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The Heavy Vehicle Electronic License Plate System Development Program: A Progress Report

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ABSTRACT

The Heavy Vehicle Electronic License Plate (HELP) System Development Program is a cooperative multi-state project designed to demonstrate the applicability and use of automated vehicle identification (AVI), weigh-in-motion (WIM), and automated vehicle classification (AVC).

Participating states are Alaska, California, Idaho, Iowa, Minnesota, Nevada, New Mexico, Oregon, Pennsylvania, Texas, and Washington.

AVI and/or AVI/WIM sites will be located along I-5 and I-10 corridors. If other states and provinces decide to participate, additional routes may be monitored.

An essential part of the project is the involvement of truck operators through the placement of Heavy Vehicle Electronic License Plates on their vehicles. The HELP will develop and implement methods for improving the management of the highway system through a linking of this electronic equipment by a telecommunication network accessible to all participants, both public and private. The project will illustrate how WIM and AVC, when integrated with a HELP system, can provide the states, federal government, and private industry with vital information for a variety of needs such as pavement and fleet management.

This paper presents the goals of the project, the organization, and the potential benefits and impacts.

I. INTRODUCTION

The HELP project began in 1983 with concept papers written by the Departments of Transportation in Oregon and Arizona. The papers were produced while seeking means of improving truck weighing operations at weigh stations and ports-of-entry. The goal was to find an economical method of gathering more pertinent information on the characteristics of heavy vehicles which would provide a data base to be used for improved highway planning, design, and management.

Current methods of collecting extensive data on the nation's highway system are very costly to both government and industry. Many of these data collection activities entail substantial efforts. Yet the data produced, over the years, have such inconsistencies among states and between sources, or have important elements missing, that much of the data are not directly useful.

A potential solution to many of these problems lies in the application of better data collection, storage and retrieval techniques using the new electronic technology. A total system would include components that would automatically weigh, classify, measure speed, and specifically identify individual vehicles. In conjunction with state-of-the-art microprocessor technology, automatic heavy vehicle monitoring systems provide an extraordinary opportunity to bring about a quantum jump in multi-use data collection of heavy vehicle characteristics.

II. THE OREGON DEMONSTRATION PROJECT

Since 1983, Oregon has been involved in an individual effort to demonstrate how weighing vehicles in motion could be used to the advantage of both the government and the trucking industry. This integration of AVI, AVC, and WIM technology should help not only with planning and design information but also in size, weight, and speed enforcement. It has the potential to improve the tracking of hazardous materials, help fleet managers monitor their vehicle movement, and promote a reduction of thefts of vehicles equipped with AVI devices (transponders). To get objective data, some weighing sites in addition to ports-of-entry and weigh stations are needed as there are by-pass routes a truck can take to avoid these stations.

The Oregon Automatic Vehicle Identification/Weigh-in-Motion demonstration project began with the installation of fast speed weigh-in-motion scales in both north-bound lanes of the I-5 freeway near the Jefferson exit. This system is used primarily for the collection of planning data. The scales register vehicle weight, length, axle spacing, 18-kip equivalent single axle loads, speed, and time.

Since these scales were installed, more than 15 million vehicles have been weighed and classified. About 20% of these vehicles are trucks. This section of the freeway was overlayed in 1983 with a design capacity of 13.5 million ESAL's. The WIM scale is registering 950,000 ESAL's per year. At this rate the pavement design life will be reached in 14.2 years without any consideration of traffic growth.

About 28 miles further north, at Woodburn, a moderate speed Weigh-in-Motion and overheight sorting system was installed at a north-bound weigh station. This WIM equipment is used to screen trucks as part of Oregon's on-going truck weight enforcement program. Legally loaded vehicles that enter the weigh station and cross over the weigh pads at 25 to 35 MPH are automatically given a green light to return to the freeway. Approximately 90% of the vehicles are passed through the station with the green light. Trucks with overheight, overweight, or

axle weight distribution problems are directed to the static scale. This sorting system has allowed the Weighmaster Unit to operate the station with one person rather than the three previously needed. Both the Jefferson and Woodburn scales were installed in February, 1984.

