Oregon Green Light CVO Evaluation

FINAL REPORT

Executive Summary

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DISCLAIMER

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1 INTRODUCTION

1.1 BACKGROUND

This Report is the Executive Summary for the independent technical evaluation of the Oregon Green Light CVO project. The Oregon Department of Transportation (ODOT) is near completion of the implementation of their Intelligent Vehicle Highway System Strategic Plan for Commercial Vehicle Operations (now referred to as ITS/CVO). Through Green Light, Oregon has installed twenty-one mainline systems featuring weigh-in-motion (WIM) devices and automatic vehicle identification (AVI) at the major weigh stations and ports-of-entry in the state. In addition, certain sites have been equipped with safety enhancements that regulate road conditions and speed. Examples are the Downhill Speed Information System at Emigrant Hill, and the installation of weather stations at three other locations.

The purpose of this report is to present a summary of the findings of all the Detailed Test Plans conducted for the evaluation. The Detailed Test Plans were published in 1997, ”The Oregon ‘Green Light’ CVO Evaluation -Detailed Test Plans” [1]. Earlier documents providing essential background to the Evaluation are the Evaluation Plan [2], and, Individual Test Plans (ITP) [3].

Each of the tests conducted by the research team for the evaluation of Green Light addressed one of five goals of the evaluation as documented in the Evaluation Plan [2]. These are:

- Assessment of Safety
- Assessment of Productivity
- Assessment of User Acceptance

- Assessment of Mainstreaming Issues
- Assessment of Non-Technical Interoperability Issues

The objectives associated with each goal are given in detail in The Oregon "Green Light" CVO Project - *Individual Test Plans* (ITP) [3]. The detailed test plan documents [1] expand on the information provided in the ITP and provide in detail the activities planned for each *evaluation measure.*

1.2 PURPOSE AND SCOPE

The purpose of this Executive summary is to summarize the principal findings from each Detailed Test Plan (DTP). Each of the DTP's is summarized in Exhibit 1-1.

As the evaluation progressed, some simplifications were made as it became clear that some elements of Green Light would be modified or eliminated. For example, objective 2.6 was eliminated because vision technology was eliminated from ODOT's plans. Also, a major change was implemented for DTP #7 where a simulation tool was developed to enable benefits of electronic screening to be evaluated. Simulation was necessary because the evaluation was proceeding concurrently with deployment, and, it was not possible to collect data that would enable measurement of impacts. Because the impact of pre-screening on fuel consumption was also determined using the simulation, that study (DTP #9) is reported with DTP #7. Exhibit 1-2 shows a summary of the DTP's that were completed.

The findings will be presented in Chapter 2, in the order of the detailed test plans. A general discussion regarding the success of the Green Light project is given in Chapter 4. Conclusions and Recommendations are given in Chapter 4.

EXHIBIT 1-1 Summary of Detailed Test Plans as Planned

Detailed Test Plan	Objective	Measure	Hypothesis / Assumption
DTP #1	1.1 Determine change in safety compliance with the Federal Motor Carrier Safety Regulations	1.1.1 Proportion of compliant (with FMCSR) trucks / carriers of total inspected and total processed per month.	The proportion of compliant trucks will eventually increase.
		1.1.2 Proportion of non-compliant (with FMCSR) trucks-carriers of total inspected and total processed per month.	The proportion of non-compliant trucks will eventually decrease.
DTP #2	1.2 Determine change in truck behavior due to the Road Weather Information System	1.2.1 Ratio of mean speed in inclement weather to that in "good" weather, before & after installation.	Truck speeds will decrease in inclement weather.
DTP #3		1.2.2 Ratio of accidents before & after installation if sufficient data exists.	Accident risk will decrease with better information available on weather conditions.
DTP #4	1.3 Determine change in truck behavior due to the Downhill Speed Information System	1.3.1 Ratio of mean speed on downhill sections, before & after installation.	Mean speeds will decrease.
DTP #5		1.3.2 Ratio of accidents before & after installation if sufficient data exists.	Accidents will decrease.
DTP #4		1.3.3 Comparison of mean speeds with advisory speeds	Mean speeds will converge towards advisory speeds.
DTP #6	2.1 Determine changes in tax administration costs	2.1.1 Determine the change in the resources required in the collection process, i.e., *hardware, software, staff etc.*	Tax collection will become more automatic and costs reduced (refer to the 1994 Green Light Document).
DTP #6		2.1.2 Determine the change in the resources required in the auditing process (government and carrier).	Audit process will become more automatic.
DTP #6	2.2 Determine changes in tax evasion	2.2.1 Determine changes in highway use tax revenues collected & why.	Oregon Green Light will support changes.
DTP #7	2.3 Determine changes in vehicles processed at each site	2.3.1 Compare total vehicles processed (cleared & not-cleared).	Number processed will increase.
DTP #7		2.3.2 Compare no. of interruptions per shift & total time.	Interruptions will decrease.
DTP #8		2.3.3 Observe system availability.	Availability will be approximately 95%.
DTP #8		2.3.4 Observe system availability for long combination vehicles at Farewell Bend	The system availability for LCVs at Farewell Bend will be approximately 95%.

DTP #7	2.4 Determine productivity to motor carriers	2.4.1 Compare truck flow on the mainline before & after installation.	Truck flow will increase.
DTP #9	2.5 Determine impacts on energy	2.5.1 Estimate changes in fuel use before and after using I-75 experience.	Fuel consumption will decrease.
DTP #10	2.6 Determine the ability of vision technology to support 100 percent electronic screening service	2.6.1 Evaluate the accuracy of the vision system by comparison of vision readout with actual plate numbers.	Vision system will be accurate at least 90% of the time.
DTP #11	3.1 Assess motor carrier acceptance	3.1.1 Determine attitude towards electronic screening, including perceived impacts.	The majority of carriers will have a positive attitude.
DTP #11		3.1.2 Determine attitude towards new services, e.g., select carriers-vehicles for inspection based on inspection and compliance status.	The majority of carriers will have a positive attitude.
DTP #11		3.1.3 Evaluate motor carrier acceptance of mainline electronic screening.	Carriers will demonstrate acceptace by installing transponders.
DTP #12	3.2 Assess agency acceptance	3.2.1 Determine agency attitude towards electronic screening, including perceived impacts.	The majority of agency personnel will have a positive attitude.
DTP #12		3.2.2 Determine agency attitude towards new services, e.g., select carriers-vehicles for inspection based on inspection and compliance status.	The majority of agency personnel will have a positive attitude.
DTP #13	4.1 Document regional and national mainstreaming issues	4.1.1 Identify, assess and document pertinent regional and national issues (e.g. IOU, HELP, CVISN, ITS Systems Architecture, DSRC) and assess the impacts to Green Light for customers and providers.	Knowledge of pertinent regional and national issues will increases the effectiveness of the Green Light program.
DTP #13	4.2 Document approaches attempted to solve mainstreaming issues and final resolutions	4.2.1 Document approaches attempted to solve regional and national mainstreaming issues as they arise, and final resolutions.	Participation in pertinent regional and national issues will contribute to the effectiveness of the Green Light program.
DTP #14	5.1 Document non-technical interoperability issues	5.1.1 Identify, assess and document pertinent non-technical interoperability issues as they arise for customers and providers.	Knowledge of pertinent non-technical issues will increases the effectiveness of the Green Light program.
DTP #14	5.2 Document approaches attempted to solve interoperability issues and final resolutions	5.2.1 Document approaches attempted to solve non-technical interoperability issues as they arise, and final resolutions.	Documentation of participation in, and approaches used to resolve pertinent non-technical issues will contribute to the effectiveness of the Green Light program.

EXHIBIT 1-2 Summary of DTP's as Completed

DTP	Test Measure	Description	Outcome
	All	Executive Summary	
DTP #1	1.1.1 and 1.1.2	Inspection Compliance	Completed as Planned
DTP #2	1.2.1	RWIS – Speed Study	Combined and Reduced in Scope
DTP #3	1.2.2	RWIS - Accidents	
DTP #4	1.3.1	DSIS - Speed Study	Combined and Reduced in Scope
DTP #5	1.3.2	DSIS – Accidents	
DTP #6	2.1.1, 2.1.2 and 2.2.1	Tax Collection and Auditing	Completed as Planned
DTP #7	2.3.1, 2.3.2, and 2.4.1	Simulating the Impact of Electronic Screening	Completed as Planned Combined with DTP #9
DTP #8	2.3.3 and 2.3.4	System Availability	Completed with Reduced Scope
DTP #9	2.5.1	Fuel Consumption	Completed as Planned Combined with DTP #9
DTP #10	2.6.1	Assess Vision Technology	No Evaluation Conducted
DTP #11	3.1.1 and 3.1.2	Assess Motor Carrier Acceptance	Completed as Planned
DTP #12	3.2.1 and 3.2.2	Assess Agency Acceptance	Completed as Planned
DTP #13	4.1.1 and 4.2.1	Mainstreaming Issues	Combined and Completed as Planned
DTP #14	5.1.1 and 5.2.1	Non-technical Interoperability Issues	

2 SUMMARY OF FINDINGS

This chapter summarizes the findings from each of the detailed test plans.

2.1 DTP #1 – Inspection Compliance

Out-of-service violations found during a series of random inspections (in 1998 and 1999) were used as an indicator of change in vehicle safety. The study found no significant changes in compliance rates at sites where Green Light technology was deployed. However, there was a significant increase in the total number of violations per inspection at non-GL, fixed sites. The most consistent pattern observed was a decrease in violation rates at non-fixed (or mobile) sites. The number of violations, the number of OOS violations, and the number of vehicle OOS violations per inspection decreased. Combining data across site types, the only significant difference was an increase in violations per inspection between 1998 and 1999.

It is important to note that over the course of the evaluation period, from January 1998 to July 1999, there was a low transponder penetration in relation to the total traffic bypassing the Green Light facility at Woodburn POE. At the end of the data collection period for this study in July 1999 there were approximately 3000 transponders in the field, less than the amount needed to actually show a change in compliance as a result of Green Light. This number increased substantially to over 10, 000 transponders in the field in July 2000. Green Light bypasses also increased dramatically from about 28,000 in July 1999 to approximately 60,000 by July 2000.

This study established a baseline for future studies that should show that safety compliance increases as Green Light is fully deployed and a significant truck population carry transponders. It is strongly recommended that ODOT conduct random inspections annually so that it can be clearly demonstrated that safety of the truck fleet is Improving.

2.2 DTP #2 – Road Weather Information System – Speed Study

ODOT's travel advisory web page has underwent several upgrades in during the last 12 months of the evaluation. In January of 2000, a test version of TripCheck was launched, a high-powered web interface that brings together several mediums of information for travelers. Information from the Green Light RWIS sensors are combined with 13 other weather stations across the state to provide timely weather and road conditions to motorists. In addition, TripCheck offers general information such as a listing of construction projects that could pose delays, public transportation services and schedules, rest area locations, and scenic byways.

The RWIS installations were successful in meeting the goal of providing real-time weather data for public use through the Traffic Management Operations Center in Portland. The server installations in La Grande, The Dalles and Ashland relay the information quickly and efficiently, enhancing the existing infrastructure used to provide weather conditions in these three areas known for their high occurrence of truck crashes.

The interface with truck traffic through the use of variable message signs was not accomplished before the evaluation was completed, due to the incompatibility of the existing hardware interfacing with the signs in Ladd Canyon. Combined with the prohibitive costs of retrofitting signs with compatible hardware and/or purchasing new signs, this led to an incomplete evaluation of the motor carriers adjusting speed to adverse weather conditions.

Detailed test plan #11, the Motor Carrier Survey, provides additional insight into how motor carriers feel about the RWIS system as intended by ODOT. The survey found that 60% of carriers agree that RWIS would benefit their company (14% disagree and 26% have no opinion).

Recommendations for future work would be to pursue the dissemination of real time data to the roadside, rather than solely through the Internet. With the advent of wireless data communications, trucks could be equipped with palmtop computers that can query road conditions via the Internet. Until such technology is mainstream, information kiosks at rest areas, truck stops, and weigh stations, could be incorporated into ODOT's existing infrastructure without a great deal of capital expense, and would reach all carriers, regardless of their technological advancements.

2.3 DTP #3 – Road Weather Information System – Accident Study

Available accident data has given a good baseline approach to continued monitoring of accidents in the Ladd Canyon area. It is strongly recommended that ODOT continue to collect data so that the impact of the RWIS can be measured.

2.4 DTP #4 – Downhill Speed Information System – Speed Study

Although the Emigrant Hill DSIS was not been deployed, the evaluation indicates that DSIS is a valuable tool that will be beneficial to the trucking community. Emigrant Hill continues to be listed as a high truck crash corridor in the state of Oregon, with 62 crashes occurring in 1999 due to speed and improper overtaking. The DSIS could aid in reducing these numbers through a warning system of advised speeds and personalized signing as proposed in the Green Light Project.

OSU recommends that ODOT continue to pursue deployment of this technology, and if possible, conduct an evaluation of its effectiveness.

2.5 DTP #5 - Downhill Speed Information System – Accident Study

Available accident data has given a good baseline approach to continued monitoring of accidents at Emigrant Hill. It is strongly recommended that ODOT continue to collect data so that the impact of the DSIS can be measured.

2.6 DTP #6 – Tax Collection and Auditing

The impact of Green Light increases the capacity of a weigh station to observe motor carriers' operations. For each truck that uses a transponder, a space is created in the weigh station queue. Assuming that the ODOT maintains the volume of traffic currently processed through the static scales, the total number of observations will increase equal to the rate of growth in transponder-equipped trucks. For trucks that have transponders, observations will be recorded at every pass by the weigh station. For trucks without transponders, the likelihood of having to stop at the static scale, thus being observed will increase.

Observations or third party data are an integral part of the weight-mile tax auditing process. Weight-mile tax reports are generated by the motor carrier on a monthly or quarterly basis. Reported trips are compared to observations within the state. Observations are currently made at the weigh station through vehicle weighing, safety inspections, and traffic citations. Weigh station observations are by far the most prevalent observations.

The increase in the number of observations enabled by Green Light will allow the audit unit to more effectively select motor carriers for audit. By having more observations, there is a greater chance of detecting unreported trips. Additional observations will also improve the accuracy of motor carrier audits. The additional information will allow the field auditors to more precisely and assuredly estimate a vehicle's pattern of operation with the boundaries of Oregon. This will also serve as a deterrent to weight-mile tax evasion.

Green Light will lead to an increase in the number of observations, improved accuracy, and, allow for a better selection of files to be audited. However, it will have little effect on the process of auditing. The auditing process calls for manual review of all files by the Pre-audit staff. A few lines of additional data might add a few seconds to the pre-audit staff review. Conversely, the additional data might allow the pre-audit staff to more quickly identify unreported operations, flag the files for audit, and move along to the next file. If either or both scenarios prove to be correct, the effect on the efficiency of the pre-audit process, measured in the amount of resources that it takes to review a file, will be negligible.

Field auditors use weigh station observations to piece together a vehicle's pattern of operation within Oregon. Because weigh station observations are more easily accessed than motor carrier records, the time that it takes to conduct an audit might be shortened. However, unless a truck is observed in several locations on all trips, review of data from a variety of sources will continue to be the norm. The effect that electronic clearance will have on the efficiency of the desk and field audit processes, measured in the amount of resources that it takes to conduct a desk or field audit, will be negligible.

With regard to tax collection, the "Oregon Weight-Mile Tax Study" of 1996 concluded that the "evasion rate of the weight miles tax is approximately five percent of the total tax liability, or ten million dollars per year." Although the amount of revenue lost to evasion each year is quite significant, it is only a small portion of motor carriers are actually submitting incomplete or inaccurate tax reports. [1] To meet the objectives set forth in Measure 2.2.1 "Determine the changes in highway use tax and why", the study team focused on the effect that Oregon Green Light technology has on the behavior of these motor carriers and the ability of the audit branch to detect and adjust inaccurate and/or incomplete tax reports. For example, the Woodburn Port of Entry currently allows all vehicles that weigh less than 62,000 lbs. on the ramp weigh in motion scale to take the

[1] Oregon Weight Mile Tax Study (Cambridge Systematics, Inc., Sydec Inc., and Pacific Rim Resources, Inc. February 20th, 1996.)

ramp bypass lane and thus avoid direct observation. Consistently, 60 percent of trucks that pass through Port of Entry are not directly observed. Assuming that the number of transponder-equipped vehicles increases as is expected, a substantial percentage of trucks will be checked electronically on the mainline and the static scales will no longer be operating at or near capacity. The weigh station will then be able to lower the threshold weight of the ramp bypass and pull in a higher percentage of non-transponder equipped trucks for static scale weighing and observation.

According to Motor Carrier Auditors, motor carriers are quite cognizant of the fact that the audit branch uses weigh station observations. For those motor carriers that are tempted to report only those trips in which they are observed, the additional observations will serve as a direct deterrent resulting in greater tax receipts per registered motor carrier.

Deterrence alone will not eliminate tax evasion. As one auditor stated during the group interviews, “Tax evasion is more often an act of omission than an act of commission.” Poor record keeping and/or a lack of understanding of reporting procedure results in inaccurate or inadequate tax filings. The increase in the number of observations resulting from the introduction of electronic clearance will allow the pre-audit team to detect and adjust inaccurate and/or incomplete tax reports. By having more observations, there is a greater chance of catching unreported trips in both in pre-audit and field audit. While Green Light will provide more observations to assist auditors, this analysis did not determine significant changes in the processes.

2.7 DTP #7 – Simulating the Impact of Electronic Screening

The simulation findings indicate that electronic screening will reduce travel time and fuel consumption for trucks participating in the electronic screening programs, or transponder equipped trucks. Findings also indicate that electronic screening will decrease the occurrence of unobserved bypasses resulting from full queues and increase the percentage of trucks being screened for safety and compliance. The effectiveness of electronic screening will be situational. Several variables, including truck traffic volumes at the weigh station, the percentage of motor carriers participating in the electronic screening program, and Oregon's commercial vehicle enforcement policies and procedures will determine the degree to which the electronic screening program meets its objectives.

An advantage of the simulation model is that the ODOT is not limited to the analysis of the scenarios selected for this report. ODOT staff can run the model on any personal computer with the Windows 95 or higher operating systems. With the Arena Viewer, users are able to alter input parameters such as traffic level, transponder rate, and number and length of inspections, to perform "what if" scenarios. ODOT can also analyze the impact that changes in operational procedure and/or staffing levels would have on the functionality of the weigh station. For example, ODOT could examine the impact of changing the threshold weight for the bypass lane or closing the ramp bypass lane entirely. Also, it can be shown that if the ramp bypass lane were closed, electronically screened vehicles would realize greater time savings than vehicles not participating in the program.

In the scenario described above, closing the ramp bypass lane would also serve the objectives of ODOT's motor vehicle enforcement objectives. At the time of data collection, the ramp bypass lane allowed vehicles weighing less than 75 percent of the legal limit to bypass the static scale and return to the mainline. By bringing all vehicles to a stop at the static scale, the Woodburn staff would have the opportunity to visually check all vehicles not participating in the electronic screening. The ramp bypass lane serves the purpose of reducing congestion within the weigh station and thus minimizing unobserved bypasses, while maintaining weight screening on all vehicles that enter the weigh station. With enough vehicles participating in the program, electronic screening will give ODOT more flexibility in setting operational procedures. The simulation model will assist ODOT in assessing the impact of proposed changes in procedures.

Although closing the ramp bypass lane would result in the most dramatic changes in travel time savings for participating vehicles and would allow for a visual check of all vehicles, it is more likely that operational procedures would change incrementally. The simulation package gives the end user the ability to vary the percentage of vehicles and determine the threshold weight that would bring the greatest number of vehicles to the static scale without resulting in unobserved bypasses.

For this evaluation of weigh station efficiency, the Arena Viewer software "packed" with the Woodburn model is considered a deliverable equal in and of itself. Not only does the simulation provide a robust medium for evaluation but the powerful animation capability makes it possible to demonstrate the functionality of the weigh station and the impact of electronic screening to a broader audience.

2.8 DTP #8 – System Availability

The evaluation was designed to take place over a two-year period after the roadside systems were deployed. However, at the time the evaluation contract was completed, only seven of the twenty-one sites had been deployed, and had not been functioning for two years. The data collected were analyzed and indicated that the system was available at least 95% of the time to Weighmasters and Motor Carriers at the seven sites, when considered in aggregate. The data collected at Farewell Bend indicate that the system availability for long combination vehicles was nearly 100%.

It is strongly recommended that ODOT continue to evaluate data available in the Trouble Report Master Log and publish the results on an annual basis.

2.9 DTP #11 – Assess Motor Carrier Acceptance

A questionnaire survey was designed to monitor and assess motor carrier acceptance of Green Light technologies. Two surveys (“before” and “after”) were sent to carriers who operate in Oregon. The first survey was conducted in 1998, and the second in 2000.

The main goal of the questionnaire surveys was to obtain the following:

- User attitudes to electronic screening and its perceived impacts on the motor carrier.
- User attitudes to new services such as Road Weather Information System (RWIS) and Downhill Speed Information System (DSIS).

The survey design was based on the method described in the “Mail and Telephone Surveys – Total Design Method” by Don A. Dilliman. Mailing included an initial cover letter, the survey, and a brief description of Green Light components, a follow-up postcard, and finally a second survey identical to the first, but with a slightly different cover letter.

Surveys were mailed to a random sample of carriers registered to operate in Oregon. The population of motor carriers was divided into three strata based on the location of the carriers listed in ODOT’s database. Twelve hundred Oregon carriers made up the first stratum (Oregon carriers). One thousand carriers based in Washington, California, Idaho, and Nevada comprised a second stratum (Pacific Norwest carriers) while 1,000 of carriers of the remaining states and Canadian provinces made up to the third stratum (Other carriers).

The percentage of respondents to the survey was about 10 percent less in the “after” survey than in the “before” survey. The experience level of the participants is evenly distributed across strata with no significant variations in both “before” and “after” surveys. Nearly half (50%) of the respondants had been working in the industry for more than 20 years. Overall, smaller carriers dominated the sample with about three-quarters (75%) having fleet sizes of one to ten trucks. However, the medium fleet size (11 – 99 tractors) showed significant changes in the “after” or second survey.

