individual motor carriers who travel along the corridor. The Kentucky Transportation Center at the University of Kentucky serves as the project's research and operations center on behalf of the lead state of Kentucky. The Center for Transportation Research and Education (CTRE) at Iowa State University serves as the evaluator of the project. The evaluation consists of four tests to determine the effectiveness of electronic clearance of commercial vehicles at weigh stations. These tests are a fuel consumption test, a weigh station throughput test, a simulation model, and an examination of jurisdictional issues. A report evaluating the Advantage I-75 MACS system prepared by the University of Kentucky, Kentucky Transportation Center with input from CTRE, is submitted separately.

The vision of the Advantage I-75 program was to incorporate existing technologies into an Intelligent Transportation System (ITS) operational setting that provides an initial step in the process of adapting the nation's highway system to accommodate the increased demands placed on it. The objective of the Advantage I-75 MACS operational test is to permit transponder-equipped trucks to travel any segment of the I-75 and Highway 401 corridor at mainline speeds while being cleared to bypass the weigh stations along the corridor.

PROJECT SCOPE

The scope of the Advantage I-75 MACS project, as identified by the partners were: (1) To increase industry and state productivity; (2) To improve highway safety; (3) To reduce congestion. The MACS project partners also identified a goal from inception to "utilize off-the-shelf technology as a tactic for getting the system up and operational quickly." Because of the far-reaching implications of the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), the MACS project partners incorporated these goals into the related project goal statements. ISTEA's broad goals are (1) To provide for a unified, interconnected transportation system, (2) To reduce energy consumption and air pollution while promoting economic development, and (3) Support the Nation's pre-eminent position in international commerce.

The evolution of electronic screening at weigh stations is an outgrowth of numerous efforts to streamline motor carrier regulatory enforcement and alleviate traffic congestion in and around weigh stations. The Advantage I-75 MACS system establishes the first step in creating "transparent borders" between states. Electronic screening at weigh stations proposes to change the ways in which state and federal

officials regulate commercial vehicle operations and to help make all concerned more efficient and productive.

As there are over 600 commercial vehicle inspection stations across the USA and the increasing emphasis on safety inspections for commercial vehicles, there are numerous occasions on which a commercial vehicle driver faces delays en route. Many of the nation's fixed inspection facilities were constructed 20 to 30 years ago. Consequently, the explosive growth in truck traffic has exceeded the station design specifications at many of these inspection stations. As truck arrivals exceed these stations' operational capacities, queues develop and drivers are delayed. Often, the backups require stations to close to avoid safety hazards on the mainline.

Background

The vision of the Advantage I-75 program is to incorporate existing electronic technologies into an ITS operational setting that provides an initial step in the process of adapting the nation's highway systems to accommodate the increased demands placed on it. This Operational Test entitled *Mainline Automated Clearance System* (MACS) was designed as the initial phase of the Advantage I-75 program. As previously stated, the objective of the Advantage I-75 MACS operational test is to permit compliant transponder-equipped trucks to travel any segment of the I-75 and Highway 401 corridor at mainline speeds while being cleared to bypass the weigh stations along the corridor.

Advantage I-75 goals identified by the partnership were: 1. To increase industry and state productivity; 2. To improve safety; and 3. To reduce congestion. The MACS project partners also stated from the project's inception to "utilize off-the-shelf technology as a tactic for getting the system up and operational quickly." Because of the far reaching implications of the Intermodal Surface Transportation Act of 1991 (ISTEA), the MACS project partners incorporated its into related project goal statements. ISTEA's broad goals provide for a unified, interconnected transportation system; to reduce energy consumption and air pollution while promoting economic development; and supporting the Nation's pre-eminent position in international commerce. As one part of a national effort to improve the transportation system, the Advantage I-75 MACS program meets these stated goals through improved procedures and systems used to verify commercial vehicle size, weight, and credentials.

Relationship to the National ITS Program

The national Intelligent Transportation System (ITS) program is designed to address these safety and productivity concerns by focusing advanced technology on commercial vehicle operations (CVO). One part of this overarching program is to enhance mainline electronic screening of CVO at the weigh stations. Presently, along the Interstate 75/Highway 401 corridor, there are approximately 4,500 trucks equipped with transponders to communicate with AVI (Automated Vehicle Identification) readers located near 29 weigh stations on the corridor. The AVI readers then identify the transponder-equipped trucks and their credentials. Those states with mainline weigh-in-motion (WIM) capabilities can also check compliance with size and weight regulations. When the information is read and verified, the trucks receive a signal, both visual and audible. The signal directs the operator to either by-pass the weigh station or to enter the station (for a random inspection). The elapsed time of this communication from the truck to the weigh station, back to the truck, is less than one second. Mainline

electronically screening of commercial vehicles permits compliant vehicles to bypass the weigh station, consequently enforcement officials can better focus their resources on non-compliant commercial vehicle operations.