While data from these two sites are still being analyzed, it is noteworthy that the high speed Jefferson WIM scales record almost 50% more overloads than the Woodburn sorter scale. This would appear to indicate a substantial scale bypass problem at the Woodburn weigh station.

In the spring and summer of 1984, General Railway Signal Automatic Vehicle Identification reader-activators were installed at these two sites and at the Ashland POE and the Ridgefield, Washington POE on Interstate-5. These reader-activators read data from precoded passive transponders mounted on trucks. Twenty-one trucking firms installed 200 transponders on their vehicles for this demonstration. Trucks equipped with transponders can be automatically tracked as they travel Interstate-5, from the California/Oregon border north to the Oregon/Washington border, a distance of 310 miles.

Nine miles north of the Woodburn weigh station site, vehicle classifiers were installed in six lanes of the freeway, both north and south-bound. These classifiers identify 19 vehicle configurations and provide information on vehicle speed and gap spacing. This is the first installation of this type of equipment in the United States.

The information received at these five locations has been tied together with a data base management system, creating a unified, accessible AVI/WIM data base.

Another element of the Oregon project is a portable Bridge Weighing System (BWS) which employs strain gauges to convert a bridge into a scale, weighing trucks as they pass over a bridge. The strain gauge data are converted to vehicle weight information by a computer housed in a van. This system is used primarily on rural highways and is useful in determining which roads are used as bypass routes by overloaded trucks. Within this element of the project, Science Applications International Corporation successfully interfaced and tested, in a rural location, the portable BWS and a portable AVI system.

III. ORIGIN OF THE MULTI-STATE CONCEPT

About this same time, the Arizona Department of Transportation received a grant from the Federal Highway Administration to study the feasibility of a WIM/AVI demonstration in a multi-state environment. This study was completed by Castle Rock Consultants in December, 1984. The report was very encouraging about the potential benefits to both the government and private sectors. This preliminary study indicated that such a program, fully implemented, could soon pay for itself. Another, more thorough, study is to be conducted to either confirm or disclaim the optimism of the Castle Rock report.

Results of the Arizona feasibility study and the positive feedback from the Oregon concept demonstration project generated a growing interest, especially in Western states, in developing a multi-state program. In February of 1985, a kick-off meeting of government officials and trucking representatives was held in Portland, Oregon. This meeting was the beginning of the concept development phase.

The project was dubbed the Crescent Study because the states that showed the strongest initial interest formed a crescent shape from the Canadian/Washington border, through the Pacific Coast states, across to Texas. The study now includes Alaska, Arizona, California, Idaho, Iowa, Minnesota, Nevada, New Mexico, Oregon, Pennsylvania, Texas and Washington. The state of Virginia has also expressed interest in joining.

IV. ELEMENTS OF THE HELP DEVELOPMENT PROGRAM

The overall aim of the HELP Development Program is to produce a system which will bring the maximum benefits to states and truckers at the least cost. The multi-state program has now reached the stage where a number of development and testing phases are starting which will continue over the next two years. Within this framework the following program elements can be identified.

1. The AVI testing element begins with laboratory and field tests of the alternative automatic vehicle identification technology. The results of these tests will be used to develop a generic AVI system specification. The specified system will then be put through a similar testing program, and any necessary fine tuning will be carried out.
2. The WIM/AVC Performance Specification elements are similar efforts addressing the weigh-in-motion and automatic vehicle classification components of the HELP system.
3. The Site Selection element involves a consultant study to develop guidelines which will enable states to locate HELP stations along the planned demonstration routes. This study will determine the optimal number and location of HELP sites to meet the aims and requirements of the program. Sites will be selected so that they can also be readily incorporated into a national system if the demonstration should prove worthwhile.
4. The Motor Carrier Services Plan element will involve a joint effort among FHWA, AASHTO, states, and national and regional motor carrier industry representatives. The purpose of this study will be to examine in greater detail how the HELP system may benefit the motor carrier industry.
5. The Satellite Reference Design System element will investigate the economic and technical feasibility of a satellite-based traffic monitoring system. This will include definition of the system, costs and benefits to both government and industry, and comparison with alternative ground-based data collection

systems. Ways in which satellites could be integrated with a ground-based HELP system will also be covered.