A summary of findings is listed below:

- 41% of carriers agree (19% disagree) that Mainline Preclearance will benefit their company in the “before” survey while about 32% of carriers agree (25% disagree) with this statement in the “after” survey.
- 60% of carriers agree (that Road Weather Information System (RWIS will benefit their company in the “before” survey and 52% of carriers agree with this statement in the “after” survey. Approximate 15% disagree with the statement in both surveys.
- Over 50% of carriers agree with the policy of screening trucking for possible inspection based on recent compliance with federal safety regulations (nearly 16 % disagree) in both “before” and “after” surveys.
- Over 60% of carriers rate the overall performance of ODOT’s Motor Carrier Services as “Good” (nearly 26% rate it “Fair” and about 4% rate it “poor”) in both “before” and “after” surveys. 9% rate it “Excellent” in the “before” survey and 6% in the “after” survey.

The evaluation of motor carrier acceptance by tracking transponder penetration since they were introduced in 1997 showed that, after a slow start, the industry embraced the technology. At the time the evaluation was completed, nearly 12,500 transponders were in use.

2.10 DTP #12 – Agency Acceptance

The purpose of this study was to gain insight about how Green Light met its initial objectives in the eyes of the personnel that work with the system as well as those that developed and deployed it. The interviews provided an opportunity to document the lessons learned during Green Light's deployment. The study used an interview process tailored to focus on both Green Light's benefits, and the obstacles that may have hindered the development of the system's integration into the ODOT's business and operations. It was intended that the results of this part of the evaluation would provide a valuable resource to those deploying similar projects.

The interviews consisted of asking up to nine questions of a targeted group of ODOT's leadership and personnel involved closely with the Green Light deployment. The summary of responses shows a high level of agency acceptance as well as an understanding of the benefits gained and recognition of lessons learned. The last question dealt with lessons learned and is repeated below, followed by a summary of the responses:

> ***"What have been some lessons learned in the inception of Green Light, and what have been deterrents to its complete and successful operation?"***

Interoperability was commented on as a problem, specifically regarding the differing business models between different systems and the competitive politics surrounding the issue. It was stated that only the federal government has the power to enforce cooperation, but they have not. The technology is not a real problem, but the political resistance is. The program also has had installation and assimilation problems because of the lack of a central coherent training or marketing plan. Training was done piecemeal all over the state, so the same battles were fought over and over again. A comprehensive and organized introduction and training program would have increased early acceptance and eased the transition. The trucking industry as a whole is not an early adopter of technology, and a solid, timely marketing program should have been implemented. Some of the marketing that was done was done prematurely, which let carrier interest fade before the system was up and running. An important lesson is that by giving out free transponders to new members, the startup risk of new technology was shifted away from the truckers, so they became much more agreeable to the program. While this method may not be appropriate everywhere, it is important to note that carriers want to save time and money, but an untried system that fails will cost them more than it saves, so they are wary about investing in it. Reducing transponder costs as much as possible will diminish this reluctance. Ultimately, the system should be nationwide. This will reduce the costs to truckers the most, and so will be the most accepted, used, and useful. The Oregon system is up and running, but at present multiple transponders must be purchased to use systems in multiple states. Overcoming the barriers between systems is necessary for the system in any state to fully mature and achieve its potential.

2.11 DTP #13 & #14 - Mainstreaming and Non-technical Interoperability Issues

This part of the evaluation was weighted heavily towards interoperability issues, because those issues proved to be significant in delaying market penetration of mainline technologies. Mainstreaming proceeded in a steady and non-controversial way. The literature supports this conclusion; there are many articles that report on the widespread adoption of the technologies.

It is clear that achieving interoperability between different programs is very difficult. Even the MAPS and Advantage CVO states (with very similar business models) took four years from the start of Green Light to form an agreement.

Although a one-way interoperability agreement was reached between NORPASS and PrePass, it was unsatisfactory to Oregon, and, caused them to withdraw from NORPASS. Green Light carriers are still interoperable with NORPASS (they must pay the $45 enrollment fee) and, NORPASS carriers operate in the Green Light system free of charge. As yet, no satisfactory agreement has been reached between Green Light and Prepass for one-way interoperability.

A positive outcome of Oregon's withdrawal from NORPASS is that it transferred ownership of transponders to the carriers, and, distributed an additional 7,500 transponders in three months. There are now 12,500 trucks equipped with Green Light transponders. This is half their original target, but, considering the current progress, they could reach their target before 12/31/2000.

A satisfactory compromise needs to be reached between Oregon and PrePass before interoperability can be achieved. Oregon should hold to its principles, which are endorsed by other states and by many in the trucking industry. However, they will likely need to compromise, but, only to the degree to which their customers agree. The major principle is regarding HELP's limitation of the use of PrePass transponders.

An issue for many Green Light carriers is the fee structure used by PrePass. However, the market will determine if carriers are prepared to pay PrePass's fees. PrePass may need to introduce alternative fee schedules to attract a diverse range of customers.

A longer term issue is reaching an interoperability agreement that will enable PrePass carriers to operate in Green Light. At this time there is an impasse with regard to PrePass obtaining some cost recovery as well as protecting there carrier's data privacy. However, there are several examples of PrePass carriers that have requested enrollment in Green Light (and NORPASS) and have been refused by PrePass. Carriers can enroll in each system separately and obtain a transponder for each, but, there are problems when a truck has two transponders in the cab. Since the Green Light and PrePass transponders are the same, this situation is unnecessary!

Oregon was very successful in the distribution of transponders after opting to withdraw from NORPASS and deciding to act as their own transponder administrator. The two significant changes that Oregon introduced (as the administrator) were: a) transferring ownership of transponders to the carrier, and, b) providing new transponders at no cost. At the time the evaluation was concluded 12,500 transponders had been distributed. Another 12,500 will be distributed free of charge, before a carrier must purchase their own transponder. It is strongly recommended that ODOT continue the successful practice of targeting those carriers that would benefit the most from mainline , i.e. those that operate most in the Green Light corridors.

It is likely that ODOT will reach its goal of issuing a total of 25,000 transponders during 2001. The state should consider continuing free distribution of transponders. A market survey may be appropriate to guide this decision. It is certainly likely that those enrolled in the program would be willing to pay (if they had to do over) but enrolling new carriers will become difficult at some point. Removing the best incentive (free transponders) may halt the rapid progress that has been made in market penetration.

3 DISCUSSION

This chapter provides a general discussion of issues relating to the evaluation but not specifically addressed in any of the detailed test plans.

The Green Light Project was initiated in 1995 to fulfill Oregon's vision of creating an automated and intelligent truck transportation system. As the project nears completion, it has proved successful, by improving the safety and efficiency of the commercial trucking industry while at the same time increasing the performance of roadside facilities without physically expanding them, and protecting the public investment in the infrastructure.

Through the Green Light weigh station modernization program, Oregon has installed Mainline Systems at 21 weigh stations to electronically screen trucks as they approach at highway speeds. The deployment at all 21 sites was completed and fully operational by March 2001. Weigh-in-motion (WIM) systems check the vehicle's weight and height, and, automatic vehicle identification (AVI) systems check records for registration, tax status, and safety inspection status. The driver is signaled with an in cab device to either Report to the station or to Bypass.

During 1999 nearly 280,000 mainline bypasses occurred at completed sites, and, in 2000 this number rose to more than 640,000. All 21 sites were fully deployed by March 2001, and, the number of bypasses will continue to increase as more carriers enroll, freeing weigh site personnel and facilities to process only those trucks that need their attention, and, saving considerable time (and money) for trucks that bypass. Calculable savings occurred in several ways:

(1) The cost of physically expanding 11 of the 21 weigh stations was avoided,

(2) The cost of building five replacement weigh stations for facilities that would otherwise be rendered obsolete was avoided,

(3) The cost of early repair to the infrastructure as a result of increased overweight truck traffic was avoided, and

(4) The trucking industry operates more efficiently and avoids costs it would have incurred in a strictly conventional, time-consuming stop-and-weigh process.

Each of these cost saving mechanisms is addressed in more detail below.

Truck traffic increased almost 40 percent in the I-5 corridor between Portland and Salem from 1990-1998. The two weigh sites in this area were designed in the mid-1980's to weigh about 2,500 trucks a day, but today the traffic load has increased to more than 5,000 trucks a day. Truck traffic along the I-84 corridor has increased by similar amounts. To accommodate these increases in truck traffic 11 weigh stations would require expansion including extension of the off-ramps and added static scales. The total estimated cost for extending the ramps and adding a static scale at each site was $2,262,700. Through the Green Light mainline system, Oregon avoided spending millions on facility expansion at major weigh stations.

An additional five weigh stations would soon be rendered obsolete, and, there is no room to physically expand them at their current location. If replacement stations could be built, within appropriate proximity to each station, the cost of construction would be a minimum of $14.5 million. However the biggest cost consideration would be in land acquisition. If electronic screening were not available at these locations Oregon would be forced to close the stations, thus removing any visible enforcement, and, forced to accept compromises to its size and weight enforcement effort.

By implementing Green Light systems, Oregon identified and stopped more overweight trucks than previously. Without Green Light these trucks would proceed with the potential to cause millions in highway pavement damage. In a model developed by researchers in Idaho, the benefit in prevented damage can be estimated for a weigh station in a typical highway application. The study indicated that a single weigh station, covering an area of 160 miles, would prevent approximately $46 million in pavement damage during an average life span of 10 years. An earlier Federally Funded study indicated that overloaded truck axles cost up to $670 million per year (nationally) in pavement damage. Thus with 21 improved weigh stations enhancing the ability to minimize overloaded vehicles, Oregon could save well in excess of $200 million during the next 10 years. Although there is no generally accepted way to calculate the actual amount, the savings realized are related to costs associated with: (1) the effect of deteriorating pavement conditions on fuel economy, tire wear, and other related maintenance costs, (2) time delays suffered during pavement resurfacing, reconstruction, rehabilitation, and maintenance, and, (3) time delays suffered due to traffic control related to remodeling, upgrading, and/or reconstruction of weigh stations.

Finally, by utilizing Green Light the trucking industry enjoys efficiencies and avoids costs that are built into the conventional weigh station operation. What's it worth to a truck driver to pre-clear a weigh station at highway speeds? Operating a heavy truck has been estimated by the American Trucking Association to cost $1.92 per mile. Assuming an average hourly speed of 39 miles-per-hour (from departure to destination), a cost of $1.24 per minute is realized. Truck drivers save at least three minutes per weigh station bypass. Therefore it is conservatively projected, based on the current rate of about 60,000 bypasses a month in Oregon, that in the next 10 years the Green Light mainline system is expected to pre-clear 7.2 million trucks. This will save the industry more than $25 million in operating costs as it saves 360,000 hours of travel time. However, it is anticipated that the number of bypasses will increase substantially as more carriers enroll, resulting in much larger savings.

In summary, the Oregon Green Light project has been immediately beneficial, yet designed for the future; the system will continue to provide financial benefits in the form of cost avoidance to the taxpayer and to the trucking industry. The model deployment has clearly demonstrated the benefits of mainline . It has also demonstrated that achieving interoperability (see sections 2.10 and 2.11) is a difficult process that may prove more difficult to achieve than providing technically excellent systems.

4 CONCLUSIONS AND RECOMMENDATION

The independent evaluation was initiated in August 1995 and concluded in June 2000. Oregon State University was prime contractor, with Iowa State University as a sub-contractor, and, WHM Transportation Engineering as a consultant. Fourteen test plans were developed to evaluate: safety, productivity, user acceptance, mainstreaming issues and interoperability issues. At the time the evaluation was concluded, the Green Light sites were not fully deployed; the Conclusions and Recommendations are therefore based on tests conducted on an incomplete system. Nevertheless, they are a strong indicator of future performance.

4.1 Conclusions

Safety: Out-of-service violations found during a series of random inspections (in 1998 and 1999) were used as an indicator of change in vehicle safety. At the time of these inspections there were few transponders distributed and, therefore, no significant changes were observed. However, the study established a baseline for future studies that should show that safety compliance increases as Green Light is fully deployed and a significant number of trucks carry transponders. Evaluation of the Road Weather Information System (RWIS) and the Downhill Speed Information System (DSIS) could not be completed as planned because the systems were not fully deployed. However, the methodology for the evaluation should be applied once deployment is completed

Productivity: A study of the auditing and collection processes for the weight–mile tax indicated that Green Light technology significantly increases the level of auditing possible. Ability to do this will improve productivity but not result in any changes to the processes. A simulation model was also developed for sites. The model clearly demonstrated that system capacity increased as transponder penetration increased, and, provides a powerful tool (because of the animation capability) to demonstrate impacts of electronic screening to a broad audience. A third productivity study of seven functional sites indicated that the system will be available at least 95% of the time. This suggests a very high productivity when all 21 sites are deployed.

User Acceptance: Before and after surveys were conducted in 1998 and 2000 to assess motor carrier acceptance of Green Light technologies (electronic screening). There was little difference in the results of the 2 surveys. However, in both surveys, the majority of motor carriers were supportive of electronic screening and were satisfied with ODOT's Motor Carrier Services. The steady increase in transponders issued is the strongest indicator of user support; 10,000 were issued in 2000 after a slow penetration in 1998 and 1999. The indication is that ODOT will reach its goal of issuing 25,000 transponders in 2001, largely due to growth in user acceptance.

Agency Acceptance: Interviews were conducted with ODOT leaders as well as with personnel involved closely with the Green Light deployment. The responses showed a high level of agency acceptance as well as an understanding of the benefits gained and recognition of lessons learned. Interoperability was commented on as a problem, specifically regarding the differing business models between different systems and the competitive politics surrounding the issue. It was stated that only the federal government has the power to enforce co-operation. However, this was not done and a solution has not yet been found.

Mainstreaming and Interoperability Issues: Mainstreaming proceeded in a steady and non-controversial way. However, there have been many interoperability issues. It is clear that ODOT and PrePass must reach a satisfactory compromise before interoperability can be achieved. ODOT should hold to its principles, which are endorsed by other states and by many in the trucking industry.

In summary, the Oregon Green Light project has been immediately beneficial, yet designed for the future; the system will continue to provide financial benefits in the form of cost avoidance to the taxpayer and to the trucking industry. The model deployment has clearly demonstrated the benefits of mainline . It has also demonstrated that achieving interoperability (see sections 2.10 and 2.11) is a difficult process that may prove more difficult to achieve than providing technically excellent systems.

4.2 Recommendation

Because the evaluation contract was concluded before all elements of the Green Light project were fully deployed, the evaluation was incomplete. Nevertheless, the evaluation conducted demonstrated that the project was successful as indicated in the foregoing sections of this Executive Summary. However, it is strongly recommended that ODOT continue evaluation of Green Light using the framework established in the evaluation contract.

5 REFERENCES

1. Bell, C.A., B. McCall, and, C.M. Walton, “Oregon Green Light CVO Evaluation – Detailed Test Plans”, GLEV9603, Oregon State University, Transportation Research Institute, March 1997.

2. Bell, C.A., B. McCall, and, C.M. Walton, “The Oregon ‘Green Light’ CVO Project, Evaluation Plan”, GLEV9601, Oregon State University, Transportation Research Institute, September 1996.

3. Bell, C.A., B. McCall, and, C.M. Walton, “The Oregon ‘Green Light’ CVO Project, Individual Test Plan”, GLEV9602, Oregon State University, Transportation Research Institute, October 1996.

Oregon Green Light

CVO Evaluation

FINAL REPORT

DETAILED TEST PLAN 1

Safety Compliance Test

Paul E. Montagne

Chris A. Bell

Transportation Research Report No. 00-12

Transportation Research Institute

Oregon State University

Corvallis, OR 97331

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The authors are indebted to the personnel of ODOT's Motor Carrier Transportation Division, who have provided information and data to the evaluation team throughout the project. We are particularly indebted to Ken Evert, Gregg Dal Ponte, Randal Thomas and David Fifer. Ken's untimely death in 1998 meant that he did not see his vision completed. The evaluation team is forever indebted to him for his support and for the opportunity to participate in the deployment.

Lastly, a special thanks to John Kinateder and John Orban of Battelle for their contributions to this Detailed Test Plan.

DISCLAIMER

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1 INTRODUCTION

1.1 BACKGROUND

This Detailed Test Report is the first of 8 reports submitted as part of the independent technical evaluation of the Oregon Green Light CVO project. The Oregon Department of Transportation (ODOT) is near completion of the implementation of their Intelligent Vehicle Highway System Strategic Plan for Commercial Vehicle Operations (now referred to as ITS/CVO). Through Green Light, Oregon is installing twenty-one mainline preclearance systems featuring weigh-in-motion (WIM) devices and automatic vehicle identification (AVI) at the major weigh stations and ports-of-entry throughout the state. In addition, certain sites have been equipped with safety enhancements that regulate road conditions and speed. Examples are the Downhill Speed Information System at Emigrant Hill, and the installation of weather stations at three location across the state.

This report presents the results of Detailed Test Plan (DTP) #1. There will be similar reports for all other Detailed Test Plans developed for the Green Light Evaluation. The Detailed Test Plans were published in 1997, Oregon “Green Light” CVO Evaluation-Detailed Test Plans [1]. Earlier documents providing essential background to the Evaluation are the Evaluation Plan [2], and , Individual Test Plans (ITP) [3].

Each of the tests conducted by the research team for the evaluation of Green Light addressed one of five goals of the evaluation as documented in the Evaluation Plan. These are:

- Assessment of Safety
- Assessment of Productivity
- Assessment of User Acceptance

- Assessment of Mainstreaming Issues
- Assessment of Non-Technical Interoperability Issues

The objectives associated with each goal are given in detail in the Individual Test Plans [3]. In addition, condensed one-page tables are contained in the appendices of the ITP, outlining the measures to be conducted for each of the stated objectives. The detailed test plan documents expand on the information provided in the ITP and provide in detail the activities planned for each *evaluation measure* during the course of the evaluation in regards to the stated objectives.

1.2 PURPOSE AND SCOPE

This report presents the results of two test measures employed to measure what effects Green Light has had on safety compliance of commercial motor vehicle operating in the state of Oregon.

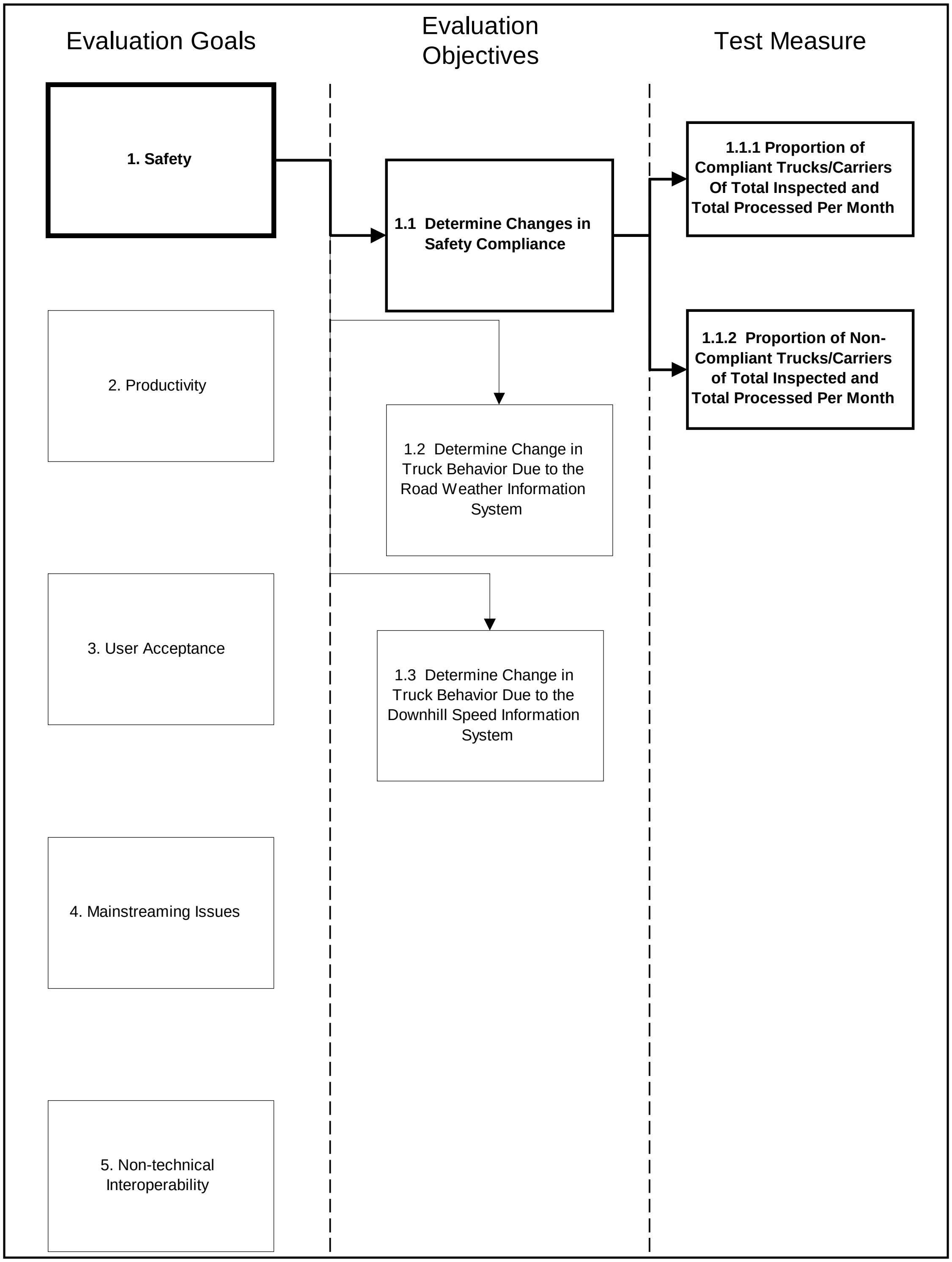
The evaluation measures used to determine change in safety compliance for the Oregon Green Light are stated below:

1.1.1 Examine changes in proportion of trucks compliant with Federal Motor Carrier Safety Regulations (FMCSR) within Oregon.

1.1.2 Assessment of targeting procedures at sites incorporating electronic screening.

A detailed description of the hypothesis to be tested as well as the test methodology and deliverables is described in detail in Chapter 2. Chapter 3 provides results of the test, while conclusions and recommendations can be found in Chapter 4. The scope of this detailed test plan within the context of the overall Green Light Evaluation is shown in Exhibit 1-1. The test measures outlined in this document are highlighted for reference.