OVERVIEW OF PROJECT METHODOLOGY

To demonstrate and evaluate the feasibility of electronic clearance at weigh stations the basic test design was to install and operate a prototype system at selected weigh stations along the corridor. In addition to operating the system, studies were conducted to determine any fuel and time savings incurred by motor carriers operating with electronic clearance. The project methodology included these tasks:

- { Motor Carrier Fuel Consumption Test
- { Weigh Station Individual Evaluation Test
- { Simulation Model
- { Jurisdictional Issues Evaluation

Motor Carrier Fuel Consumption Test

This portion of the evaluation was to determine if mainline electronic clearance produces significant fuel savings for motor carriers. The test used to make this determination applied accepted Society of Automotive Engineers' (SAE) guidelines. The prescribed method directed one truck to stay on the mainline and a second truck to enter the weigh station. The second truck would then either stop or slow at the scale, depending on the design of the weigh station. The fuel used by each truck was then precisely measured to determine the fuel used by each vehicle. The difference in fuel used was the estimated savings of fuel attributable to a truck bypassing a weigh station.

Key Findings

The fundamental hypothesis tested was that reduction or elimination of stops at weigh stations by transponder-equipped truck will result in measurable fuel savings for that vehicle. While the fuel savings generated from a single stop were minimal, the accumulated benefit from reduced stops at a weigh station were significant. Fuel savings estimates were measured at five sets of weigh stations along the corridor. These five sets of weigh stations represent three main weigh station design types. They are: The static scale design type, the ramp weigh-in-motion (WIM) design type, and the high speed ramp WIM design type. The estimated fuel savings were different for each weigh station design type. The static scale design type provided the most substantial fuel savings of the three different designs. Bypasses at Knoxville, Tennessee and Findlay, Ohio, provided measurable savings of 0.16 (0.61 liters) and 0.18 gallons (0.68 liters) per vehicle per station bypassed respectively. The fuel savings accrued at the ramp WIM scales are less dramatic. The savings in Monroe, Michigan were estimated at 0.11 gallons (0.42 liters) per vehicle per station bypassed. The savings in Monroe County, Georgia, however, were estimated at 0.06 gallons (0.23 liters) per station. Finally, the savings accrued in Charlotte County, Florida, at the high speed ramp WIM, were 0.05 gallons (0.19 liters) per vehicle per station bypassed. A small study of fuel consumption in queues suggests that the fuel savings for static scales may be as much as twice the values given here when trucks are in stop-and-go driving conditions

averaging 4 mph (6.4 kph). As this was a controlled experiment, the fuel savings gained from this exercise were nominal. The principal conclusion from the experiment, however, is that there are measurable fuel savings obtained by electronic clearance. The value of these savings, however, depends upon the number and nature of stations electronically cleared.

Weigh Station Individual Evaluation

Electronic screening at weigh stations proposes to change the ways in which state and federal officials regulate commercial vehicle operations and to help make all concerned more efficient and productive. By screening commercial vehicles electronically, and permitting compliant vehicles to bypass the weigh station, enforcement officials can better focus their resources on the non-compliant commercial vehicle operations. This evaluation assesses the effect of electronic clearance on the amount of travel time confronted by commercial motor vehicles at weigh stations, thus providing a measure of benefit to motor carriers. Benefits to state enforcement officials and the traveling public are assessed informally in this section, but more substantially in the simulation study discussed in a later report.

Data Collection

The purpose of this portion of the evaluation is to determine if mainline electronic clearance produces significant travel time savings for motor carriers. The data collection procedure used to make this determination was designed by Iowa State University. The prescribed method was to position recorders at the entrance point of the weigh station, at the static scale, and at the exit point of the weigh station. The recorders, equipped with stop watches, then recorded the time each truck crossed the specific point. Mainline speeds of commercial vehicles were also recorded. The difference in time between the commercial vehicle in the weigh station, and one on the mainline was the estimated time savings attributable to being electronically screened on the mainline.