6. The Systems Design element will define the communications and processing requirements for public and private sector applications. The main tasks will involve communications systems design and computer systems analyses for data processing and utilization.

V. THE CRESCENT PROJECT

The final phase of the program is the Crescent Project. This HELP System demonstration is planned for the western United States and southwest Canada, including the states of Texas, New Mexico, Arizona, California, Oregon and Washington, and the province of British Columbia. The Crescent corridor includes the major interstate highways of I-5 and I-10. The Crescent Installation Program and Evaluation Study will, as the name implies, involve the installation and evaluation of the HELP System developed in the preceding portions of the development program. This system demonstration will be a good test of the technical practicality and usefulness of this type of technological integration. Unfortunately, a complete measure of the possible benefits to be derived from a fully developed HELP System is not possible without a more saturated implementation of of sites than is provided for in this study.

VI. OTHER CURRENT RESEARCH

Two closely related projects, that are being undertaken during the same time frame as HELP, are Iowa and Minnesota's Low Cost Automatic Weight and Classification System and the National Cooperative Highway Research Program's (NCHRP) "The Feasibility of a National Heavy-Vehicle Monitoring System".

The Iowa and Minnesota research will involve the installation of piezo-electric sensors and an inductive loop at one Iowa and one Minnesota site. The output from the sensors and loops will be analyzed using microprocessor technology. The system will include off scale detection, tire width measurement, vehicle speed, classification by axle spacing, axle and gross weights, and equivalent single axle loading calculations.

The objective of the NCHRP research, which is being conducted by Arthur D. Little, Inc., is to identify and evaluate the needs, issues, requirements, and feasibility, on a national level, of using an automated system as a cost-effective, statistically sound replacement and/or supplement to existing heavy-vehicle data collection systems. This study will build on the knowledge gained from the HELP program and any other related studies.

VII. HELP PROGRAM ORGANIZATION

The HELP Project is guided by two committees, the Executive Committee and the Policy Committee. An important aspect of the project is to have full private sector involvement. Each Crescent state is represented on each committee by a state government official and a trucking industry representative. From the government point of view, this project will be successful only if the private sector believes that the project is of proven benefit to them.

The function of the Policy Committee is to develop the program's budget, approve the work program, and appoint the Executive Committee.

The Executive Committee is to select a policy consultant, approve a technical consultant contracting plan, approve requests for proposals and consultant selections, update the project's budget and work program, and make recommendations to the Policy Committee.

Subcommittees deal with the technical proposals and make recommendations to the full Executive Committee for letting contracts.

The HELP System Development Program is ambitious and complex. The Policy and Management Consultant Services elements are a direct response to these characteristics of the program. The policy consultant will address policy issues that emerge during the course of the program and will handle public relations, educational and promotional activities. The management consultant will manage and coordinate the technical aspects of the program.

The generic AVI system selection is currently scheduled to be completed in 1987. Within a few months after this selection, the states along the Crescent path are expected to have 10,000 test vehicles from two hundred trucking companies equipped with transponders. The demonstration continues through 1988. The final evaluation of the project and the report should be finished by May of 1989.

VII. HELP PROGRAM BENEFITS

To reiterate the kinds of benefits that are possible with the use of a Heavy Vehicle Electronic License Plate System.

For Government:
- Better tax auditing information.
- Improved speed, weight and load enforcement information.
- Automatically recorded permits and safety inspections.
- Better data for planning and design purposes.

For Industry:
- Improved fleet management information for truck operators to monitor their vehicle movement, weight and speed.
- Reduced delays at Ports-of-Entry and weigh stations, saving time and money for the operators and causing fewer safety hazards.
- A reduction in paperwork and recordkeeping.
- A possibility of lower insurance rates due to better tracking of stolen equipment.
- Better highways with the use of better data for superior roadway designs.

Trucking firms participating in Oregon's demonstration project see as the two big advantages coming from this system: time savings at weigh stations, which they are already experiencing; and the pos-

sibility of this system promoting fairer competition. Most of the trucking industry operate within the legal limits. There are, however, an increasing number of violators attempting to take advantage of the system to gain a competitive edge. Because of these violators, the industry as a whole suffers. First, because the legal operators are at a competitive disadvantage, and second because the negative image of the violators reflects on all operators.