Exhibit 1-1 Evaluation Goals, Objectives, and Measures

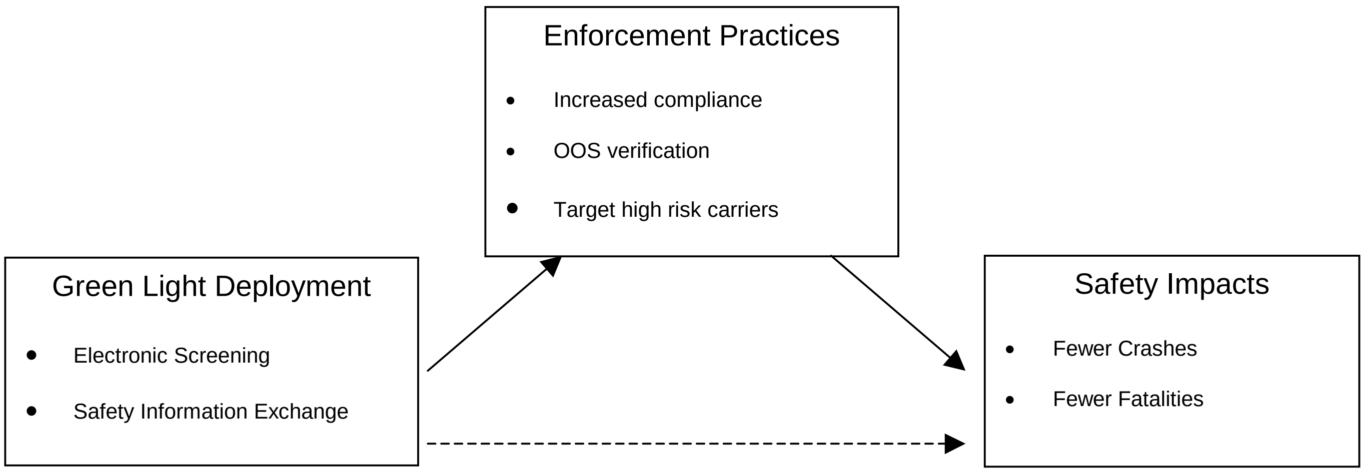


1.3 DISCUSSION

According to the Federal Highway Administration's (FHWA's) Office of Motor Carriers (OMC), over 150,000 trucks (including commercial and private vehicles) were involved in highway accidents in 1994 Truck and Bus Accident Fact Book, October 1996 [4]. These accidents caused injuries to 110,000 persons and resulted in 5,500 deaths. To combat this problem, state and federal agencies employ various strategies such as stricter enforcement of traffic laws, improving vehicle and highway designs, and developing and using on-board safety systems (e.g., driver warning systems). For commercial vehicles, the strategy also includes improved enforcement of Federal Motor Carrier Safety Regulations (FMCSR) and Hazardous Materials Regulations (HMR). In 1996, OMC estimated that 32 percent of the vehicles traveling the nation's highways are out of compliance with applicable commercial vehicle regulations [*OMC National Fleet Safety Survey*, 1996]. Green Lights' use of roadside screening is expected to have significant impacts on roadside safety enforcement practices. In particular, Green Light will result in more efficient enforcement operations, increased compliance with safety regulations, and, ultimately, safer highways.

The main focus of this study will be on the relationship between Green Light deployment and its impact on enforcement practices. The relationship between enforcement practices and safety impacts (i.e., reduced crashes and fatalities) also needs to be established to link safety benefits to the deployment of Green Light. Results from literature, as well as new analyses, can help determine this relationship. This two-step approach is illustrated in Exhibit 1-2. The third relationship (indicated by the dashed line between Green Light deployment and safety impacts) can also be studied using empirical methods. However, this approach has significant challenges because the Green Light -related reduction in crashes and fatalities is expected to be small compared to the impacts of other factors (e.g., weather, road construction, traffic changes).

Exhibit 1-2 Relationships Between Green Light Deployment, Enforcement Practices, and Safety Impacts.



Green Light technologies are expected to help improve compliance with safety regulations in two ways both resulting from increased effectiveness of roadside inspection operations. The direct, but smaller, impact is the removal of unsafe drivers and vehicles from the highways. It is anticipated that the screening and safety information exchange technologies will allow inspectors to rapidly select commercial vehicles for inspection based on the carrier's safety record. Also, on-line access to driver violation records and results of recent truck inspections will help target unsafe drivers and trucks.

The indirect effect, which is expected to be much larger, is that drivers and carriers will modify their behavior to avoid inspections. Specifically, it is assumed that carriers will expend more resources to ensure that their vehicles stay in compliance. Carriers with good safety records (low risk) will have a small probability of being inspected. High-risk carriers will try to improve their safety rating to avoid increased inspections. Of course, if Green Light does not help inspectors target the high-risk carriers, there will not be any *added* incentive for a carrier to maintain a good safety rating.

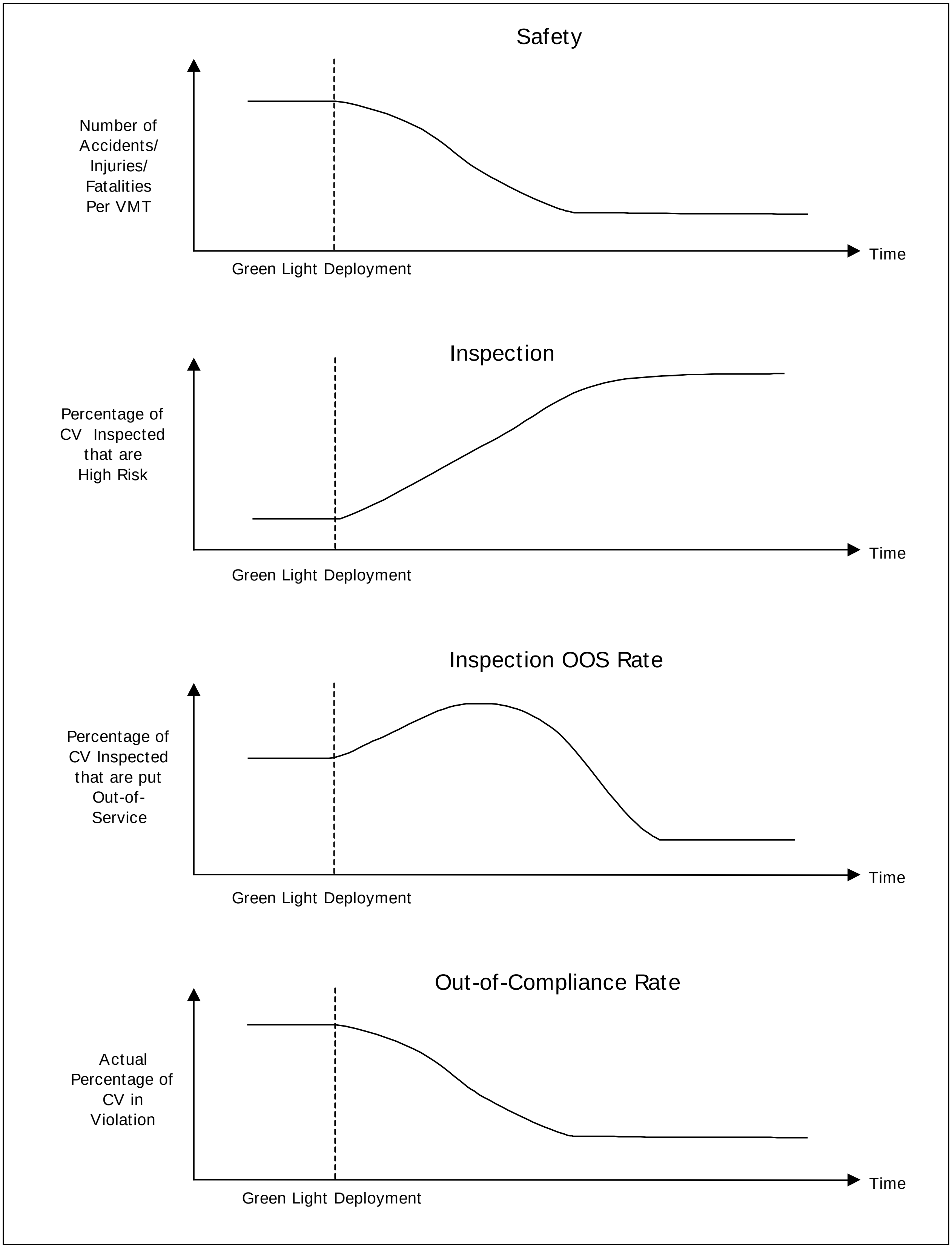
The impacts of Green Light on safety will be difficult to quantify. In fact, these impacts will probably take effect over a long period of time. Initially, the high-risk carriers must perceive an increase in the cost of doing business resulting from increased fines and more frequent delays at roadside inspection sites. The hypothesis is that these operators will then adjust their safety program in order to improve compliance rates. Of course it is possible that they will, instead, choose to employ avoidance tactics. This impact also needs to be investigated. Assuming that a high-risk carrier chooses to improve its safety program, the improvement in compliance rates will eventually result in improved safety performance.

Estimating the impact of Green Light in terms of safety simply by analyzing accident data is not feasible for a number of reasons. First, because accidents are rare events, their associated consequences (property damage, etc.) are highly variable, and therefore may provide limited evidence of a change from a short period of deployment and evaluation. Second, even if an effect is measured, it may be difficult to attribute the effect to the introduction of the technology.

Using compliance rates as a surrogate for accident rates will help to address both of these issues. Estimating compliance rates is much more feasible than estimating rates of accidents that are attributable to safety violations. Also, the hypothesis that Green Light affects safety by improving motor carrier compliance can be tested separately.

Exhibit 1-3 qualitatively illustrates the relationships among key data elements in this approach. The first panel shows a decrease in the number of accidents, injuries, and fatalities that is anticipated following the deployment of Green Light. However, in order to infer that an observed decrease in accidents was caused by the deployment of Green Light, a more detailed analysis of the process is required. *It is anticipated that the deployment of the electronic clearance components of Green Light will improve compliance enforcement through better targeting of high-risk carriers and more efficient use of inspection resources.* Thus, as illustrated in the second panel, it is expected that there will be an increase in the percentage of vehicles inspected that belong to high-risk carriers. High-risk in this context refers to carriers that are more likely than others to be put out of service (OOS) for failing to comply with the FMCSR. Alternative definitions of high-risk carriers based on accident and fatality rates will also be investigated. The third panel reflects how the percentage of vehicles that are put OOS is expected to rise initially because of the improved targeting of high-risk carriers. Eventually, the carriers will modify their behavior to improve compliance. Thus, assuming that enforcement procedures do not change, the OOS rate is expected to decrease. The fourth panel shows how the out-of-compliance rate (percent of violators on the road) is expected to change. This decrease is then expected to result in the safety improvement.

Exhibit 1-3 Relationships Between Key Elements in the Green Light Safety Analysis



2 TEST METHODOLOGY

2.1 PHYSICAL DESCRIPTION

The random inspection study was developed in conjunction with Battelle as part of their evaluation of CVISN. The purpose of this test is to measure the rate of compliance with safety regulations by motor carriers traveling in the northern I-5 corridor in Oregon. This study will incorporate random selection of vehicles to ensure that the screening practices usually followed by the inspectors do not bias the compliance rate estimates. The random sampling conducted under this study is not intended to improve enforcement efficiency. Rather, the results will be used to infer whether the advances introduced under Green Light result in reduced rates of violation by average carriers, thereby addressing the evaluation objective to determine whether Green Light has a positive impact on safety.

This test is designed to measure whether the new technologies introduced under Green Light help to deter violations of safety regulations. To measure this, we plan to test whether if there is a change in commercial vehicle safety violation rates. Towards this end, we would like to estimate the compliance rate of the commercial vehicle population at large – not only those that are targeted for inspection. This requires some degree of random inspection. The compliance rate study was conducted along the northern I-5 corridor Oregon.

2.1.1 Survey Design

A survey design was used to select sites along the northern I-5 corridor, including dates and times to conduct inspections, and to select vehicles at those sites for inspection. Four, month-long random inspection campaigns were conducted six months apart. The data collected was analyzed by standard survey methods, based on a random sample. Trends were estimated, and comparisons will be made across sites and over time based on linear models. Battelle's statistics group conducted data analysis, with findings being presented to OSU for inclusion in this report.

2.1.2 Assumptions and Constraints

Several assumptions and constraints are necessary in the design of the random sampling plan.

- The selected sites cover a network representing same truck compliance rate as the entire area.
- The volume counts made during the course of the inspections are representative of the traffic that passes that site.
- An assumption is made that the compliance rate during the night shift is the same as that during the "swing shift."

Some of the key constraints in Oregon are:

- Due to safety, inspections can only be conducted at night at the ports of entry. It will be necessary to assume that these locations have similar compliance properties with the other types of sites.
- Participants in Green Light are subject to scrutiny with regard to their safety status. Those meeting high safety standards may be enrolled as premium carriers or "Trusted Carrier Partners". Upon meeting these qualifications the carriers are not subject to random selection – *at the Green Light (transponder reader) sites*. At the sites where all vehicles are recorded manually, basic enrollees can be included in the random selection process.

The test will be conducted in one-month intervals. The first test was conducted during January of 1998, with subsequent tests following in July 1998, January 1999, and July 1999.

ODOT MCEO managers followed the same schedule in each if the four campaigns according to the day of week and time of day an inspection occurred. This schedule of random inspections planned for the first month is provided in Exhibit 2-1. The schedule was generated based on past inspections conducted in Oregon. For instance, if the vast majority of inspections were conducted at the ports-of-entry, this schedule was generated so that the same proportion of randoms were completed at the ports-of-entry as well. Many of the selected sites had conflicts, especially those sites that were randomly chosen for night inspections, but are not equipped. These sites were subsequently changed to daytime inspections.

Those inspections that were selected at non-fixed sites, i.e. Multnomah Co. and Yamhill Co., were conducted at sites routinely chosen by the inspectors who work that area.

Exhibit 2-1 Site Selections For January 1998

Date of Shift	Site ID (Scale No)	Location	Day of Shift	Time of Shift
02JAN98	1404	Cascade Locks POE	Friday	Day
	3602	Dayton.	Friday	Day
06JAN98	2677	Multnomah Co.	Tuesday	Day
07JAN98	1404	Cascade Locks POE	Wednesday	Day
	2409	Woodburn POE	Wednesday	Day
	2677	Multnomah Co.	Wednesday	Day
08JAN98	0261	Blodgett, WB	Thursday	Day
	1404	Cascade Locks POE	Thursday	Day
			Thursday	Day
09JAN98	2408	Woodburn POE	Friday	Day
			Friday	Day
			Friday	Day
	1404	Cascade Locks	Friday	Day
	2677	Multnomah Co.	Friday	Day
10JAN98	2004	Lombard and N. Simmons	Saturday	Day
11JAN98	2409	Woodburn POE	Sunday	Day
12JAN98	1404	Cascade Locks POE	Monday	Day
13JAN98	2601	Rocky Point	Tuesday	Day
	2408	Woodburn NB	Tuesday	Night
	2409	Woodburn POE	Tuesday	Day
			Tuesday	Night
	3677	Yamhill Co.	Tuesday	Day
	2677	Multnomah Co.	Tuesday	Day
14JAN98	0261	Blodgett, WB	Wednesday	Day
	2409	Woodburn POE	Wednesday	Day
			Wednesday	Night
15JAN98	2409	Woodburn POE	Thursday	Day
			Thursday	Day
	0307	Brightwood, WB	Thursday	Day
	2601	Rocky Point	Thursday	Day
	2677	Multnomah Co.	Thursday	Night
16JAN98	304	Rock Creek	Friday	Night
	2677	Multnomah Co.	Friday	Day
	2409	Woodburn POE	Friday	Day
18JAN98	1404	Cascade Locks POE	Sunday	Day
19JAN98	2601	Rocky Point	Monday	Day
	2409	Woodburn POE	Monday	Day
			Monday	Day
20JAN98	2002	Walterville	Tuesday	Day
21JAN98	2002	Walterville	Wednesday	Day
	2205	Foster	Wednesday	Day
	2409	Woodburn POE	Wednesday	Day
22JAN98	2407	Hubbard	Thursday	Night
	1404	Cascade Locks POE	Thursday	Night
	2409	Woodburn POE	Thursday	Day
			Thursday	Day
			Thursday	Night
23JAN98	2677	Multnomah Co.	Friday	Day
	2701	Eola	Friday	Day

Date of Shift	Site ID (Scale No)	Location	Day of Shift	Time of Shift
25JAN98	2409	Woodburn POE	Sunday	Day
26JAN98	2409	Woodburn NB	Monday	Day
	2601	Rocky Point	Monday	Day
	3677	Yamhill Co.	Monday	Day
27JAN98	2601	Rocky Point	Tuesday	Night
28JAN98	2409	Woodburn POE	Wednesday	Day
29JAN98	0304	Rock Creek	Thursday	Day
	2409	Woodburn POE	Thursday	Day
			Thursday	Day
			Thursday	Day
			Thursday	Day

Exhibit 2-2 provides a list of random non-fixed locations inspected within Multnomah County and were randomly selected from a list of six locations provided by the Multnomah Co. inspectors. The two days assigned to non-fixed random inspections in Yamhill Co. were chosen by the inspectors to reflect characteristics of vehicles using I-5 in the northwest corridor.

Exhibit 2-2 Specific Locations to Sample in Multnomah County

Date	Day	Time	Location
January 6	Tuesday	Day	Lombard and N. Simmons
January 7	Wednesday	Day	NE 223rd and NE Glisan
January 9	Friday	Day	NE Marine Drive and NE 223rd
January 10	Saturday	Day	Lombard and N. Simmons
January 13	Tuesday	Day	NE 223rd and NE Glisan
January 15	Thursday	Night	NE 223rd and NE Glisan
January 16	Friday	Day	NE 122nd and NE Inverness
January 23	Friday	Day	NE 122nd and NE Inverness

The primary supporting data used to design the study include:

- Oregon's past inspection data, as downloaded from SafetyNet for the period October 1996 through September 1997. This was used to characterize their existing inspection program.

- A list of non-fixed inspection sites for Multnomah Co. that are indicative of truck travel in that county. Ideally, these inspection sites would be mutually exclusive and selectively exhaustive of trucks travelling in the county.
- Estimates of truck volume at the inspection locations in the northern I-5 corridor

2.1.3 Scope of Survey

Although about 30,000 inspections are conducted on trucks throughout Oregon each year, it was decided that the desired information could probably be obtained from a corridor study, provided that enough data could be collected there.

Using the information obtained about where most of the inspections were done and by whom, and using judgement to identify sites that could be used to characterize compliance characteristics of vehicles traveling in the I-5 corridor, a geographic scope was decided upon.

Determining the number of random inspections to conduct involved a tradeoff of desired precision with the impact that a random campaign would, itself, have on compliance characteristics. Specifically, Green Light's mainline preclearance deployment introduces technologies that are, among several enhancements, intended to improve the state's vehicle selection protocols – and supposedly, this will have a deterrence effect on violators. Conducting too many random inspections might have its own effect on compliance rates which may obscure the effect of Green Light on compliance rates. Therefore, it was decided that no more than 10 percent of the inspections conducted in the region of interest during the course of a year should be devoted to the evaluation because of the potential impact on operations. In the targeted corridor, this means that about 600 to 700 random inspections should be performed per year as part of the evaluation. With two campaigns per year, this reduces to 300 to 350 per campaign.

2.1.4 Sampling Design

To enable an inference that is representative of all the sites within the geographic scope illustrated in Exhibit 2-2, a random sample of sites must be identified for conduct of inspections. In addition, it is necessary that all sites within that region have a positive, known probability of being selected. However, it is neither necessary nor practical to give each location the same probability of selection. Sites where several inspections are conducted can be emphasized, and sites where inspections are conducted only rarely can be included with only very low probability and still achieve an unbiased estimate of the true compliance rate.

The 48 sites in the northern I-5 corridor were divided into four strata: Ports of Entry (POEs), Green Light sites, fixed non-GL sites, and non-fixed sites. Based on the historical allocation of inspections to these strata, Exhibit 2-3 illustrates the allocation of random inspections to these strata for the inspection campaigns.

Exhibit 2-3 Allocation of Inspections to Strata

Stratum	Inspections conducted 10/1/96 through 9/30/97	Planned Random Inspections
Ports of Entry	3381	32
Green Light Sites	793	8
Fixed Sites (non-GL)	932	10
Non-Fixed Sites	954	10

For each inspection campaign, a schedule was issued to the MCEO managers and the Multnomah Sheriff's Department for deployment of their staff conduct the inspections. There were slight departures resulting from weather and illness, but it was mostly adhered to. When dates were not met, inspections were conducted at a similar day and time.

3 RESULTS

The compliance rate study in Oregon provided data to test the two hypotheses associated with safety impacts. These are:

> Hypothesis 1: The number of violations per inspection did not change after Green Light technologies were introduced in the corridor.
>
> Hypothesis 2: Changes in compliance rates between 1998 and 1999 were the same for sites with GL technologies as for sites without GL technologies.

It was assumed that carriers and truck drivers would tend to improve compliance with safety regulations to reap the benefits, or avoid the enforcement ramifications, of electronic screening.

About Deployment

The study was conducted with the assumption that as more carriers became equipped with transponders and are actively participating in Green Light, that the general trucking population would move towards compliance. In order for this to actually take place, the truck stream entering sites equipped with mainline preclearance would have to change significantly. The key component of Green Light that makes this assumption work is that carriers are actively screened based on their safety records. Those trucks with “clean” bills of health remain out of the traffic stream reporting to the scale. As more “safe” trucks are screened on the mainline and taken out of the stream to the static scale, the truck stream changes to one that is more likely to have an OOS violation.

As was described in the previous chapter, data was collected and examined on compliance rates in the general trucking populations. This required conduct of random Level I inspections, in contrast to targeted inspections conducted under standard procedures, when standard practices are designed to inspect the vehicles with the greatest problems. Random inspections were conducted to allow characterization of the general trucking population, these inspections were conducted at three different types of sites during four campaigns, over a period of two years. Most of the inspections were conducted at weigh stations, but a good number were also conducted at roadside or mobile locations (which in Oregon are often referred to as “non-fixed”).