Key Findings

The fundamental hypothesis tested was that reduction or elimination of stops at weigh stations by participant transponder-equipped vehicles will result in travel time savings for that truck. Travel time estimates were measured at 19 sets of weigh stations along the corridor. These 19 sets of stations represent the three main weigh station design types. They are the static scale design type, the ramp weigh-in-motion (WIM) design type, and the high-speed ramp WIM design type.

The estimated time savings were different for each weigh station design type. Travel time savings were most substantial at the static scale design types. At the static scales in Knoxville, Tennessee and Findlay, Ohio, vehicle bypasses provided measurable time savings, on average, of 4.86 minutes, and 2.22 minutes, per station respectively. Part of the time difference is the amount of truck traffic at each facility. Trucks entered the Knoxville, Tennessee weigh station at a rate of 450 trucks per hour, while the rate of arriving vehicles at the stations near Findlay, Ohio was 215 trucks per hour. The travel time savings between driving on the mainline and driving through the weigh-in-motion stations are smaller. Travel time savings at WIM stations such as those in Monroe, Michigan were estimated at 1.33 minutes per station. The time savings accrued in Charlotte County, Florida, at the high-speed ramp WIM, were

1.92 minutes per station cleared to bypass. The principal conclusion from this experiment is that there are measurable time savings obtained by electronic screening of commercial vehicles. As with the fuel savings, the time savings attributed to bypassing an individual station are minimal though, the accumulative value to bypassing several stations is significant. The value of these savings, however, depends on the number and nature of the stations being electronically screened.

Simulation Modeling

One of the tasks that the Center for Transportation Research and Education (CTRE) at Iowa State University was given for this program evaluation was to quantify the impact of electronic screening of commercial motor vehicles in terms of travel time savings for motor carriers and enhanced productivity of weigh stations. As part of that evaluation, CTRE developed a simulation model that provides visual animation of commercial vehicle traffic approaching, traveling through, and exiting a weigh station. The simulation provides a robust medium for evaluation as it can quantify the benefits of electronic screening under a variety of parameters and display the operation of the system using animation. The animation provides the audience a better understanding of the analysis of electronic screening on weigh station throughput.

This report examines the use of computer simulation of electronic screening at weigh stations on the I-75 corridor. For this portion of the evaluation of the Advantage I-75 MACS program, we developed computer simulation models for seven weigh stations along the I-75 corridor. The stations we modeled are in Halton, Ontario; Monroe, Michigan; Hancock, Ohio; Kenton, Kentucky; Knoxville, Tennessee; Lowndes, Georgia; and Punta Gorda, Florida. These stations were chosen by the Evaluation Task Force because they represent varying station design, commercial vehicle traffic flows, and topography.

The weigh station simulation design is based on the existing geometry and functionality of a given weigh station, yet is flexible enough to accommodate the potential modifications of the weigh station policy and procedure. The model allows the user to change the model's parameters to perform "what-if" scenarios.

The ability to change the model's parameters and simulate hypothetical scenarios is a powerful tool for decision-makers when considering performance of a given weigh station. One goal of the evaluation is to extrapolate the results of electronic screening into the future. By using simulation, performance measures such as transponder-equipped trucks, queue length, and unauthorized bypasses can be projected into the future. The model clearly illustrates the impact of these performance measures on weigh stations. Therefore, traffic planners and enforcement officials can see that electronic screening of commercial vehicles is a feasible option for increasing capacity without costly investments in expanding the physical infrastructure of a weigh station. Simulation is a process of modeling the operation of an actual system. Its purpose is to provide a better understanding of the behavior of actual systems and to evaluate the potential modifications of the system design. Computer simulation is a well known and powerful tool for testing the impact of changes in variables or parameters for systems where the effect of such changes cannot be determined analytically. One example in which simulation is useful is to evaluate traffic experiments which, for one reason or another, cannot be easily carried out and measured in the field. The MACS evaluation is an example of a complex system where observational studies aimed at estimating the MACS potential to reduce queues and unauthorized bypasses would be too costly or impossible to conduct. The model developed by CTRE and the Advantage I-75 MACS program vividly demonstrates the potential of computer simulation. Because of this potential, research is continuing in this area by CTRE and others in the field.

Key Findings

The evaluation of the Advantage I-75 MACS project has studied the effects of electronic screening on reducing travel time and fuel consumption for motor carriers and enhancing the productivity of weigh stations for enforcement officials. The results of the simulation model show that as participation in electronic screening grows, participant trucks, enforcement officials, and even non-participant trucks benefit by a more efficient system.