IX. THE FUTURE OF HELP

Oregon is currently working on plans for automated ports-of-entry. The prototype will be the newest Oregon POE at Woodburn, south-bound on I-5. This port is open 24 hours a day, year round, and processes about 2000 trucks a day, with as many as 200 per hour at peak times. AVI, WIM, and AVC will be combined with a Supervisory Computer and various software and hardware packages to link the technologies. In addition to the usual weighing functions, personnel at POE's also fulfill regulatory and tax collecting functions. It is estimated that nine of the thirteen manual tasks currently required of a weighmaster per truck can be eliminated. With this technology, 85% of the vehicles going through the POE can be automatically processed, saving time for both government and industry.

The promise of the benefits to be derived from a system of this type is immense. Oregon is planning for the future implementation of an automated vehicle monitoring system, even if other states decide that they do not have uses for this type of program. Preliminary plans suggest the possibility of instrumenting 100 bridges for the portable BWS system, and installing 100 in-ground piezo cable WIM. Many of these installations may be interfaced with AVI. With the information derived from such a system, highway planning and designing would be greatly improved. The proper placement of these installations should also go a long way toward eliminating the scale bypass problem and, therefore, the vehicle overload problem.

The multi-state Help System Development Program is essentially a cooperative research and demonstration project investigating the new technological tools available to gather pertinent heavy-vehicle data. The purpose of research such as this is not to reach conclusions, but to discover things that are presently unknown. What we hope to learn from the testing of the HELP system is what functional and practical applications there are for automated systems on the nation's highways. Out of this and the previously mentioned NCHRP study, transportation professionals will gain insight into what it will take to develop and implement a national vehicle monitoring system that may benefit both government and industry.

REFERENCES

Bell, Chris A., and Alaeddin E. Mohsene, 1985, *Processing and Presentation of Traffic Data From Oregon's Automatic Vehicle Monitoring System*, Oregon State University, Corvallis, Oregon.

Burgess, George, and H. Scott Coulter, July 1984, "Managing the Highway System in an Era of Technological Change", *Western Highway Institute Conference*, San Francisco, California.

Davies, Peter, 1984, *Heavy Vehicle Electronic License Plate(HELP) System, Phase 1A: Feasability Study*, CRC Corp., Nottingham, England.

Davies, Peter, 1985, *Heavy Vehicle Electronic License Plate(HELP) System, Phase 1C: Feasability Study*, CRC Corp., Nottingham, England.

Henion, Loyd, July 1983, "Weigh in Motion, New Technology to Assist Us in Managing Our Highway Investment", *National Weigh In Motion Conference*, Denver, Colorado.

Henion, Loyd, February 1985, *What is the Crescent Project?*, Oregon State Highway Division, Salem, Oregon.

Krukar, Milan, 1983, "The Benefits of Using Automatic Vehicle Identification Tracking Devices to the State of Oregon and the Trucking Industry", Oregon Department of Transportation, Salem, Oregon.

Krukar, Milan, and Loyd Henion, 1984, "The Oregon Weigh-in-Motion Project", *18th Annual Pacific Northwest Regional Economic Conference*

Krukar, Milan, and Loyd Henion, May 1985, "The Use of Weigh-in-Motion/Automatic Vehicle Identification Data in Oregon", *2nd National Conference on Weigh-in-Motion Technology and Applications*, Atlanta, Georgia.

McDaniel, T. L., and J. W. Schmidt, April 1985, *The Development of an AVI/WIM Data Base and the Demonstration of A Combination of Bridge WIM and Portable AVI Data*, Science Applications International Corporation, San Diego, California.

Moses, F., and M. Ghosn, December 1981, "Weighing Trucks-in-Motion Using Instrumented Highway Bridges", *Report No. FHWA/OH-81/008.*

Moses, F. and M. Ghosn, August 1983, "Instrumentation for Weighing Trucks-in-Motion for Highway Bridge Loads", *Report No. FHWA/0H-83/001.*

ENDNOTE

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