Random inspections were conducted at two sites with electronic screening systems deployed. These were the Woodburn Southbound port of entry (POE), which was the first site established with the “Green Light” system in Oregon, and the Woodburn Northbound (NB) weigh station. Both of these sites are on I-5 in Northern Oregon. The Woodburn POE was equipped and running before the start of this random inspection campaign, and Woodburn NB was equipped halfway through. Roughly the same sampling design and inspection schedule was used for each of the four campaigns, so the number of inspections conducted at Green Light sites increased for the second half of the test (due to the inspections conducted at Woodburn NB during the second half of the test).

Exhibit 3-1 displays the division of the various sites (where inspections were performed) into three categories for presentation: Green Light sites, non-Green Light fixed sites, and non-Green Light non-fixed sites. At the top of each column is the number of inspections conducted. A total of 1,223 random inspections were conducted for this evaluation.

Exhibit 3-1 Site Categories

Type of Site		
Green Light (408 Inspections)	Non-Green Light Fixed (591 Inspections)	Non-Fixed (224 Inspections)
Woodburn POE Woodburn NB	Blodgett EB Blodgett WB Brightwood Cascade Locks Dayton Eola Foster Rocky Point Rock Creek Walterville	Hwy 18 McKibbon Rd, Unspecified location (Yamhill Co.) Lombard and N Simmons, Lombard and Pier Park, McMinnville, Yamhill Co. N. Lombard and Bruce Ave., NE 122nd and NE Inverness, NE 223rd and NE Glisan, NE Marine Dr and NE 223rd (Multnomah Co.)

Exhibit 3-2 provides estimates of the violation rates for each of the three categories, estimated from each of the sampling campaigns. The table displays the number of shifts during which random inspections were conducted and the total number of random inspections performed. Three different violation rates are displayed:

- Average number of violations per vehicle (any FMCSR)
- Average number of OOS violations per vehicle
- Proportion of vehicles with at least one OOS violation
- Average number of Driver OOS violations
- Average number of Vehicle OOS violations

Each of these violation rates should be interpreted as "violations per vehicle," and not "violations per inspection." The statistical design and random nature of this study allows us to make inferences to the general truck population.

Exhibit 3-2 Violation Rates

Type of Site	Sampling Campaign	Number of Shifts	Total # Inspections	Average # Violations Per Vehicle (± 2 SD)	Average # OOS Violations Per Vehicle (± 2 SD)	Proportion of Vehicles with OOS Violations (± 2 SD)	Average # Driver OOS Violations Per Vehicle (± 2 SD)	Average # Vehicle OOS Violations Per Vehicle (± 2 SD)
GL	**Jan 98**	15	93	1.74 ± 0.44	0.52 ± 0.18	0.34 ± 0.12	0.04 ± 0.06	0.43 ± 0.18
	July 98	15	90	1.17 ± 0.40	0.22 ± 0.12	0.16 ± 0.08	0.02 ± 0.04	0.19 ± 0.10
	Jan 99	17	107	2.28 ± 0.76	0.38 ± 0.18	0.24 ± 0.12	0.05 ± 0.04	0.34 ± 0.16
	July 99	17	118	1.65 ± 0.66	0.46 ± 0.18	0.31 ± 0.12	0.04 ± 0.04	0.41 ± 0.18
NGL-Fixed	**Jan 98**	25	154	**1.81 ± 0.46**	0.40 ± 0.14	0.24 ± 0.08	0.00	0.39 ± 0.14
	July 98	25	170	**1.61 ± 0.32**	0.31 ± 0.12	0.22 ± 0.06	0.00	0.83 ± 0.86
	Jan 99	21	131	2.52 ± 0.82 ↑	0.48 ± 0.18	0.26 ± 0.10	0.00	0.47 ± 0.18
	July 99	21	148	2.25 ± 0.38 ↑	0.40 ± 0.14	0.23 ± 0.08	0.05 ± 0.06	0.35 ± 0.12
Non-Fixed	**Jan 98**	10	57	3.08 ± 0.68	0.95 ± 0.34	0.47 ± 0.16	0.01 ± 0.02	0.87 ± 0.32
	July 98	10	60	3.01 ± 0.72	0.92 ± 0.36	0.51 ± 0.16	0.09 ± 0.12	3.09 ± 1.28
	Jan 99	10	59	**2.09 ± 0.62** ↓	**0.55 ± 0.28** ↓	0.24 ± 0.08	0.05 ± 0.06	**0.50 ± 0.24** ↓
	July 99	9	54	**1.91 ± 0.54** ↓	**0.55 ± 0.16** ↓	0.54 ± 0.16	0.01 ± 0.02	**0.53 ± 0.16** ↓
Combined Across Site Types	**Jan 98**	50	304	**1.93 ± 0.34**	0.48 ± 0.10	0.28 ± 0.06	0.01 ± 0.02	0.44 ± 0.10
	July 98	50	320	**1.69 ± 0.26**	0.36 ± 0.10	0.24 ± 0.06	0.01 ± 0.02	0.98 ± 0.64
	Jan 99	48	297	2.43 ± 0.60 ↑	0.46 ± 0.14	0.25 ± 0.06	0.02 ± 0.02	0.45 ± 0.14
	July 99	47	320	2.08 ± 0.30 ↑	0.43 ± 0.10	0.28 ± 0.08	0.05 ± 0.04	0.38 ± 0.10

The following figures show confidence intervals for each of the five responses measured, over time, by site. Each violation rate estimate is listed with a +/- number, which can be used to calculate an approximate 95 percent confidence interval. The intervals were constructed with

95 percent confidence of containing the true violation rate.

Statistical tests were performed to determine if the rates observed in 1999 were significantly different from those observed in 1998 (addressing Hypothesis 1). The results are presented in the boxes showing the 1999 results. In Exhibit 3-2, if '↑' appears in the boxes showing the 1999 results, that implies that (on average) violation rates were found to be higher in 1999 than in 1998, and the increase was statistically significant. Similarly, '↓' means that violation rates decreased. Simple year-to-year comparisons were performed, in which aggregate rates from 1999 were compared with aggregate rates from 1998. So either no arrows appear (if the difference was insignificant), or two up arrows appear (if violation rates increased), or two down arrows appear (if violation rates decreased).

Exhibits 3-3 through 3-5 display the violation rate estimates presented in Exhibit 3-2, with 95 percent confidence bounds, by sampling campaign, separately for each stratum. Notice that no changes in compliance rates were significant at sites where GL technology was deployed. However, there was a significant increase in the total number of violations per inspection at non-GL, fixed sites. The most consistent pattern observed was a decrease in violation rates at non-fixed (or mobile) sites. The number of violations, the number of OOS violations, and the number of vehicle OOS violations per inspection decreased. Combining data across site types, the only significant difference was an increase in violations per inspection between 1998 and 1999.

Exhibit 3-3 Average Number of Violations per Vehicle Over Time

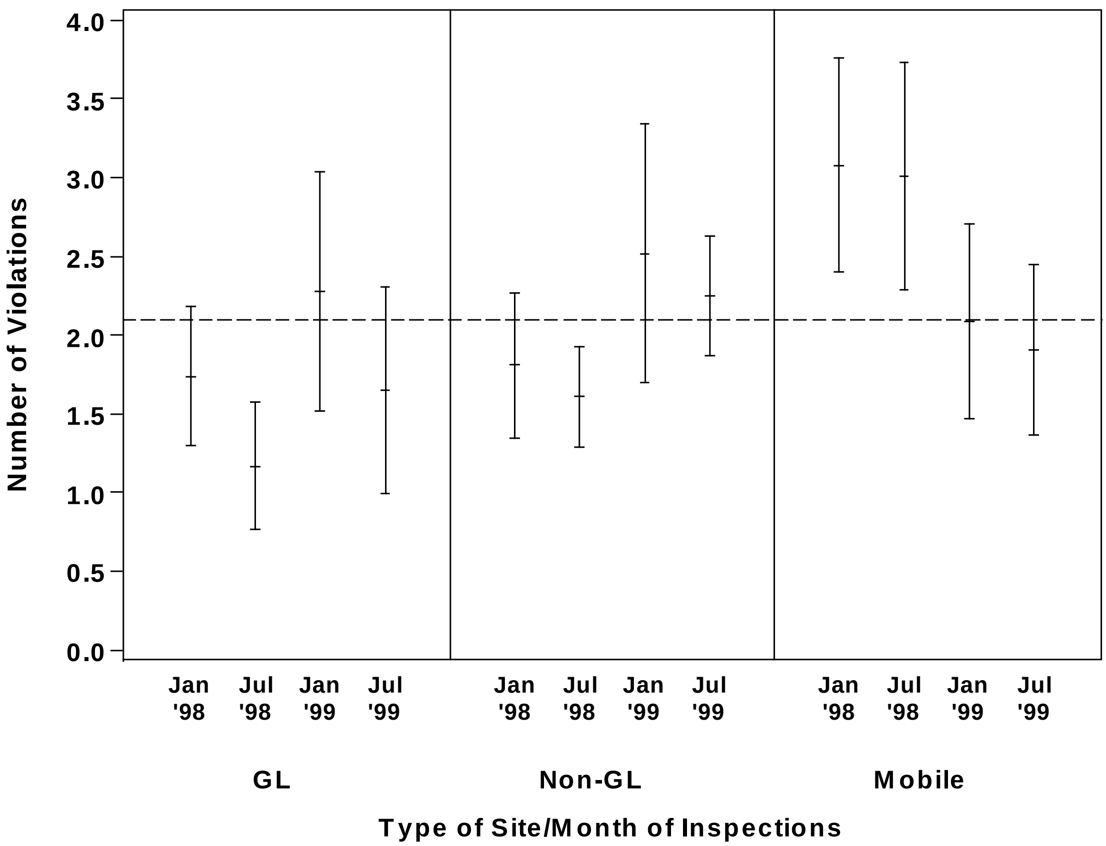


Exhibit 3-4 Average Number of OOS Violations per Vehicle

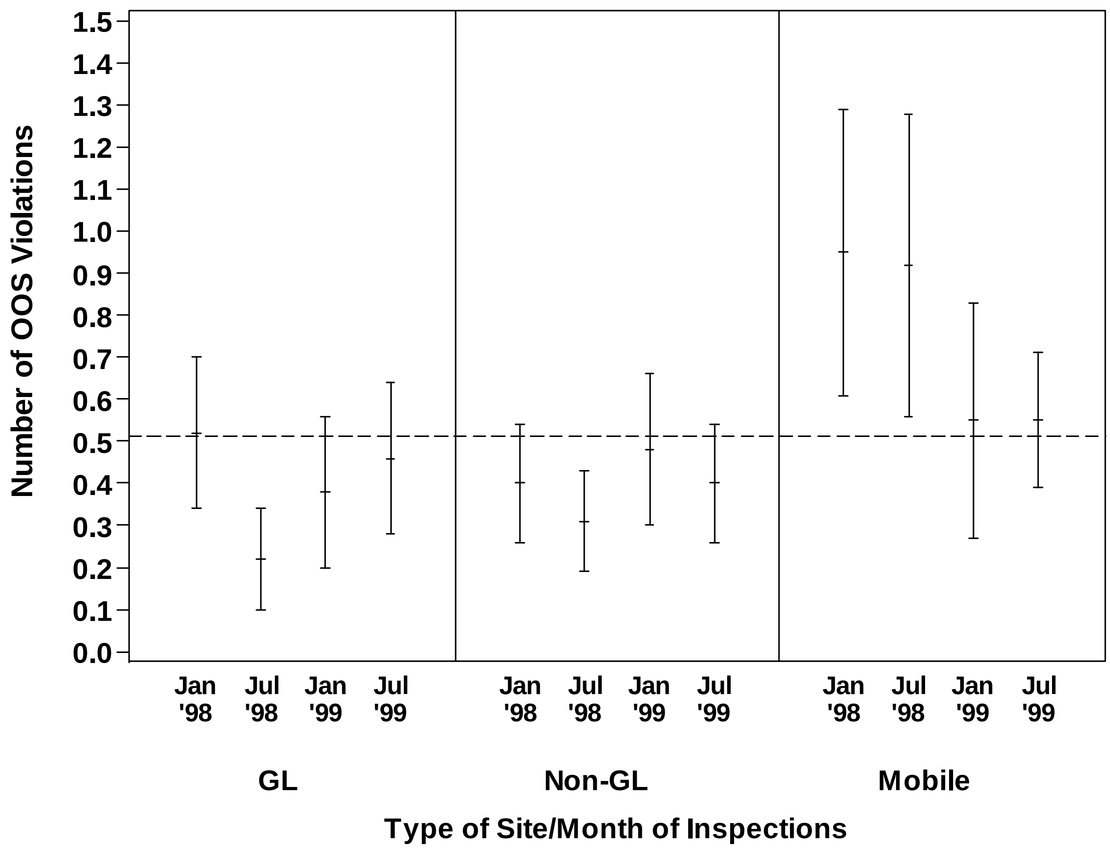


Exhibit 3-5 Percentage of Vehicles With an OOS Violation

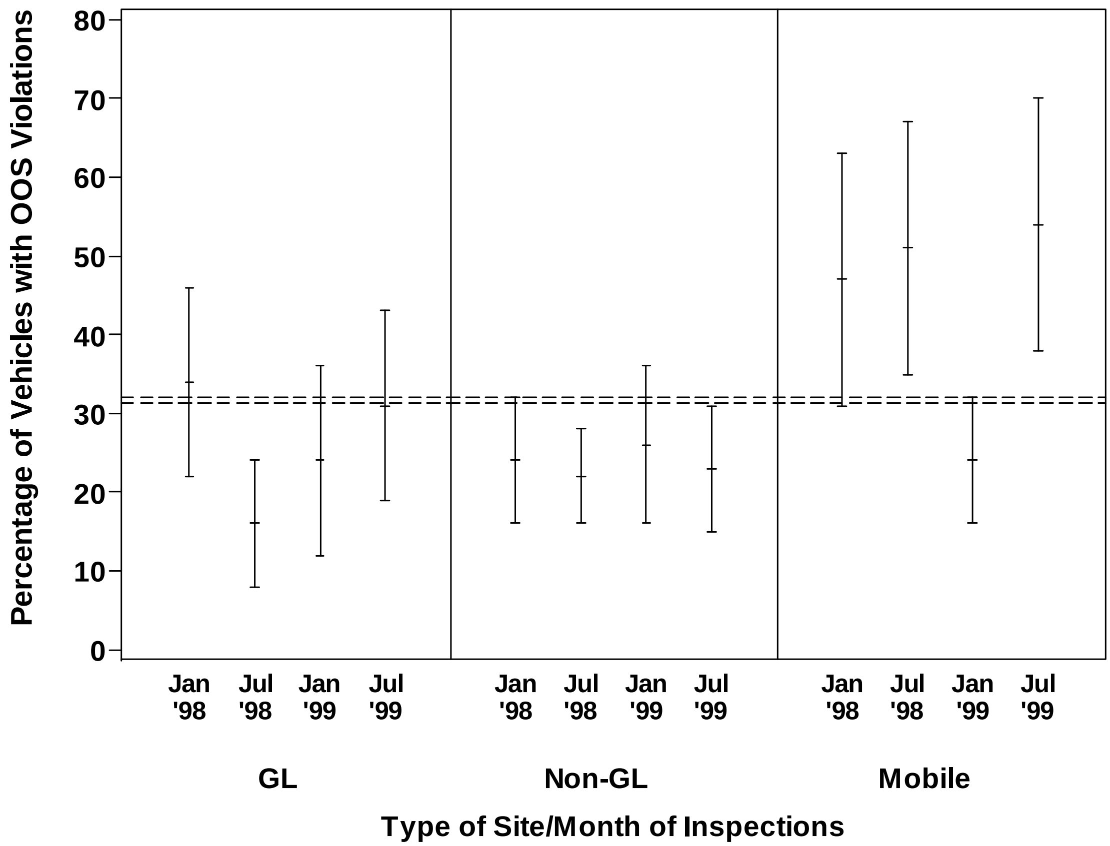


Exhibit 3-6 Average Number of Vehicle OOS Violations per Vehicle

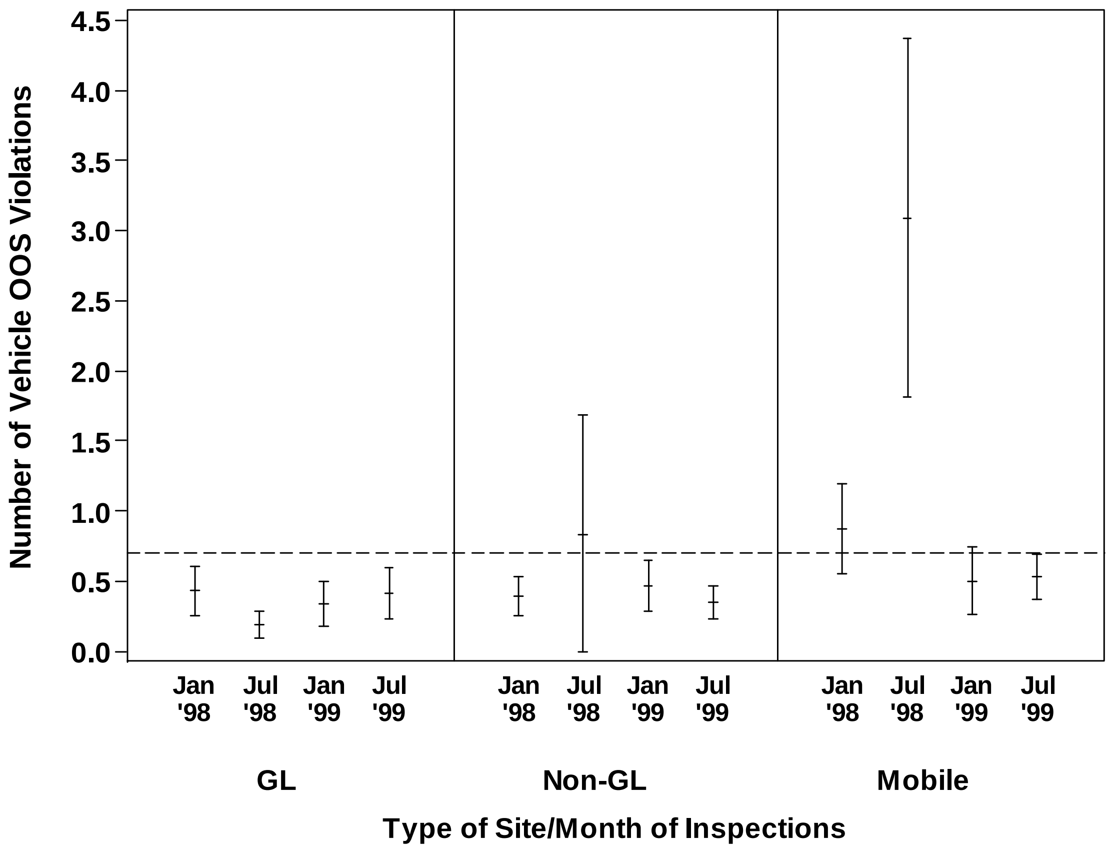
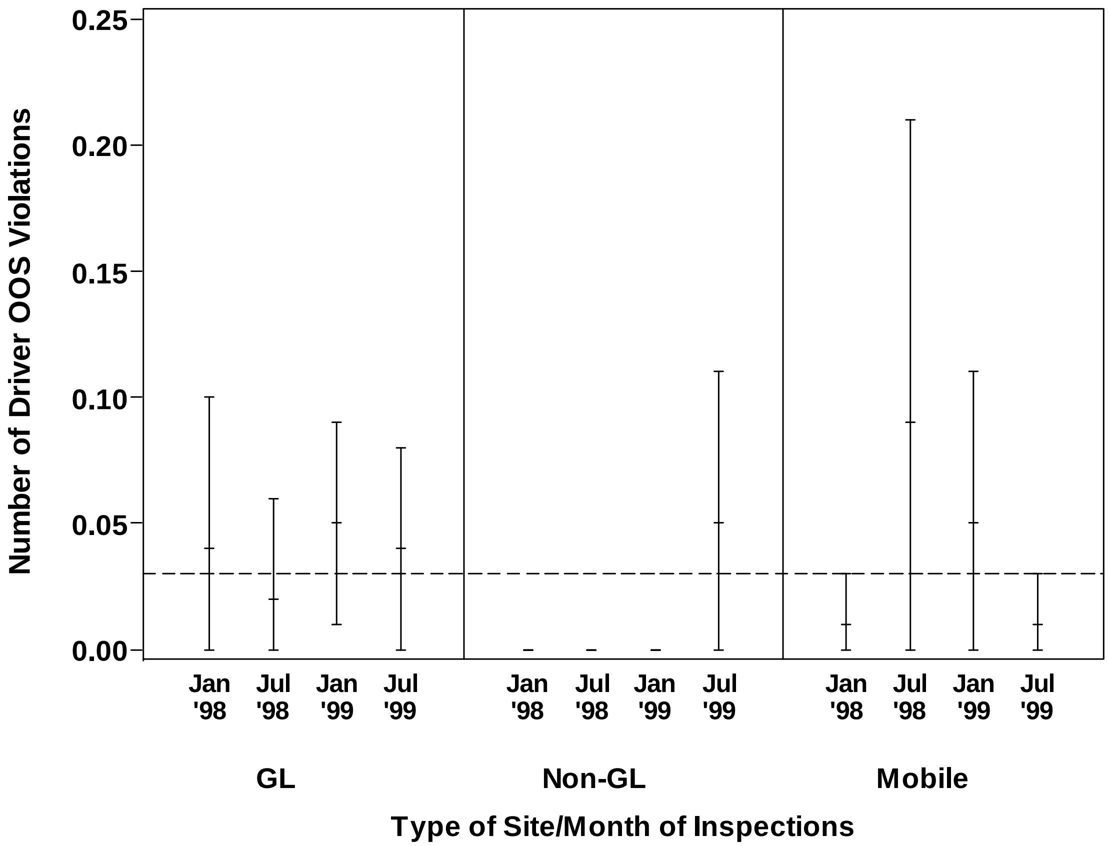


Exhibit 3-7 Average Number of Driver OOS Orders per Vehicle



Exhibits 3-8 through 3-12 present subsets of the information in Exhibit 3-2 with an emphasis on the contrasts between 1998 and 1999.