Jurisdictional Issues

The purpose of this report is to document the jurisdictional issues encountered in the implementation of electronic screening technologies for commercial vehicle operations in the participant states and provinces. The report also documents whether or not states will continue using MACS or an enhanced version of electronic screening, and motor carriers' reactions to using the MACS version of electronic screening.

The jurisdictional issues portion of the Advantage I-75 MACS evaluation examined several items including interstate, intrastate, and regional issues with regard to the implementation of electronic clearance systems. As part of the evaluation, agency staff members and motor carriers were interviewed and surveyed to obtain their views and opinions of the processes leading to electronic screening. The examination then set out to determine whether or not the states and province in the project planned to continue with electronic screening, or an enhanced form of MACS.

As a primary goal, the Advantage I-75 MACS operational test was to demonstrate and evaluate the jurisdictional issues involving electronically screening commercial vehicles at weigh stations. This evaluation of jurisdictional issues among the Advantage I-75 MACS partnership was designed to provide states and motor carriers with information to support decisions about continuing or discontinuing electronic screening or an enhanced form of electronic clearance and verification.

Key Findings

The research into the jurisdictional issues was guided by meeting three objectives: (1) To determine whether or not states, along with Province of Ontario, will continue to offer electronic screening of motor vehicles; (2) To determine whether or not motor carriers will continue to participate in Advantage I-75 MACS after the operational test is completed; and (3) To record all significant jurisdictional issues addressed during the operational test and document the resolution to issues addressed.

The first objective of the evaluation was met, as the states in the partnership, along with the Province of Ontario, have agreed to continue to offer mainline electronic screening. The second objective of the evaluation was also met as our findings conclude that there is support from the industry to continue with electronic screening of commercial vehicles. Finally, the third objective was met by documenting the issues encountered in the operational test. These issues were the following: (1) In order to facilitate the implementation of the system, technical standards and information sharing must be agreed to early on in the project; and (2) There must be "buy-in" from upper management in order to succeed.

System Evaluation

The purpose of this portion of the evaluation was to compare the performance of the as-built MACS system during the operational test to the performance levels specified in the Functional Requirements Document (FRD). The system evaluation is a cooperative effort including the team from the Center for Transportation Research and Education (CTRE) and the operations and support staff from the Kentucky Transportation Center (KTC). The system evaluation report was prepared by the Kentucky Transportation Center and will be submitted separately by KTC.

EVALUATION CONCLUSIONS

The Advantage I-75 MACS Project has demonstrated that both states and motor carriers expect to reap benefits from mainline electronic screening of commercial vehicles at weigh stations. The fuel consumption tests demonstrated that there are measurable fuel savings generated from mainline electronic screening. The savings, however, are dependent upon the number and nature of stations electronically cleared. The weigh station tests measured the effect of mainline electronic screening on the amount of travel time confronted by commercial motor vehicles at weigh stations, thus providing a measure of benefit to motor carriers. The principal conclusion from this experiment was that there are measurable time savings obtained by mainline electronic screening. The value of these savings, again however, depends on the number and nature of the stations being electronically cleared. Another part of the evaluation was to develop a computer simulation model. The model that CTRE developed provides visual animation of commercial vehicle traffic approaching, traveling through, and exiting a weigh station. The evaluation of the Advantage I-75 MACS project studied the effects of mainline electronic screening on reducing travel time and fuel consumption for motor carriers and enhancing the productivity of weigh stations for enforcement officials. The results of the simulation model show that as participation in electronic screening grows, participant trucks, enforcement officials, and even non-participant trucks benefit by a more efficient system.

For motor carriers, the benefits in fuel and time savings are dependent upon the number, the design, and the level of traffic at each of the weigh stations encountered en route. For states, the benefits are dependent on the cost avoidance of building new weigh stations by installing mainline electronic screening systems in the existing weigh stations. As more motor carriers implement electronic screening, states reap greater benefits without additional costs.

Future ITS projects should seriously consider the methods developed by Advantage I-75 MACS. This method includes a lead agency to facilitate the project and lead representatives from each jurisdiction in close contact with the lead agency to enhance communication. While there were issues that caused minor delays in the project because of uncertainties, with few exceptions, the parties made the commitment to work together to complete the goals and objectives for the project satisfactorily. The lessons learned from this project will serve others well in future ITS projects.