Exhibit 3-8 Number of Violations per Vehicle, by Stratum

Type of Site	1998	1999	% Increase1	GL	Non-GL Fixed	Non-Fixed
GL	1.46	1.97	+35%			
Non-GL Fixed	1.71	2.39	+39%			
Non-Fixed	3.05	2.00	-34%	*	*	

* denotes statistical significance across strata

Exhibit 3-8 provides for each stratum the estimated compliance rate averaged across January and July campaigns for 1998 and 1999, and the difference, measured as a percentage of the 1998 rate. These months were averaged to account for seasonal variations. **The difference is printed in bold italics if it was statistically significant**. In addition, Exhibit 3-8 shows which of the increases (or decreases) over time were statistically different from each other, when compared across strata as identified with an asterisk. This identifies site categories for which compliance behavior has changed to a degree different from other site categories (addressing Hypothesis 2).

An explanation is best understood with an example. When examining Exhibit 3-8, the drop of 34 percent in violations per vehicle observed at the non-fixed sites is not statistically significant in terms of the change in violations between the two years. The drop was significantly different from the changes observed in both of the "fixed" types of sites. The other sites exhibited increases in this measure, though only for non-GL sites was the increase (in its own right)

[1] A negative number indicates that the rate in Jan 99 was lower than the rate in Jan 98

significant. Exhibit 3-9 presents similar test results, simplified by combining all non-Green Light sites into one class, called Non-Green Light.

Exhibit 3-9 Number of Violations per Vehicle, Green Light versus Non-Green Light

Type of Site	1998	1999	% Increase	Green Light	Non Green Light
Green Light	1.46	1.97	+35%		
Non Green Light	1.88	2.34	+24%		

* denotes statistical significance across strata

Exhibits 3-10 and 3-11 present similar information and test results, focusing on OOS violations instead of all violations. Exhibit 3-10 indicates that there was a significant drop in OOS rates at the non-fixed sites, and this drop was significantly different from the changes observed at the two types of fixed sites (Green Light and non-Green Light). Averaged with the fixed non-Green Light sites, there were no significant changes between 1998 and 1999.

Exhibit 3-10 Number of OOS Violations per Vehicle, by Stratum

Type of Site	1998	1999	% Increase	GL	Non-GL Fixed	Non-Fixed
GL-Other	0.37	0.42	+14%			
Non-GL Fixed	0.36	0.44	+24%			
Non-Fixed	0.94	0.55	**-41%**	*	*	

* denotes statistical significance across strata

Exhibit 3-11 Number of OoS Violations per Vehicle, Green Light versus Non-Green Light

Type of Site	1998	1999	% Increase	Green Light	Non Green Light
Green Light	0.37	0.42	+14%		
Non-Green Light	0.43	0.45	+5%		

Exhibits 3-12 and 3-13 focus on the percentage of vehicles with at least one OOS violation. There were no significant drops in the percentage of vehicle with an OoS violation between the categories.

Exhibit 3-12 Percentage of Vehicles with OOS Violations, By Stratum

Type of Site	1998	1999	% Increase	GL	Non-GL Fixed	Non-Fixed
GL-Other	25%	28%	+10%			
Non-GL Fixed	23%	25%	+7%			
Non-Fixed	49%	39%	-20%			

Exhibit 3-13 Percentage of Vehicles with OOS Violations, GL versus Non-GL

Type of Site	1998	1999	% Increase	Green Light	Non Green Light
Green Light	25%	28%	+10%		
Non-Green Light	27%	26%	-2%		

Exhibit 3-14 and 3-15 display similar test results for the proportion of vehicles with at least one OOS violation and Exhibits 11a and 11b display test results for driver OOS violations. No changes or differences were statistically significant by either stratification for either of these measures.

Exhibit 3-14 Number of Driver OOS Orders per Vehicle, By Stratum

Type of Site	1998	1999	% Increase	GL	Non-GL Fixed	Non-Fixed
GL-Other	0.03	0.05	+50%			
Non-GL Fixed	0.00	0.03	NA			
Non-Fixed	0.05	0.03	-40%			

Exhibit 3-15 Number of Driver OOS Orders per Vehicle, Green Light versus Non-Green Light

Type of Site	1998	1999	% Increase	Green Light	Non Green Light
Green Light	0.03	0.05	+50%		
Non Green Light	0.01	0.03	+200%		

Exhibits 3-16 and 3-17 show the number of vehicle OOS violations per vehicle. Exhibit 3-17 shows a significant drop of 74 percent in vehicle OOS orders at non-fixed sites. This drop was not observed at the fixed sites. No changes were significant when comparing Green Light to non-Green Light sites.

Exhibit 3-16 Number of Vehicle OOS Orders per Vehicle, By Stratum

Type of Site	1998	1999	% Increase	GL	Non-GL Fixed	Non-Fixed
GL-Other	0.31	0.38	+21%			
Non-GL Fixed	0.61	0.41	-33%			
Non-Fixed	1.98	0.52	**-74%**	*	*	

* denotes statistical significance across strata

Exhibit 3-17 Number of Vehicle OOS Orders per Vehicle, Green Light versus Non-Green Light

Type of Site	1998	1999	% Increase	Green Light	Non Green Light
Green Light	0.31	0.38	+21%		
Non Green Light	0.79	0.43	-45%		

As described in the study design, vehicles were selected independently at sites divided into four different strata during three different sampling campaigns. In our analysis, we assume that inspections conducted in different campaigns are independent (i.e., the choice of a vehicle in any of the campaigns has no effect on the choice of vehicles in any of the other campaigns).

Thus, we can treat the results obtained from separate campaigns as if they were from different strata.

4 CONCLUSIONS AND RECOMENDATIONS

Overall, the study found no significant changes in compliance rates at sites where GL technology was deployed. However, there was a significant increase in the total number of violations per inspection at non-GL, fixed sites. The most consistent pattern observed was a decrease in violation rates at non-fixed (or mobile) sites. At these sites, the number of violations, OOS violations, and vehicle OOS violations per inspection decreased. Combining data across site types, the only significant difference was an increase in violations per vehicle between 1998 and 1999 in non-GL fixed sites vs GL sites.

It is important to note that over the course of the evaluation period, from January 98 to July 1999, there was a low transponder penetration in relation to the total traffic bypassing the Green Light facility at Woodburn POE. At the end of the data collection period for this study in July of 1999, there were approximately 3000 transponders in the field, less than the amount needed to actually show a change in compliance as a result of Green Light. This number has since increased substantially to over 10,000 transponders in the field in July 2000. Green Light bypasses have also increased substantially from 28,000 bypasses in July 1999 to approximately 60,000 by July 2000. With these changes, one can expect considerable changes in compliance at GL vs. non-GL sites.

While the results of this study were largely inconclusive in establishing the relationship between Green Light deployment and its impact on enforcement practices, it did lay the groundwork for establishing such a relationship in the future. With increased transponder penetration and the continuing deployment of Green Light technology at Oregon weigh stations, random inspection studies can establish documented change in truck safety as a result of mainline preclearence. It is a recommendation that ODOT MCTD consider continuing random inspections as outlined in this study to document how this new technology is effecting truck safety. The results of this study provide a controlled baseline from which such future studies can be contrasted.

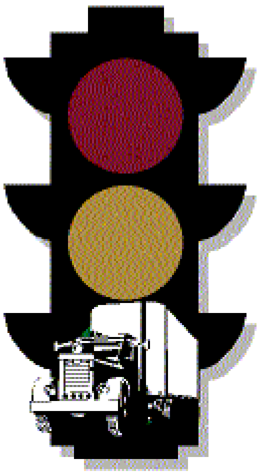
5 REFERENCES

1. Bell, C.A., B. McCall, and, C.M. Walton, A “The Oregon ‘Green Light’ CVO Project, Evaluation Plan” GLEV9601, Oregon State University, Transportation Research Institute, September 1996.

2. Bell, C.A., B. McCall, and, C.M. Walton, “The Oregon ‘Green Light’ CVO Project, Individual Test Plan” GLEV9602, Oregon State University, Transportation Research Institute, October 1996.

3. ODOT Research and New Technology, Transportation Development Branch, “Oregon Green Light CVO Project - Overview and Phase III Workplan” Oregon Department of Transportation, Salem OR, January 1997.

4. Bell, C.A., S.U. Randhawa, P. Ryus, and, Z. Xu, “Development of an Integrated System For Evaluation of Oregon’s Truck Data - Phase I: Database Development and Preliminary Evaluation of Data” TNW93-05 Transportation Northwest Final Report, August 1993.



Oregon Green Light

CVO Evaluation

FINAL REPORT

DETAILED TEST PLANS 2 and 3

Evaluation of the Road Weather Information System (RWIS)

Paul E. Montagne

Chris A. Bell

Transportation Research Report No. 00-13

Transportation Research Institute

Oregon State University

Corvallis, OR 97331

June 2000

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The authors are indebted to the personnel of ODOT's Motor Carrier Transportation Division, who have provided information and data to the evaluation team throughout the project. We are particularly indebted to Ken Evert, Gregg Dal Ponte, Randal Thomas and David Fifer. Ken's untimely death in 1998 meant that he did not see his vision completed. The evaluation team is forever indebted to him for his support and for the opportunity to participate in the deployment.

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1 DETAILED TEST INTRODUCTION

1.1 BACKGROUND

This Detailed Test Report is the second of 8 reports submitted as part of the independent technical evaluation of the Oregon Green Light CVO project. The Oregon Department of Transportation (ODOT) is near completion of the implementation of their Intelligent Vehicle Highway System Strategic Plan for Commercial Vehicle Operations (now referred to as ITS/CVO). Through Green Light, Oregon is installing twenty-one mainline preclearance systems featuring weigh-in-motion (WIM) devices and automatic vehicle identification (AVI) at the major weigh stations and ports-of-entry throughout the state. In addition, certain sites have been equipped with safety enhancements that regulate road conditions and speed. Examples are the Downhill Speed Information System at Emigrant Hill, and the installation of weather stations at three location across the state.

This report is to present the results of Detailed Test Plan (DTP) #2. There will be similar reports for all other Detailed Test Plans developed for the Green Light Evaluation. The Detailed Test Plans were published in 1997, Oregon “Green Light” CVO Evaluation-Detailed Test Plans [1]. Earlier documents providing essential background to the Evaluation are the Evaluation Plan [2], and , Individual Test Plans (ITP) [3].

Each of the tests conducted by the research team for the evaluation of Green Light addressed one of five goals of the evaluation as documented in the Evaluation Plan. These are:

- Assessment of Safety
- Assessment of Productivity
- Assessment of User Acceptance

- Assessment of Mainstreaming Issues
- Assessment of Non-Technical Interoperability Issues

The objectives associated with each goal are given in detail in the Individual Test Plans [3]. In addition, condensed one-page tables are contained in the appendices of the ITP, outlining the measures to be conducted for each of the stated objectives. The detailed test plan documents expand on the information provided in the ITP and provide in detail the activities planned for each *evaluation measure* during the course of the evaluation in regards to the stated objectives.

1.2 PURPOSE AND SCOPE

This report presents the results of two test measures employed to determine what effects Green Light has had on commercial motor vehicle safety due to the installation of the Road Weather Information System (RWIS).

The evaluation measures used to determine change in safety compliance due to RWIS are stated below:

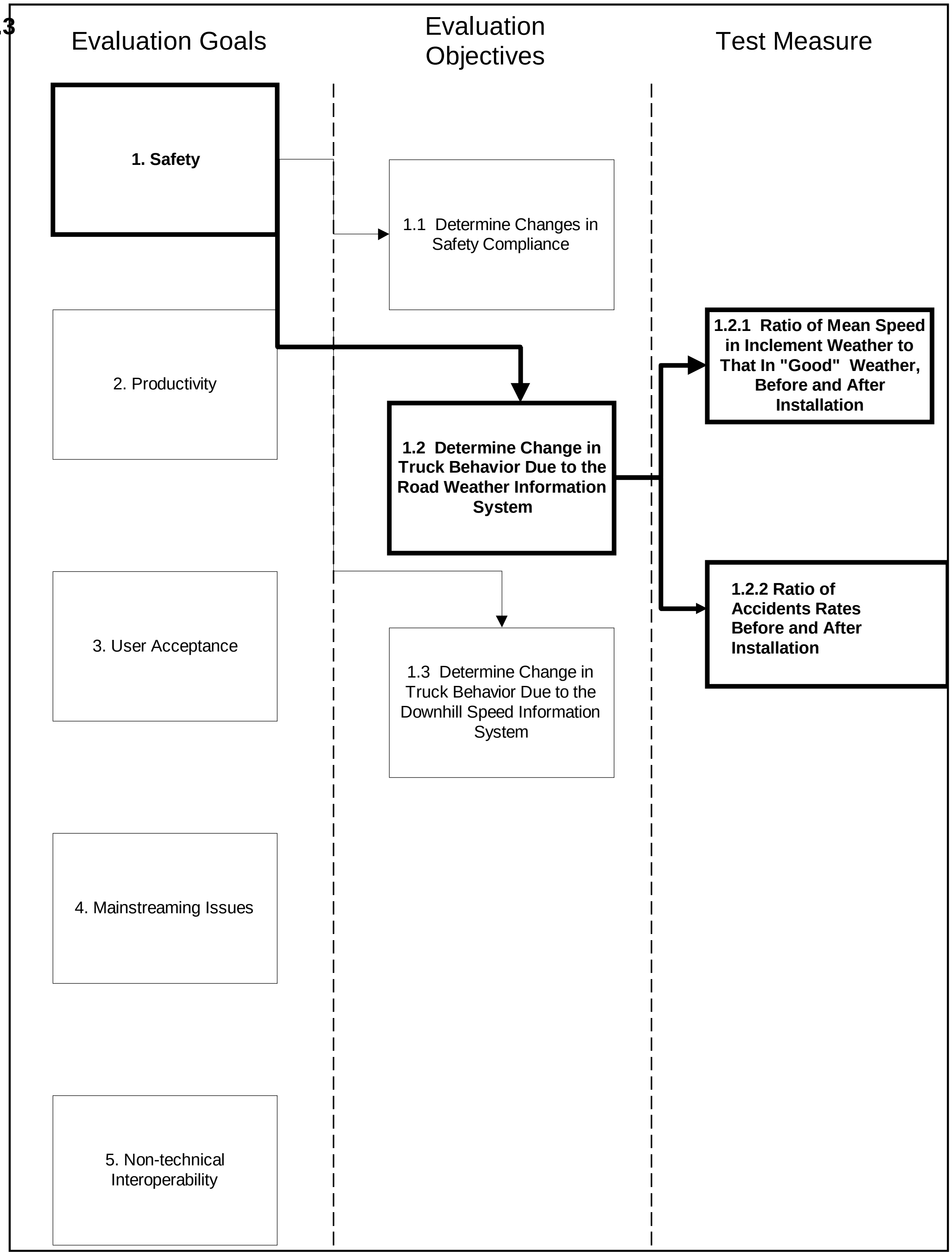
Measure 1.2.1 Ratio of mean speeds in inclement weather to that in "good" weather, before and after installation of Road Weather Information System

Measure 1.2.2 Ratio of accidents before and after installation of the Road Weather Information System

A detailed description of the hypothesis to be tested as well as the test methodology and deliverables is described in detail in Chapter 2. Chapter 3 provides results of the test, while conclusions and recommendations can be found in Chapter 4. The scope of this detailed test plan within the context of the overall Green Light Evaluation is shown in Figure 1-1. The test measures outlined in this document are highlighted for reference.

Figure 1-1 Evaluation Goals, Objectives, and Measures

1.3



1.3 DISCUSSION

Currently, most highway agencies rely on regional forecasts supplied by the National Weather Service for operation planning with regards to snow and ice control and travel advisories. In an effort to collect more timely data with accurate shot-term predictions of snowfall or icing on a small stretch of highway or county road, Road Weather Information Systems are currently being used primarily by maintenance crews as an aid in reducing costs for snow and ice control. The information has been shown to reduce the costs of winter maintenance by as much as 10% [4]. Recently, these systems have been incorporated into intelligent transportation systems (ITS) as a means of aiding vehicle operators.

In general, the technologies incorporated into an RWIS include a combination of pavement sensors, subgrade sensors, meteorological sensors, roadway thermography, pavement and weather forecasts, and communication hardware such as variable message signs (VMS) or computer monitors for the dissemination of information. The system configuration is typically one or more remote weather stations and/or pavement sensors each with its own on-site computer or remote processing unit (RPU). A central processing unit (CPU) polls each of the RPUs and creates a database for output. A description of the weather systems slated for construction under Green Light is given in the report "The Green Light CVO Project-Phase 1, Road Weather Information Services Scope of Work [5]. A progress report from January 1997 appends the "Scope of Work" document and provides recent changes including the proposal for an additional RWIS at Siskiyou Summit [6].

Remote processing units will be installed in three locations under the auspices of Green Light. These locations are identified in Figure 1-2. Several other RPU locations are being upgraded to create a statewide weather information database that can provide information to motorists via the Traffic Management Operations Center (TMOC) in Portland, through message signs located around the state. Future expansion called for disseminating the information to motorists through information kiosks, and on the Internet.

Initially, the research team focused evaluation efforts on the Ladd Canyon installation on I-84 east of LaGrande. The Ladd Canyon RWIS is located near the center of the canyon adjacent to the existing rest areas at approximately milepost (MP) 270. A single remote processing unit was installed at this location for integration with existing variable message signs at either side of the canyon. Currently, the signs are manually activated via computer and modem to deliver weather warnings to passing traffic. Existing signs are located at MP 263 westbound (WB) at the North Powder exit and at MP 286 eastbound (EB) just south of LaGrande. Each of these signs were installed because of the dangerous conditions that develop in the microclimates of Ladd Canyon, namely high winds, drifting snow and poor visibility. The canyon is frequently closed to mobile home use during winter months.

Figure 1-2 Green Light RWIS Locations

- Green Light RWIS Locations

2 TEST METHODOLOGY

Two separate tests were developed for the evaluation of the Ladd Canyon RWIS System. One, the RWIS Speed Study, was to examine the change in truck vehicle speeds as various messages were transmitted to oncoming drivers through a variable message sign installed at either end of the canyon. The second test, the RWIS Accident Study, was a cursory examination of accident data before and after the RWIS installation in the area of Ladd Canyon.

2.1 RWIS SPEED STUDY

This section discusses in detail the work conducted in the evaluation of the Ladd Canyon RWIS system on I-84 east of La Grande. Because of changes in the configuration of the RWIS and how it was incorporated into ODOT's existing weather information system, the evaluation did not take place as outlined in the DTP. In lieu of the original plan of networking the RPU's and servers with variable message signs that can give real time feedback to passing trucks, the Green Light installations were incorporated into the development of a state-wide weather database. The database was intended to provide the latest weather observations to all motorists via the INTERNET as part of ODOT's Tripcheck, a web-based travel information site (www.tripcheck.com).

This test was initially designed to focus on the collection and analysis of message sign logs and vehicle speed data under a variety of climatic conditions in order to determine the effectiveness of the RWIS system in controlling driver behavior. Of primary concern are what effects the existing variable message signs in Ladd Canyon have on vehicle speeds, and how that impact will change once the RWIS has been deployed. The test is a before/after study in which comparisons will be made between similar data sets collected before and after the system is installed.

The following hypothesis is given in support of the test measure and will be tested according to accepted statistical techniques:

1.2.1 Vehicle speeds will decrease after the installation of RWIS message boards in inclement weather.

2.1.1 Pre-test Activities

Pre-test activities for this measure focused on the sources, quality and availability of data, developing a time frame for establishing benchmarks, and determining site locations. Accomplishments of the activity undertaken by OSU as part of the pre-test activities is summarized in Figure 2-1.

Figure 2-1 Pre-Test Activities RWISA Speed Study

Work Planned	Work Accomplished
Identification of Data Sources and Availability	• Samples of speed records were collected by existing weigh-in-motion (WIM) loops in Ladd Canyon • WIM data samples were output using the REPORTER software package for input into EXCEL spreadsheets to develop data collection procedures. • Records of displayed messages appearing on the VMSs in Ladd Canyon were collected from ODOT district offices in La Grande. • Samples of activity logs of construction activities were collected from ODOT district offices in La Grande. • Sources for daily records of pavement conditions in Ladd Canyon were reviewed. These are provided via the existing Ladd Canyon weather station, and are available for download via the Internet. • OSU collected a base set of data in January 1997 by radar gun in Ladd Canyon. The data was to be used to supplement speed data collected by the WIM.
Determination of Benchmark Timeframe	• WIM speed data is available from 1991 and was collected over the course of the study period by ODOT. • VMS logs are available from 1992 and will continue to be collected by ODOT over the course of the study. Records for calendar year 1994 up until the RWIS installation in 1997 is deemed sufficient for benchmark data.

2.1.2 Test Conduct Activities

Test conduct activities and accomplishments are summarized below in Figure 2-2.

Figure 2-2 Test Conduct Activities RWIS Speed Study

Work Planned	Work Accomplished
1. Collection and Analysis of WIM Data	
1a) Collect all available WIM data for the years 1994 up to the time of installation	• Baseline data was collected from May 1994 through 1996. • A second piezo sensor was installed on the east bound passing lane over the summer of 1997.
1b) Process the daily binary files using REPORTER	• Data collected through 1996 was processed.
1c) Import the data into Excel Spreadsheets	• not completed
2. Collection and Analysis of VMS Message Logs	
2a) Collect VMS message logs	• Message Logs were collected from 1994 through 1996.
2b) Correlate VMS logs with WIM data in EXCEL	• not completed
3. Collection and Analysis of Construction Activity Logs	
3a) Collect construction logs	• not completed
3b) Correlate construction logs with WIM data in EXCEL	• not completed
4. Collection of ODOT Road Reports	
4a) Collect ODOT Road Reports	• not completed
4b) Correlate road conditions with WIM data in EXCEL	• not completed
5. Collection of new speed data (spot speed surveys)	
5a) Acquire vehicle and radar gun	• A speed gun was acquired for ODOT regional office in LaGrande to be used throughout the evaluation
5b) Determine when to collect data	• A schedule was developed, collecting data three times per year beginning in January 1997.
5c) Conduct the spot speed survey	• The first spot survey was completed in January of 1997.
5d) Compile data using SPEEDZONE	• January 97 speed survey was compiled
5e) Import the data into EXCEL spreadsheets	• not completed
6. Collection of Data after Installation	
	• not completed

2.2 RWIS ACCIDENT STUDY

This test was initially designed to present truck crash data occurring in the vicinity of Ladd Canyon. The test was intended to measure what effects weather patterns and road conditions have had on truck crashes, and how that impact will change once the RWIS had been deployed with messages to passing truck drivers about road conditions in Ladd Canyon. The test was designed as a before/after study in which comparisons will be made between similar data sets before and after the RWIS is installed.

The following hypothesis is given in support of the measure and will be tested according to accepted statistical techniques:

1.2.1 Accidents in the vicinity of the RWIS system will decrease as timely information on road conditions is provided to motorists.

2.2.1 Pre-test Activities

Pre-test activities for this measure will focus on the sources, quality and availability of accident data, developing a time frame for establishing benchmarks, and determining site locations. Accomplishments of the activity undertaken by OSU as part of the pre-test activities is summarized in Figure 2-3.

Figure 2-3 Pre-Test Activities RWIS Accident Study

Work Planned	Work Accomplished
1) Data Sources and Availability	Potential data sources were identified as: • Oregon DOT's accident records database • Records of displayed messages appearing on the VMSs in Ladd Canyon • Activity logs of construction activities during the study period • Daily records of pavement conditions Samples of the data sources were collected
2) Determination of Benchmark Timeframe	• Completed • Available accident data for 1994 through deployment will be compared with data collected after deployment of RWIS.

2.2.2 Test Conduct Activities

Below is a summary of the work planned and accomplishments achieved according to the original DTP.

Figure 2-4 Test Conduct Activities RWIS Accident Study

1) Collection and Analysis of Accident Data	
1a) Collect all recorded accidents between milepost 263 and 286 up to RWIS installation	• Completed
1b) Tabulate accident data into EXCEL spreadsheets	• Not completed, results in next draft
1c) Calculate the accident rate for the section of highway in question	• Not completed, results in next draft
2) Collection and Analysis of VMS Message Logs	
2a) Collect VMS Logs	• Not completed, no results presented
2b) Correlate VMS logs with WIM data in EXCEL	• Not completed, no results presented
3) Collection and Analysis of Construction Activity Logs	
3a) Collect construction logs	• Not completed, no results presented
3b) Correlate construction logs w/ accident data	• Not completed, no results presented
4) Collection of ODOT Road Reports	
4a) Collect ODOT Road Reports	• Not completed, no results presented
4b) Correlate road conditions with accident data in EXCEL	• Not completed, no results presented

3 RESULTS OF EVALUATION

3.1 RWIS Speed Study

The installation of the RWIS equipment provided through Green Light was completed in August of 1997 at Ladd Canyon, Siskiyou Summit and at Celio on the Columbia Gorge. This included RPUs, inroad sensors, and servers to collect and disseminate the data. At this time OSU had been collecting speed and VMS data for nearly a year for the evaluation of the Ladd Canyon installation. There was still a degree of uncertainty as to whether the new equipment would be compatible with the software used to deliver messages to the existing VMS in Ladd Canyon, and other technologies were being considered.

ODOT continued to test the interface of the existing signs in Ladd Canyon. The interface to the VMS was developed by Vultron, and was the same system that provided output of the signs display for the evaluation. The software was written using 16-bit code, and was in effect, incompatible with the 32-bit architecture of the NT systems used to collect data fro the RPU's. This made it impossible for the signs to be automatically interfaced with the sensor data coming from the RWIS. The prices of variable message signs were prohibitive in cost ($250,000+) for the scope of the project.

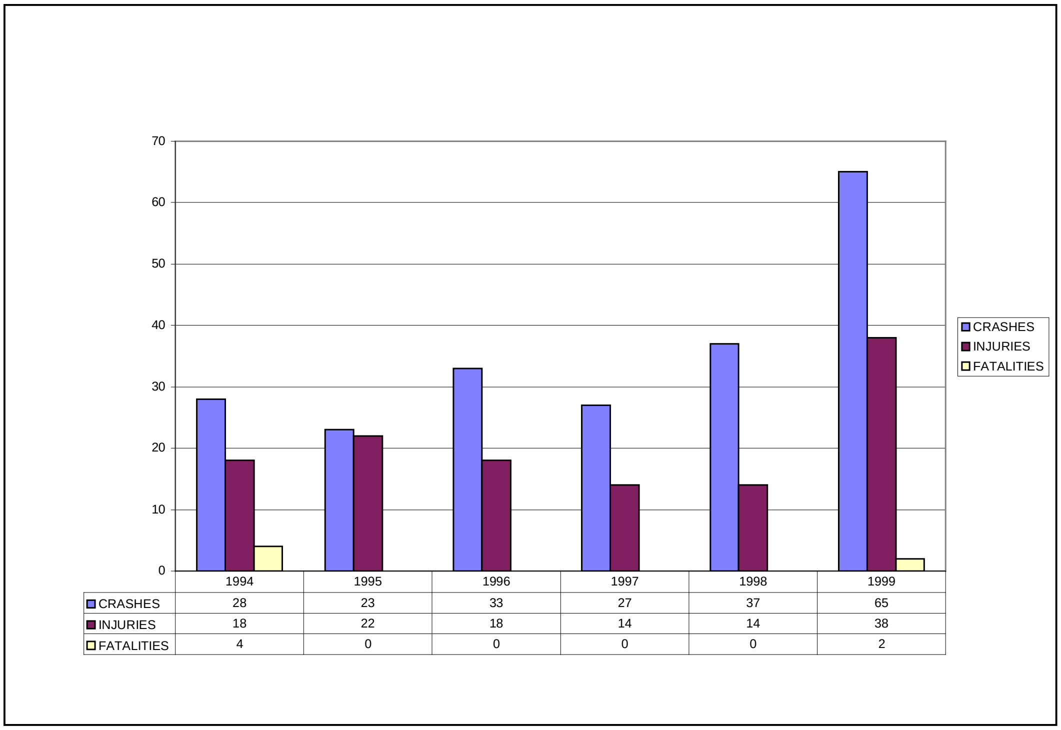
By 1998, after much testing the idea of interfacing with the existing VMS in North Powder and La Grande, a decision was made by ODOT to move towards the idea of integrating the Green Light RWIS technology with ODOTs plan for a travel advisory network via the Internet. Included in this was consideration of kiosks at truck stops and/or rest areas for dissemination of real time information to truck drivers about road conditions. Subsequently, efforts to interface the RWIS with the VMS were not pursued. At that point the process of "pre-data" collection was postponed.

3.2 RWIS Accident Study

The original intent of this evaluation was to examine changes in driver behavior as a result of the installation of the RWIS in Ladd Canyon focusing on its ability to relay real-time road conditions to motorists approaching the canyon. ODOT had existing VMS signs on either side of the canyon to relay the road conditions reported by the system. The intended result was to show decreases in accident rates over time. With the decision to incorporate the RWIS into a statewide database, the ability to pinpoint the effects of the RWIS system on crash events was difficult to do with any real precision. Accidents are very rare events, and with the loss of control over the messages being relayed to passing motorists, the evaluation was altered to a presentation of cursory accident statistics in the study area.

Figure 3-1 illustrates the results of available crash data in the Ladd Canyon corridor on Interstate 84.

Figure 3-1 Vehicular Crashes in Ladd Canyon 1994-1999

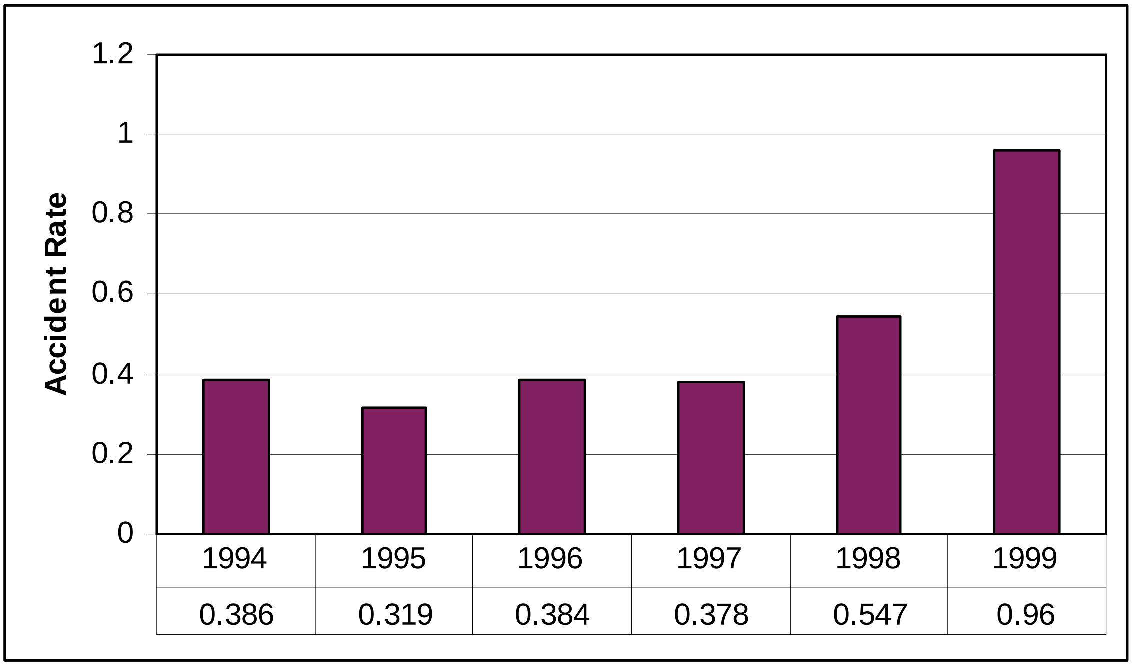


	1994	1995	1996	1997	1998	1999
CRASHES	28	23	33	27	37	65
INJURIES	18	22	18	14	14	38
FATALITIES	4	0	0	0	0	2

This data represents *all crashes* in the corridor, including both automobiles and commercial motor vehicle traffic. There has been a steady upward trend in the number of crashes over the course of the study period, with the exception of 1997. The reasons for changes in the numbers of crashes reported in Ladd Canyon vary for a number of reasons. One reason is that significant changes have been made in the accident reporting procedure over the course of the study period. Accidents are more likely to be reported now that more stringent guidelines have been adopted by the state of Oregon. In addition, traffic has increased significantly on Oregon's interstates.

Figure 3-2 shows accident rate figures over the course of the study period.

Figure 3-2 Ladd Canyon Accident Rates 1994-1999



Accident rates adjust crash figures to take into account the increases in average daily traffic in the study area. Accidents rose sharply during the course of 1999 as compared to previous years. The majority of these accidents took place under adverse conditions as shown in Figure 3-3.

Figure 3-3 Accidents By Road Condition Ladd Canyon 1994-1999

ROAD CONDITIONS	1994	1995	1996	1997	1998	1999
DRY	5	8	15	11	13	19
ICY	19	10	14	10	14	43
SNOW	2	3	1	1	1	1
OTHER/UNKNOWN	0	0	0	2	1	0
WET	2	2	3	3	8	2
TOTAL	28	23	33	27	37	65

4 CONCLUSIONS AND RECOMMENDATIONS

ODOT's travel advisory web page has undergone several upgrades in recent months. In January of 2000, a test version of TripCheck was launched, a high powered web interface that brings together several mediums of information for travelers. Information from the Green Light RWIS sensors are combined with 13 other weather stations across the state to provide timely weather and road conditions to motorists. In addition, TripCheck offers general information such as a listing of construction projects that could pose delays, public transportation services and schedules, rest area locations, and scenic byways.

The RWIS installations were successful in meeting the goal of adding additional realtime weather data for public use through the Traffic Management Operations Center in Portland. The server installations in La Grande, The Dalles and Ashland relay the information quickly and efficiently, enhancing the existing infrastructure used to provide weather conditions in these three areas known for their high occurrence of truck crashes.

The interface with truck traffic through the use of variable message signs was never accomplished due to the incompatibility of the existing hardware interfacing with the signs in Ladd Canyon. That, combined with the prohibitive costs of retrofitting signs with compatible hardware and/or purchasing new signs led to an incomplete evaluation of the motor carriers adjusting speed to adverse weather conditions.

Detailed test plan #11, the Motor Carrier Survey, provides additional insight into how motor carriers feel about the RWIS system as intended by ODOT. The survey found that 60% of carriers agree that RWIS would benefit their company (14% disagree and 26% have no opinion).

Recommendations for future work would be to pursue the dissemination of real time data to the roadside, rather than solely through the Internet. With the advent of wireless data communications, the idea of trucks equipped with palmtop computers that can query road conditions via the Internet, is available. On the other hand, it is technology that is far from mainstream. Providing information kiosks at rest areas truck stops, and weigh stations, is technology that can be incorporated into ODOT's existing infrastructure without a great deal of capital expense, and would reach all carriers, regardless of their technological advancements.

Accident and speed data collected in the Ladd Canyon area over the course of this study is useful in providing a baseline for determining the effects of RWIS technology as it relates to truck safety. It is strongly recommended that ODOT continue to collect and analyze truck crashes and their causes in relation to weather to help determine the effects RWIS is having on truck safety. Speed data, where available , can also be useful in providing relationships in those areas where RWIS is deployed with a feedback mechanism, such as a variable message sign. If ever ODOT integrates real time feedback to truck drivers about road conditions, the collection and analysis of speed data can provide insight into how the technology is altering truck behavior.

5 REFERENCES

1. Bell, C.A., B. McCall, and, C.M. Walton, "Oregon Green Light CVO Evaluation-Detailed Test Plans, Detailed Test Plans 1-14", GLEV9603-GLEV9711, March 1997.

2. Bell, C.A., B. McCall, and, C.M. Walton, "The Oregon 'Green Light' CVO Project, Evaluation Plan" GLEV9601, Oregon State University, Transportation Research Institute, September 1996.

3. Bell, C.A., B. McCall, and, C.M. Walton, The Oregon Green Light CVO Project, Individual Test Plan GLEV9602, Oregon State University, Transportation Research Institute, October 1996.

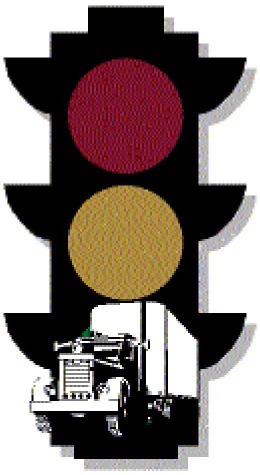
4. Boselly, S.E. "Benefit-Cost Assessment of the Utility of Road Weather Information Sysytems for Snow and Ice Control" Transportation Research Record No. 1352. Washington DC. 1992.

5. Research and New Technologies Unit, Policy Section, Transportation Development Branch, and Automation and Weighing Facilities Unit, Motor Carrier Services, Oregon Department of Transportation, "The Green Light CVO Project Phase 1, Road Weather Information Systems (RWIS) - Scope of Work for federal Highway Administration" , January 1996.

6. "Project Green Light CVO Project - Progress Report, Vehicle Operator Weather Advisory System" January 1997.

7. "Mesoscale Weather Forecasting: Technological and Institutional Challenges" Minutes from http://www.volpe.dot.gov/series3.htm. Volpe Center July 16, 1996.

8. North Dakota DOT, Materials and Research Division, Experimental Study No. NDEP92-03. "Road Condition - Weather Monitor System to Determine Pavement Surface and Atmospheric Conditions - Fourth Year Report". May 1996.



Oregon Green Light

CVO Evaluation

DRAFT FINAL REPORT

DETAILED TEST PLANS 4 and 5

Evaluation of the Downhill Speed Information System (DSIS)

Paul E. Montagne

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Transportation Research Report No. 00-14

Transportation Research Institute

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Corvallis, OR 97331

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The authors are indebted to the personnel of ODOT's Motor Carrier Transportation Division, who have provided information and data to the evaluation team throughout the project. We are particularly indebted to Ken Evert, Gregg Dal Ponte, Randal Thomas and David Fifer. Ken's untimely death in 1998 meant that he did not see his vision completed. The evaluation team is forever indebted to him for his support and for the opportunity to participate in the deployment.

DISCLAIMER

The contents of this report reflect the views of the authors who are solely responsible for the facts and accuracy of the material presented. The contents do not necessarily reflect the official views of the Oregon Department of Transportation or the Federal Highway Administration. The report does not constitute a standard, specification or regulation. The Oregon Department of Transportation does not endorse products or manufacturers. Trademarks or manufacturer names appear herein only because they are considered essential to the subject of this document.

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1 DETAILED TEST INTRODUCTION

1.1 BACKGROUND

This Detailed Test Report is the fourth of 12 reports submitted as part of the independent technical evaluation of the Oregon Green Light CVO project. The Oregon Department of Transportation (ODOT) is near completion of the implementation of their Intelligent Vehicle Highway System Strategic Plan for Commercial Vehicle Operations (now referred to as ITS/CVO). Through Green Light, Oregon is installing twenty-one mainline preclearance systems featuring weigh-in-motion (WIM) devices and automatic vehicle identification (AVI) at the major weigh stations and ports-of-entry throughout the state. In addition, certain sites have been equipped with safety enhancements that regulate road conditions and speed. Examples are the Downhill Speed Information System at Emigrant Hill, and the installation of weather stations at three location across the state.

The purpose of this report is to present the results of Detailed Test Plan (DTP) #4. There will be similar reports for all other Detailed Test Plans developed for the Green Light Evaluation. The Detailed Test Plans were published in 1997, Oregon “Green Light” CVO Evaluation-Detailed Test Plans [1]. Earlier documents providing essential background to the Evaluation are the Evaluation Plan [2], and , Individual Test Plans (ITP) [3].

Each of the tests conducted by the research team for the evaluation of Green Light addressed one of five goals of the evaluation as documented in the Evaluation Plan. These are:

- Assessment of Safety
- Assessment of Productivity
- Assessment of User Acceptance

- Assessment of Mainstreaming Issues
- Assessment of Non-Technical Interoperability Issues

The objectives associated with each goal are given in detail in the Individual Test Plans [3]. In addition, condensed one-page tables are contained in the appendices of the ITP, outlining the measures to be conducted for each of the stated objectives. The detailed test plan documents expand on the information provided in the ITP and provide in detail the activities planned for each *evaluation measure* during the course of the evaluation in regards to the stated objectives.

1.2 PURPOSE AND SCOPE

This report presents the results of three test measures employed to determine what effects Green Light has had on commercial motor vehicle *safety* due to the installation of the Downhill Information System (DSIS). The analysis concerns changes in speed of truck traffic descending Emigrant Hill westbound under a variety of scenarios. An analysis of accident data before and after the installation of the DSIS system (Measure 1.3.2) completes the evaluation of the Emigrant Hill DSIS.

The evaluation measures for this particular test plan are stated below:

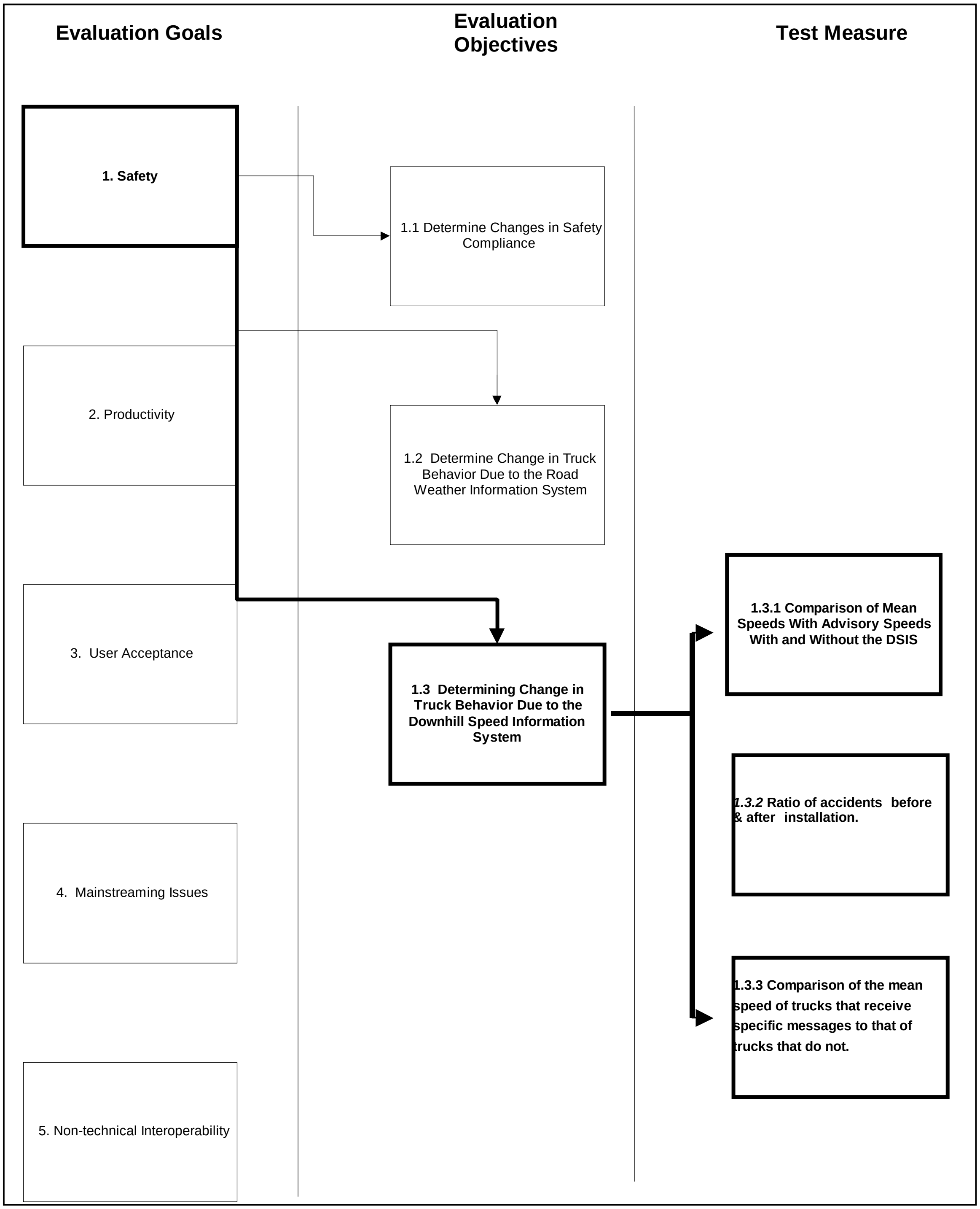
1.3.1 Comparison of the mean speed of ODOT-transponder-equipped vehicles when the DSIS is operating with when it is not.

1.3.2 Ratio of accidents before and after installation of Downhill Speed Information System

1.3.3 Comparison of the mean speed of ODOT-transponder-equipped vehicles with that of trucks with no transponders when the DSIS is operating.

A detailed description of the hypothesis to be tested as well as the test methodology and deliverables is described in detail in Chapter 2 for the Speed Study, and in Chapter Three for the Accident Analysis. Chapter 4 provides results of the tests, while conclusions and recommendations can be found in Chapter 4. The scope of this detailed test within the context of the overall Green Light Evaluation is shown in Figure 1-1. The test measures outlined in this document are highlighted for reference.

Figure 1-1 Evaluation Goals, Objectives, and Measures



1.3 DISCUSSION

Downhill Speed Information Systems seek to affect commercial vehicle driver behavior by providing a safe downhill speed message for their specific vehicle via a variable message sign. The purpose is to reduce the frequency and severity of downgrade truck accidents. Two of the systems are being installed in Oregon, one at Emigrant Hill on I-84 and a second atop Siskiyou Summit on I-5 (see Figure 1-2). The Emigrant Hill system is currently operational, while the Siskiyou Summit location is not yet under construction.

Figure 1-2 DSIS Locations in Oregon

In the case of Oregon's downhill system, a weigh-in-motion device, electronic transponder, and an overhead variable message sign all combine to effectively weigh a vehicle, retrieve its OPUC information, and relay a message to the driver. [4]

The DSIS will calculate and display a safe descent speed for each truck passing through the system at greater than 40,000 lb. gross vehicle weight, based on three factors:

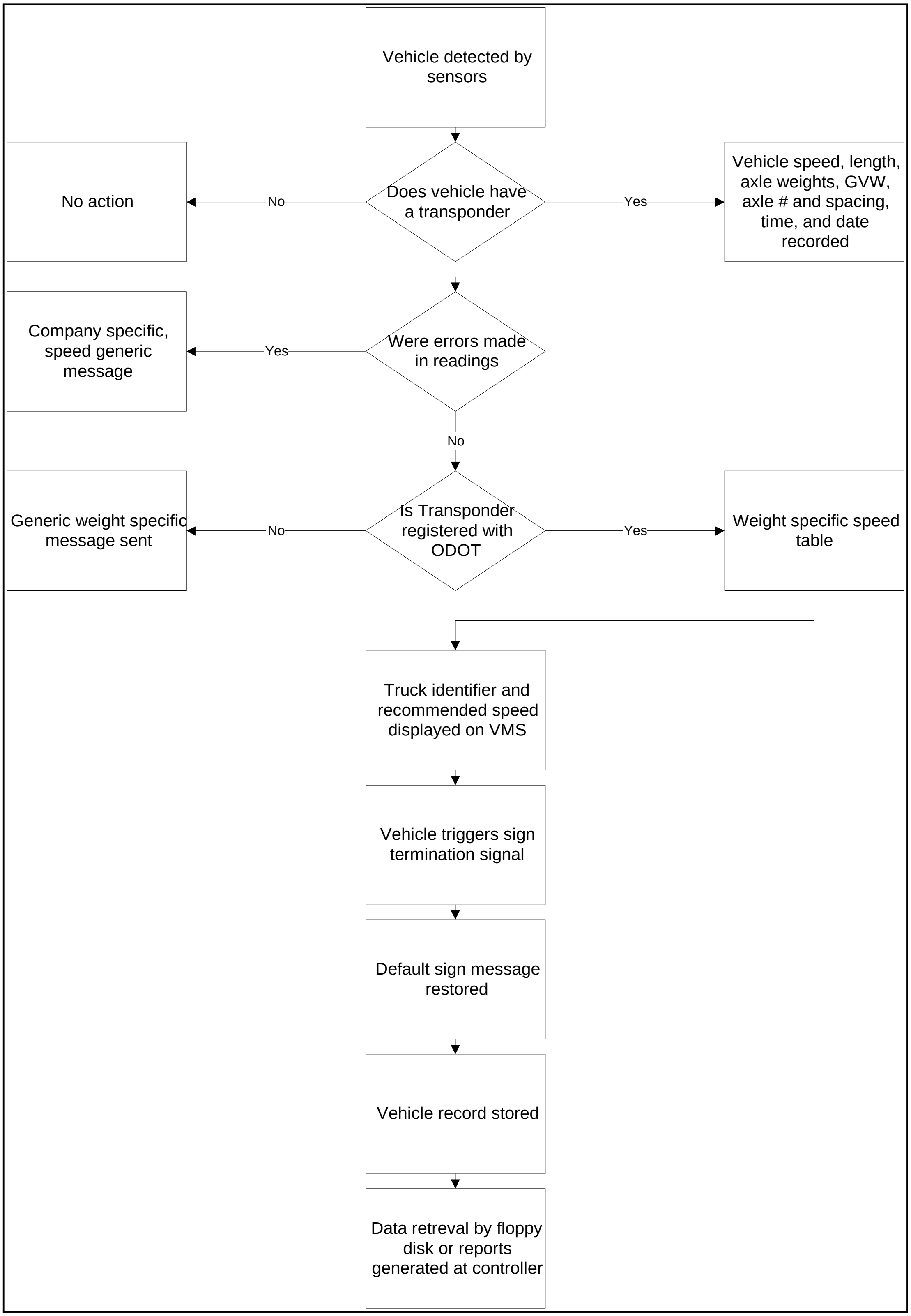
truck configuration

gross vehicle weight

steepness of grade

A flow chart of the system operation for the DSIS is shown in Figure 1-3.

Figure 1-3 DSIS Operation Flowchart



An overhead variable message sign down stream of the loop detectors and weight-in-motions strips will display the advised speed. In the case of Emigrant Hill, as shown in Figure 1-4, a weigh station is conveniently located at the top of the pass and a variable message sign is in place after it.

Figure 1-4 VMS From Emigrant Hill Weigh Station

WIM strips and transponder scanners have been installed one mile upstream of the weigh station directly on the freeway as part of Green Light's integration of mainline preclearence. Based on the weight measured by the WIM and the information gathered from the transponder signal, a decision whether to pull the truck into the weigh station is made. Trucks that are within the legal limit and have the proper registration and safety credentials bypass the weigh station and continue on the freeway. Once past the weigh station, the bypassed trucks receive an advisory message from the VMS such as "Mayflower truck #XXX, based on your weight of 70,000lbs, your recommended speed is 20 mph." (See Figure 1-3). Trucks that are not bypassed receive a similar message when they exit the weigh station.

2 TEST METHODOLOGY (Speed Study)

2.1 PHYSICAL DESCRIPTION

This section discusses in detail the activities to be carried out in the evaluation of the DSIS system at Emigrant Hill on I-84 east of Pendleton. Because of increased delays in the construction and deployment of the Emigrant Hill DSIS, the evaluation was postponed until the site became operational. To date, the Emigrant Hill DSIS has not been deployed and as a result this portion of the Detailed test plan was not completed.

The test is scheduled to take place of the course of two days in the month of June 2000. Oregon State University has agreed to conduct the evaluation as part of a no-cost extension using graduate students to conduct the research study. The actual schedule will be set according to ODOT's approval of the site.

2.1.1 Purpose

These tests will focus on the collection and analysis of commercial motor vehicle (CMV) speed data on the descent WB from Emigrant Hill on Interstate 84. For the purposes of this study, a commercial motor vehicle is any vehicle with a gross vehicle weight greater than 60,000 lb. Specifically, the tests will measure:

1. How truck speeds change when the DSIS is operating compared with when it is not
2. How the truck speeds differ from the recommended speed.

The descent from the summit is approximately nine miles, with a 6% grade and some sharp curves. It is an area that has seen a number of truck accidents due to excessive speed and brake failure. The DSIS system is being installed at this site to encourage drivers to descend at a recommended speed based on weight.

2.1.2 Hypothesis

The following hypotheses were given in support of the two measures and will be tested according to accepted statistical techniques.

1.3.1 Mean speeds in the vicinity of the operating DSIS system will converge towards advisory speeds.

1.3.2 Mean speeds of trucks that receive a specific message will converge toward advisory speeds more quickly than those that do not receive a specific message.

2.2 PRETEST ACTIVITIES

Pretest activities for this measure will focus on the sources, quality, and availability of data, and determining the appropriate sample size. These steps are discussed in detail below.

2.2.1 Data Sources and Availability

The primary data source for this test measure is speed data collected by radar gun at Emigrant Hill (spot speed surveys). As the DSIS system is operational but many CMV carriers have not yet installed transponders, the following four "focus groups" of trucks will be simultaneously sampled for comparison.

1. Trucks that have transponders that are registered in the ODOT database
2. Trucks with transponders that are not registered with ODOT
3. Trucks with transponders, but received some error in reading them or in measuring the truck's weight. This group includes trucks outside the weight range of 60 to 80klb.
4. Trucks that have no transponders

As shown in the DSIS flow chart, Figure 1-2, these four groups will be treated differently by the DSIS. Trucks with ODOT transponders will receive a message specific to their truck, e.g. “Bi-Mart Truck #XXX, your speed….” Trucks with non-ODOT transponders will also receive a message, but it will not be specific to them, e.g. “Truck Advisory – Recommended Downhill Speed for your weight….” Trucks that were erroneously read will receive a generic caution or a truck specific message depending on the error that occurred. Trucks with no transponders will not trigger the system and so will not receive a variable message. There is still the painted sign at the top of Emigrant Hill giving suggested speeds for weight ranges, and these trucks will read their advised speed from that sign.

The collection of new speed data will measure changes in driver behavior and how much those changes can be attributed to the recommended speed displayed to them. The speed data will be collected using a calibrated radar gun at several points of the descent. Speeds will be logged by hand into data collection sheets that ODOT will provide. Data can then be keyed directly into EXCEL. The data will be analyzed using accepted statistical techniques.

2.2.2 Calculation of Sample Size

A basic premise of statistical analysis is that any “natural phenomenon” occurring a large number of times will approximate the normal distribution or “bell curve.” Depending on the degree of accuracy desired from the normal approximation, “a large number” could be anywhere from thirty to several hundred. The composition and volume of traffic is measured by ODOT each year at various points around the state and is reported in the transportation volume tables [5]. From those measurements, an estimate of the population size, or the number of trucks descending Emigrant Hill each day, can be calculated. In both 1997 and 1998 At ODOT recorder 30-004, which is on I-84 near Pendleton, approximately 27% of traffic volume would be considered truck traffic. This included single-unit, 3-axle vehicles and larger. The volume of traffic, per day, at milepost 233.45 near Emigrant Park was 8,700 vehicles in 1997 and 8,300 vehicles in 1998. Projecting these measurements, we can expect somewhere in the vicinity of 2300 trucks to descend Emigrant Hill on any particular day in 1999, which is a sufficiently large number to assume a normal distribution of truck behavior.

When estimating the mean of a normal population, such as the mean speed of trucks descending Emigrant Hill, it is possible to calculate the sample size necessary to ensure a certain degree of confidence. Standard estimation theory states that the sample size *n* necessary to ensure that the error in estimating the population mean μ will be less than a specified amount e according to the following theorem [4]:

$$n = \left(\frac{z\frac{\alpha}{2} / \sigma}{e}\right)^2$$

Where n is the sample size
Z is the value of the standard normal distribution
σ is the variance, α the uncertainty, and e the acceptable error

Therefore, if the sample mean *x* is to be used as an estimate of $\underline{\mu}$, one can be (1-σ)100% confident that the error will be less than a specified amount *e*.

Strictly speaking, the formula above is applicable only if the population variance for the sample is known. Lacking this information, a preliminary sample size of n>30 can be used to calculate a standard deviation which will suffice as an estimate of σ, and then an estimate of the necessary number of additional measurements can be made. However, previous studies have given the approximate variance of traffic speeds, and so with a 95% confidence interval (z=1.96) and a degree of uncertainty of α at .05, approximately 150 trucks for each group will be surveyed. A revised estimate will be made on site after 30 or more samples.

2.3 TEST CONDUCT ACTIVITIES

2.3.1 Participants

Transportation Research Institute (Paul Montagne, staff) - will conduct the research, including collection and analysis of data.

ODOT Motor Carrier Enforcement Officer - will operate the weigh scale during the test.

2.3.2 Equipment

- Calibrated speed gun provided by ODOT
- WIM Mainframe computer and variable message sign provided by ODOT
- Two sets of two-way radios provided by TRI
- Clipboards, data collection sheets, paper provided by ODOT
- Van provided by OSU

2.3.3 Procedure

1) Predetermine collection period

The data will be collected during daylight hours and on days when weather is not a factor. High visibility days are preferred to eliminate any unnecessary bias. Two different locations will be selected on the descent for data collection. The spot surveys will be recorded for each focus group simultaneously, so there will be a minimum of complicating factors such as weather, road construction, etc. The weigh station must also be closed.

2) Acquire equipment

The vehicle used for the speed study will be an inconspicuous, white mini-van, provided by the state motor pool at Oregon State University. There are no distinct markings on the van other than a "state motor pool" bumper sticker and state issued license plates. The radar gun will be provided by ODOT. The same gun will be used throughout the study. It is regularly serviced and calibrated and is reasonably accurate. The research team will keep a calibration history of the gun. Oregon State University will provide the two-way radios, clipboards, and any other minor equipment.

3) Conduct the spot speed survey

Each spot survey will require two researchers, one at the top of Emigrant hill to record vehicle types, weights, and recommended speeds, and a second researcher downstream manning the radar gun. Data will be collected when the weigh station is not officially operating, but the system will be on so the researcher at the top of the hill can record weights, truck id's and recommended speeds. Two-way radios will be used to communicate between the researchers.

The data will be collected from inside the vehicle. The van will be parked on the right hand shoulder in a conspicuous location away from any overpasses or exits. The gun will be mounted on the dashboard and covered with a newspaper or other inconspicuous camouflage. This will hopefully prevent drivers from knowing that their speeds are being measured and encourage them to drive normally.

1d) Analysis of data

Speeds will be keyed into an EXCEL spreadsheet for analysis. The data, time, location, recommended speed and weather and road conditions will be recorded. Mean speeds will be calculated from the data and then compared to the advisory speeds. Data sets for each focus group will be compared to the others so as to reveal changes in mean speeds.

2.4 POST-TEST ACTIVITIES

2.4.1 Reporting Procedures for Individual Test

A test report will be prepared for each of the test measures outlined in the evaluation plan and will proceed as follows.

1. Preparation of a draft report for the test (this document) to be submitted to the steering committee (SC) for their approval.
2. Approval of the SC at a scheduled meeting.
3. Preparation of a final report for each test, incorporating SC recommendations.
4. Submittal of 1 hardcopy original, 1 electronic original, and ten bound copies of the report to ODOT's project management team.
5. Transmittal of the report by ODOT to FHWA.

2.4.2 Reporting Schedule

A test summary report will be prepared highlighting findings from all of the test measures. The document will be produced as follows:

1. Preparation of a draft report summarizing the results of all the individual test reports for submittal to the SC.
2. Approval of the SC at a scheduled meeting.
3. Preparation of a final test summary report, incorporating SC recommendations.
4. Submittal of 1 hardcopy original, 1 electronic original, and ten bound copies of the summary report to ODOT's project management team.
5. Transmittal of the test reports by ODOT to FHWA.
6. Reporting Schedule for Test Summary

A reporting schedule is shown below for the test summary report:

Figure 2-4 Reporting Schedule - Test Summary Reports

Deliverables	Schedule	Scheduled Due Date*
Drafts of Test Summary Report	July 1 - July 15, 2000	July 15, 2000
Review of Test Summary Report by Steering Committee	July15, 2000-July 31, 2000	July 31 , 2000
Test Summary Report (Final)	Aug 1 – Aug 30, 2000	Aug 30, 2000

3 TEST METHODOLOGY (ACCIDENT STUDY)

3.1 PHYSICAL DESCRIPTION

This section discusses in detail the work conducted in the evaluation of the Emigrant Hill DSIS system on I-84 east of La Grande. OSU has altered the original DTP to that of a cursory analysis of available crash data for a number of reasons:

- Interstate 84 was under construction for most of the evaluation period, with traffic on the westbound lanes rerouted to the eastbound lanes, or vice versa for approximately 16 months.
- The DSIS is still in the process of being deployed, all “post- deployment” accident analysis was not conducted

Accident studies require a great deal of control to eliminate noise presented by other factors such as road construction and varying delays. With changes to the study area, and an inability to collect any post DSIS accident data, it was determined that the a cursory examination of accident rates be compiled lieu of the original plan. A continuation of this analysis once the DSIS becomes operational will be recommended in this report.

3.1.1 Purpose

This test was initially designed to present truck crash data occurring in the westbound lanes of I-84 descending from Emigrant Hill. The test was intended to measure what effects DSIS would have on truck crash rates, and how that impact would change with the installation of the DSIS at the summit. The test was designed as a before/after study in which comparisons will be made between similar data sets before and after the DSIS is installed. As was mentioned above, this approach has been altered, with the presentation of accident results only through 1999.

The descent from the summit is approximately nine miles, with a 6% grade and some sharp curves. It is an area that has seen a number of truck accidents due to excessive speed and brake failure. The DSIS system is being installed at this site to encourage drivers to descend at a recommended speed based on weight. This area is identified by ODOT as one of ten "high truck crash corridors" due to it steep grades and frequency of crashes.

3.1.2 Hypothesis

The following hypothesis was given in support of the test measure and will be tested according to accepted statistical techniques.

1.3.2 Accidents in the vicinity of the DSIS system will decrease as messages are relayed to passing trucks prior to descent of Emigrant Hill

3.2 PRETEST ACTIVITIES

Work Planned	Work Accomplished
1) Data Sources and Availability	Potential data sources were identified as: • Oregon DOT's accident records database • Records of displayed messages appearing on the VMSs in Ladd Canyon • Activity logs of construction activities during the study period • Daily records of pavement conditions • Escape Ramp Data, if available • Samples of the data sources were collected
2) Determination of Benchmark Timeframe	• Completed • Available accident data for 1997 through deployment will be compared with data collected after deployment of DSIS.

3.3 TEST CONDUCT ACTIVITIES

Below is a summary of the work planned and accomplishments achieved according to the original DTP.

1) Collection and Analysis of Accident Data	
1a) Collect all recorded accidents between milepost 263 and 286 up to DSIS installation (1997-1999)	• Completed
1b) Tabulate accident data into EXCEL spreadsheets	• Completed
1c) Calculate the accident rate for the section of highway in question	• Completed
2) Collection and Analysis of VMS Message Logs	
2a) Collect VMS Logs	• Not completed, no results presented
2b) Correlate VMS logs with WIM data in EXCEL	• Not completed, no results presented
3) Collection and Analysis of Construction Activity Logs	
3a) Collect construction logs	• Not completed, no results presented
3b) Correlate construction logs w/ accident data	• Not completed, no results presented
4) Collection of ODOT Road Reports	
4a) Collect ODOT Road Reports	• Not completed, no results presented
4b) Correlate road conditions with accident data in EXCEL	• Not completed, no results presented

4 RESULTS

4.1 RESULTS - DSIS SPEED STUDY

To date, the Emigrant Hill DSIS has not been deployed and as a result this portion of the detailed test plan was not completed.

4.2 RESULTS - DSIS ACCIDENT STUDY

Three years of accident data was collected for the pre-deployment phase accident analyses of Emigrant Hill. Figure 4-1 below shows the total number of reported accidents (both cars and trucks) occurring between mileposts 216 and 218 of I-84 for the years 1997-1999. This includes both eastbound and westbound lanes.

Figure 4-1 Emigrant Hill Accidents 1997-1999

	INJURY	FATAL	TOTAL
1997	17	0	21
1998	8	0	24
1999	38	2	65

Causes of all reported accidents occurring at Emigrant Hill for the years 1997-1999 are shown below in Figure 4-2.

Figure 4-2 Accident Causes, Emigrant Hill 1997-1999

	1997	1998	1999
SPEED	8	6	59
IMPROPER OVERTAKING	6	10	3
FOLLOW TOO CLOSE	1	1	1
DUII	1	2	1
OTHER	5	5	1
TOTAL	21	24	64

Accidents due to speed and improper overtaking, continue to dominate the crashes that occur on the hill.

Figure 4-3 Accident Conditions Emigrant Hill 1997-1999

	1997	1998	1999
DRY	8	16	19
ICY	11	3	43
SNOW	1	1	1
OTHER	1	4	2
TOTAL	21	24	65

As accidents are rare events, it is useful to express the frequency of accidents in terms if the rate in which they occur. This is based on changes in average daily traffic from year to year. Figure 4-4 below shows the accident rates for Emigrant Hill from 1997-1999.

Figure 4-4 Accident Rates, Emigrant Hill 1997-1999

1997	0.535
1998	0.626
1999	0.652

5 CONCLUSIONS AND RECOMMENDATIONS

Although the Emigrant Hill DSIS has not been deployed, OSU feels that the system is a valuable tool that will truly prove beneficial to the trucking community. Emigrant Hill continues to be listed as a high truck crash corridor in the state of Oregon, with 62 crashes occurring in 1999 due to speed and improper overtaking. The DSIS could aid in reducing these numbers through a warning system of advised speeds and personalized signing as proposed in the Green Light Project.

In conclusion, OSU recommends that ODOT continue to pursue deployment of this technology, and if possible, conduct an evaluation of its effectiveness.

6 REFERENCES

1. Bell, C.A., B. McCall, and, C.M. Walton, "Oregon Green Light CVO Evaluation-Detailed Test Plans, Detailed Test Plans 1-14", GLEV9603-GLEV9711, March 1997.

2. Bell, C.A., B. McCall, and, C.M. Walton, "The Oregon 'Green Light' CVO Project, Evaluation Plan" GLEV9601, Oregon State University, Transportation Research Institute, September 1996.

3. Bell, C.A., B. McCall, and, C.M. Walton, The Oregon Green Light CVO Project, Individual Test Plan GLEV9602, Oregon State University, Transportation Research Institute, October 1996.

4. ODOT Research and New Technology, Transportation Development Branch, "Oregon Green Light CVO Project - Overview and Phase III Workplan" Oregon Department of Transportation, Salem OR, January 1997.

7 APPENDICES

APPENDIX A

TEST PLAN FOR THE TRACKING FUNCTIONALITY OF THE GREEN LIGHT PROJECT EMIGRANT HILL DOWNHILL SPEED INFORMATION SYSTEM (DSIS)

APPENDIX A

TEST PLAN FOR THE TRACKING FUNCTIONALITY OF THE GREEN LIGHT PROJECT EMIGRANT HILL DOWNHILL SPEED INFORMATION SYSTEM (DSIS)

1.0 Introduction

The purpose of this document is to outline the tests to be performed for the Emigrant Hill DSIS tracking functionality.

2.0 Required Equipment

The configuration of the vehicles to be used for the DSIS functionality test include:

a) A vehicle with five or more axles with a weight that is > 60(kips) and < 80(kips), and is equipped with a transponder that is registered in the ODOT database;

b) A vehicle with five or more axles with a weight that is > 60(kips) and < 80(kips), and is equipped with a transponder that is not matched in the ODOT database;

c) A vehicle with a weight that is > 80(kips) or < 60(kips), and/or a vehicle that has less than five axles, and is equipped with a transponder that is registered in the ODOT database.

3.0 Procedure

The test is broken down into 4 areas to test the operation of the DSIS system. For each of the tests the test vehicle will proceed over the mainline Weigh-In-Motion (WIM) Location in order to:

a) Verify that the VMS is able to display all types of messages required for the operation of the DSIS System,

b) Verify that the VMS will not display a downhill message when ODOT is displaying a message such as "CONSTRUCTION ZONE," and,

Verify that an ODOT message will immediately override any downhill message that is being displayed (the downhill message will immediately cease to appear).

Verify that the DSIS System will continue to function when the Weigh Station is closed and the

Pre-Clearance System is off.

The test vehicles may either be trucks from the mainstream traffic, or a dedicated test vehicle such as the scale truck.

The Downhill Warning System (DWS) needs to query the Variable Message Sign (VMS) because ODOT has the higher priority of using the VMS. When the VMS is not being used by ODOT, the DWS can send a Downhill Warning message to the VMS and the VMS will display the message.

The VMS will display three lines of information when providing a Downhill Warning message. All three lines of the Downhill Warning message should be centered in capital letters on the VMS. The company name in the second line of the Downhill Warning message will have 18 characters or less (including spaces) and will display only whole words. For example, the company name WINDSOR ROCK PRODUCTS would be shortened to WINDSOR ROCK rather than WINDSOR ROCK PRODU.

In accordance with the Emigrant Hill Downhill System Design, Section 2.4, Downhill Warning System (DWS), the Downhill Message will be displayed as soon as it is received by the VMS, and will be displayed during the user definable time. At the end of the user definable time, the DWS software will send a command to blank the displayed message on the VMS.

If there is no Downhill Warning message displayed for the vehicle, the vehicle is expected to follow the recommended safe speed for the respective type of vehicle as specified on the fixed road message sign.

3.1 DSIS Systems Messages

Verify that the VMS is able to display all types of messages required for the operation of the DSIS System. Four functional tests, using four different conditions, are required to create the four different DWS message options.

3.1.1 Downhill Message Displayed (Carrier/Warning Specific)

The Company name for this test will exceed 18 characters. The transponder will identify the vehicle as it passes over the mainline WIM. The WIM scale system and the State Supervisory Computer (SSC) display will make a sort decision and send this sort decision to the Automatic Vehicle Identification (AVI) writer. The AVI unit will write the sort decision to the vehicle's transponder and direct the driver to either bypass or enter the Weigh Station. The WIM system will then communicate with the SSC to retrieve a company name and unit number from the vehicle database. After the vehicle bypasses or exits the Weigh Station, it will pass the post Weigh Station AVI Reader and approach the DWS. The SSC will communicate to the Automatic Vehicle Classification (AVC) system which will in turn communicate a message to the VMS, if available (not being used by ODOT), using a speed based on vehicle weight, and that is consistent with the law. The Downhill Warning Message will not truncate the Company name and will only display whole words for the vehicle, and will be displayed as follows:

TRUCK ADVISORY

COMPANY NAME

XX MPH DOWNHILL

TRUCK-SPECIFIC MESSAGE DISPLAYED ON THE VMS	YES	NO
WHOLE-WORDS ONLY MESSAGE DISPLAYED ON THE VMS	YES	NO
WARNING-SPECIFIC MESSAGE DISPLAYED ON THE VMS	YES	NO

Downhill Message Displayed (Carrier/Warning-Generic)

The transponder will be configured in such a way so that it is not matched with the vehicle, or is not in the ODOT database. The WIM scale system and the SSC display will make a sort decision and send this sort decision to the AVI writer. The AVI unit will write the sort decision to the vehicle's transponder and direct the driver to either bypass or enter the Weigh Station. The WIM system will then communicate with the SSC in an attempt to retrieve a company name and unit number from the vehicle database. However, because the vehicle is unmatched, a company name will not be available. After the vehicle bypasses or exits the Weigh Station, it will pass the post Weigh Station AVI Reader and approach the DWS. The SSC will then communicate to the AVC system, which will in turn communicate to display a Company- and Warning-generic message to the VMS if available (not being used by ODOT). The Downhill Warning Message for the vehicle will be displayed as follows:

TRUCK ADVISORY

CAUTION

STEEP DOWNGRADE

REPORT REASON CODE ONOTDB APPEARS	YES	NO
VEHICLE MATCHED (TRANSPONDER # APPEARS ON SSC)	YES	NO
GENERIC DWM DISPLAYED ON THE VMS	YES	NO

Downhill Message Displayed (Carrier Specific - Warning Generic)

The test vehicle will have less than five axles and a vehicle weight of < 60(kips). The transponder will identify the vehicle as it passes over the mainline WIM. The WIM scale system and the SSC display will make a sort decision and send this sort decision to the AVI writer. The AVI unit will write the sort decision to the vehicle's transponder and direct the driver to either bypass or enter the Weigh Station. The WIM system will then communicate with the SSC to retrieve a company name and unit number from the vehicle database. After the vehicle bypasses or exits the Weigh Station, it will pass the post Weigh Station AVI Reader and approach the DWS. The SSC will communicate to the AVC system, which will in turn communicate to display a Company-specific, Warning-generic message to the VMS if available (not being used by ODOT). The Downhill Warning Message for the vehicle will be displayed as follows:

TRUCK ADVISORY

COMPANY NAME

STEEP DOWNGRADE

VEHICLE MATCHED (COMPANY NAME APPEARS ON SSC)	YES	NO
COMPANY NAME DISPLAYED ON THE VMS	YES	NO
GENERIC WARNING DISPLAYED ON THE VMS	YES	NO

Message Not Created

The test vehicle, which will not be equipped with a transponder, will pass over the mainline WIM. As a result, the DWS software will not be able to initiate the process for creating a Downhill Warning message and the VMS will not display a message for the test vehicle.

MESSAGE DISPLAYED ON THE VMS	YES NO

3.2 AVC Generated Message Unable to Override ODOT Display

ODOT will display the message “Test Message” on the VMS. The test vehicle will pass over the mainline WIM. The transponder will identify the vehicle as it passes over the mainline WIM. The WIM scale system and the SSC display will make a sort decision and send this sort decision to the AVI writer. The AVI unit will write the sort decision to the AVI transponder and direct the driver to either bypass or enter into the Weigh Station. After the vehicle bypasses or exits the Weigh Station, it will pass the post Weigh Station AVI Reader and approach the DWS. The WIM system will then communicate with the SSC to retrieve a company name and unit number from the vehicle database. The SSC will communicate to the AVC which will in turn attempt to communicate a truck-specific message to the VMS, however it will be unable to override the ODOT message.

VEHICLE MATCHED (COMPANY NAME APPEARS ON VMS)	YES NO
ODOT MESSAGE DISPLAYED ON VMS (TEST MESSAGE)	YES NO
WIM SYSTEM OVERRIDE OF ODOT MESSAGE	YES NO

3.3 ODOT Overrides AVC Generated Message

The test vehicle will pass over the mainline WIM. The transponder will identify the vehicle via the AVI Reader as it passes over the mainline WIM. The WIM scale system and the SSC display will make a sort decision and send this sort decision to the AVI writer. The AVI unit will write the sort decision to the transponder and direct the driver to either bypass or enter the Weigh Station. After the vehicle bypasses or exits the Weigh Station, it will pass the post Weigh Station AVI Reader and approach the DWS. The WIM system will then communicate with the SSC to retrieve a company name and unit number from the vehicle database. The SSC will communicate to the AVC, which will in turn communicate a truck-specific message to the VMS. ODOT will then override the AVC with the message "Test Message" which will display on the VMS. The AVC-generated message will cease to appear.

VEHICLE MATCHED (COMPANY NAME APPEARS ON VMS)	YES	NO
DWS MESSAGE DISPLAYED ON THE VMS	YES	NO
ODOT MESSAGE OVERRIDE DWS MESSAGE	YES	NO

Message Displayed for AVI-Equipped Carriers When Weigh Station is Closed

The test vehicle will pass over the mainline WIM. After the vehicle bypasses the Weigh Station, it will pass the post Weigh Station AVI Reader and approach the DWS. The WIM system will then communicate with the SSC to retrieve a company name and unit number from the vehicle database. The SSC will communicate to the AVC system which will in turn communicate a message to the VMS, if available (not being used by ODOT), using a speed, based on vehicle weight and that is consistent with the law. The Downhill Warning Message for the vehicle will be displayed as follows:

TRUCK ADVISORY

COMPANY NAME

XX MPH DOWNHILL

VEHICLE MATCHED (COMPANY NAME APPEARS ON SSC)	YES	NO
TRUCK-SPECIFIC MESSAGE DISPLAYED ON THE VMS	YES	NO
WARNING-SPECIFIC MESSAGE DISPLAYED ON THE VMS	YES	NO

4.0 Repeat Test Scenarios, as Necessary

If the system fails any of the tests in 3.1 to 3.3, the failed test must be repeated three (3) additional times. If the system does not pass the test in 3 out of 4 cases, the configuration of the software should be checked before re-testing that portion of the functionality.

Oregon Green Light

CVO Evaluation

FINAL REPORT

DETAILED TEST PLAN 6

Evaluation of the Changes in the Auditing Process and Collection of Highway Use Tax Revenues

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Conducted by sub-contract for Oregon State University
Transportation Research Institute
Transportation Research Report No. 00-015

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The authors are indebted to the personnel of ODOT's Motor Carrier Transportation Division, who have provided information and data to the evaluation team throughout the project. We are particularly indebted to Ken Evert, Gregg Dal Ponte, Randal Thomas and David Fifer. Ken's untimely death in 1998 meant that he did not see his vision completed. The evaluation team is forever indebted to him for his support and for the opportunity to participate in the deployment.

DISCLAIMER

Table of Contents

Table of Exhibits

1. INTRODUCTION

This Detailed Test Report is Number 6 submitted as part of the independent technical evaluation of the Oregon Green Light CVO project. The Oregon Department of Transportation (ODOT) is in the process of implementing their Intelligent Transportation System Strategic Plan for Commercial Vehicle Operations (referred to ITS/CVO). Through Green Light, Oregon is installing twenty-two mainline preclearance systems featuring weigh-in-motion (WIM) devices and automatic vehicle identification (AVI) at the major weigh stations and ports-of-entry (P.O.E.) throughout the state. In addition, certain sites are being equipped with further safety enhancements that regulate road conditions and speed.

Each of the tests conducted by the research team for the evaluation of Green Light addresses one of the five goals of the evaluation as documented in the Evaluation Plan. These goals are:

- Assessment of Safety
- Assessment of Productivity
- Assessment of User Acceptance
- Assessment of Mainstreaming Issues
- Assessment of Non-Technical Interoperability Issues

The objectives associated with each goal are given in the Oregon Green Light CVO Project- Individual Test Plans (ITP). In addition, condensed one-page tables are contained in the appendices of the ITP, outlining the measures to be conducted for each of the stated objectives. The detailed test plan documents expand on the information provided in the ITP and provide in detail the activities carried out for each evaluation measure during the course of the evaluation in regards to the stated objectives.

1.2 PURPOSE AND SCOPE

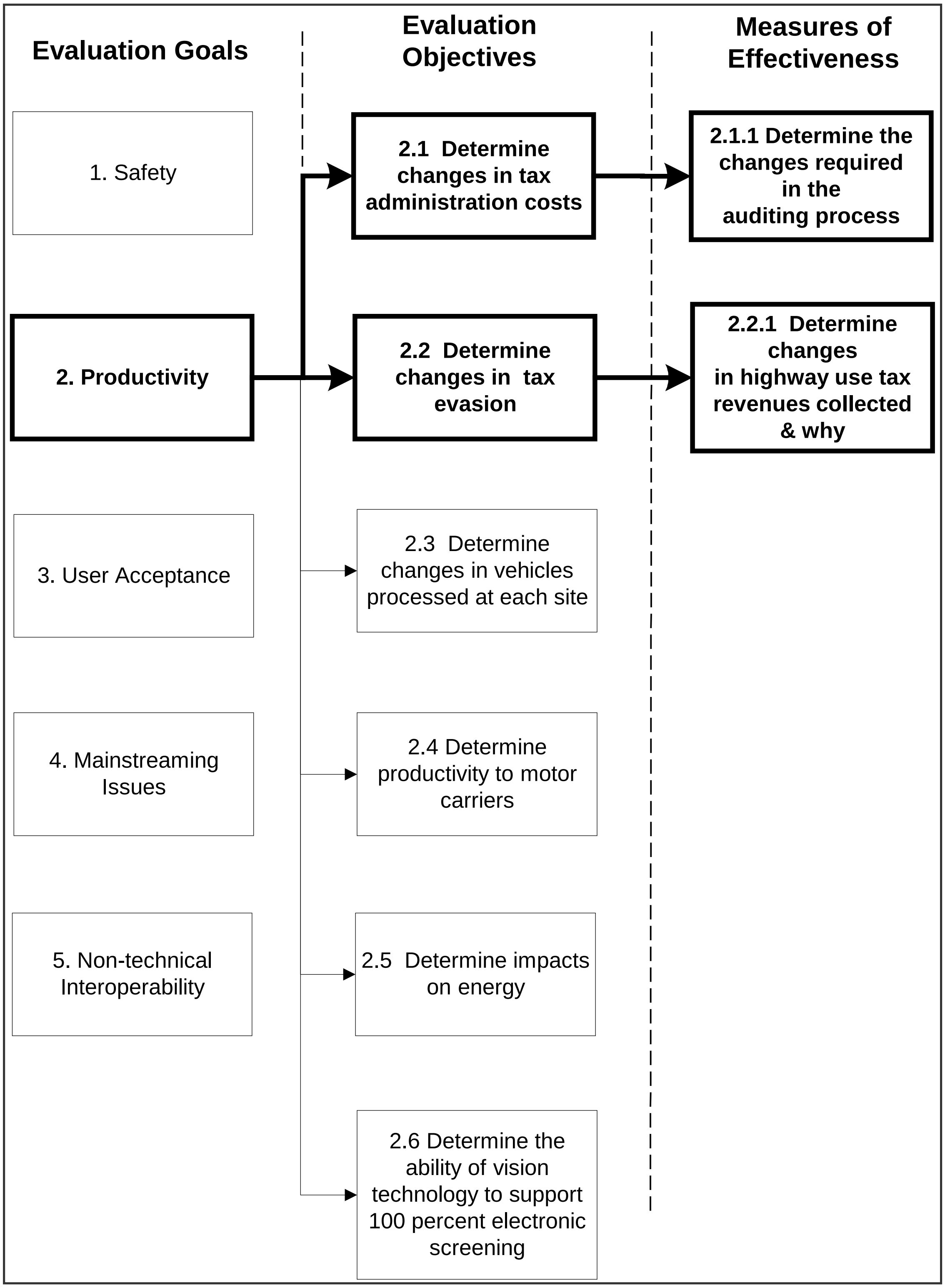
This report represents the findings employed to determine the following evaluation objectives: Determine changes in tax administration costs, and Determine changes in tax evasion; two of the six objectives in support of the goals of assessing productivity . The accompanying Detailed Test Plan for this report is DTP #6.

The evaluation measures used to determine the changes in productivity are stated below:

- Determine changes in the auditing process.
- Determine changes in the highway use tax revenues collected and why.

Exhibit 1-1 describes the relationship among the overall evaluation goals to the evaluation objectives and the measures of effectiveness (MOE) for this evaluation report.

EXHIBIT 1-1 EVALUATION GOALS, OBJECTIVES, AND MEASURES



1.3 DISCUSSION

For the 1993 – 1995 biennium, the cost of administering (including all costs of collection, auditing, and enforcement activities) Oregon's highway use tax collections was estimated to be $21.1 million, or 4.8 percent of revenues collected. The evasion rate was estimated to be five percent of total receipts, equating roughly to $22 million in lost revenue for the same biennium.

In 1993, the Oregon Department of Transportation and the then Oregon Public Utilities Commission drafted a strategic plan for ITS/CVO in Oregon. Included in this plan were a list of specific goals, the second of which was to benefit government through increased efficiency and effectiveness. The resulting Green Light initiative was designed to improve the efficiency of the tax auditing process, as well as the effectiveness of the process in terms of the collection rate. The evaluation report describes the impact that Green Light has had to date on both the efficiency and effectiveness of Oregon's highway use tax collection.

2. TEST METHODOLOGY

2.1 PHYSICAL DESCRIPTION

This section describes the activities that were carried out to meet the evaluation objectives. The purpose of test was to measure any changes in the weight-mile tax auditing process and the impact of Green Light on the process.

The test was designed to measure whether the technologies introduced under Green Light increased the efficiency and effectiveness of the auditing process. To measure this, we examined the auditing process prior to the deployment of Green Light, and re-examined the processes after Green Light deployment.

2.1.1 Purpose and Scope

The first step in determining the changes in the auditing process was to establish a baseline. That is, identify the individual transactions and activities that make up the processes and determine the resources required to execute these activities. A process map was developed to clearly identify these activities for tax auditing. The auditing process was identified through interviews with the Oregon Department of Transportation staff and reviews of budget reports and records.

The second step was to develop a process map of planned modifications to the tax collection and auditing processes that were the result of the introduction of Green Light. The resources required to support each planned activity were identified through interviews with the Oregon Department of Transportation staff and review of budget reports and estimates of future activity costs.

Finally, since it was not entirely clear how Green Light would change the auditing process the research team revisited the process approximately one year after the beginning of Green Light deployment. The process map reflects any changes following the deployment of Green Light.

Any changes in the weight-mile tax collection rate were to be determined by comparing the estimated rate for three fiscal years following implementation of Green Light with baseline estimates. The tax evasion rates stated in the 1996 *Oregon Weight-Mile Tax Study* (Cambridge Systematics, Inc. and SYDEC, Inc. February 1996) served as a baseline measurement.

2.1.2 Hypotheses

The following hypotheses were tested:

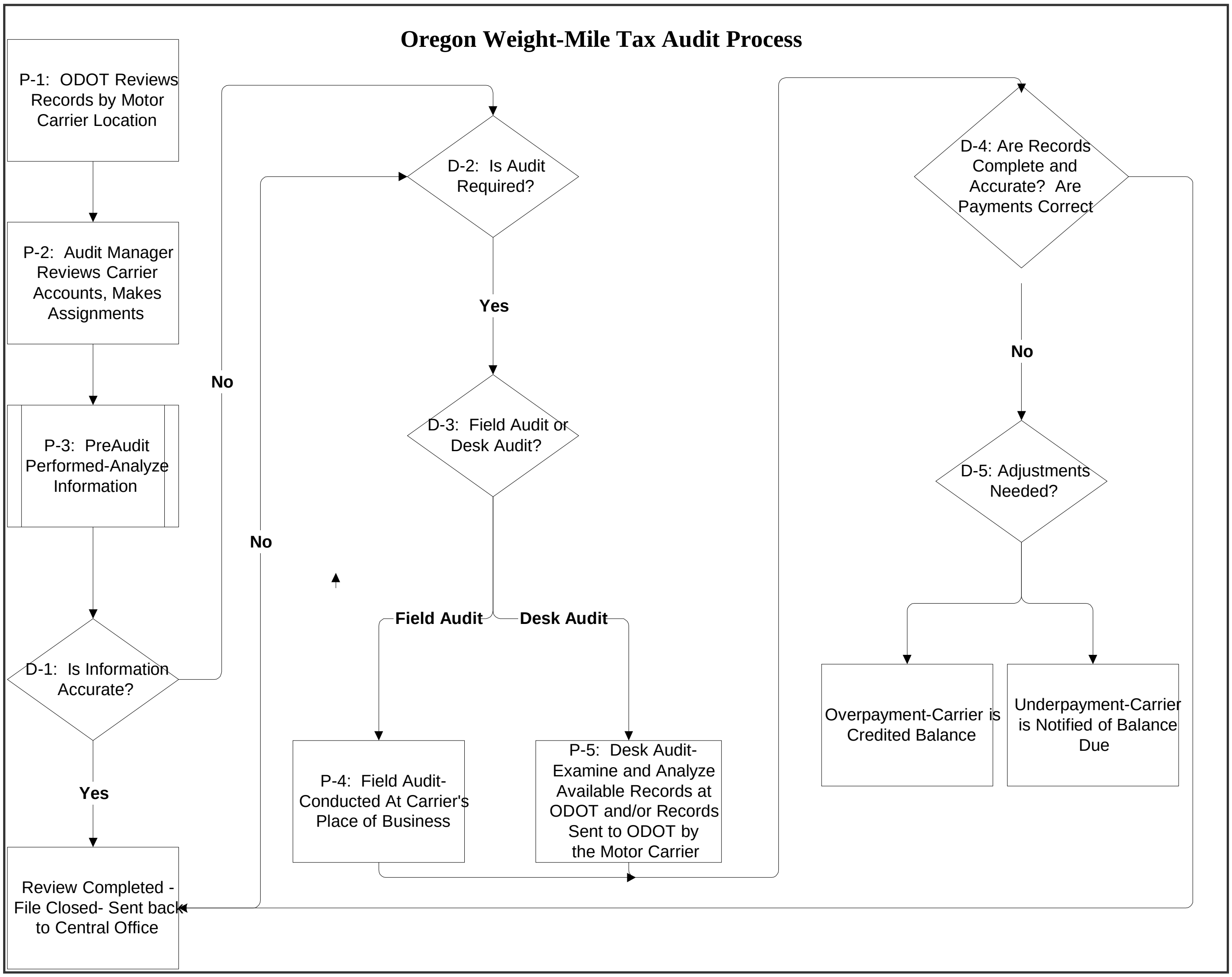
2.1.2.1 The audit process will become more automatic.

2.1.2.2 Oregon Green Light will support changes.

The following report is based on interviews with the staff of the Oregon Motor Carrier Audit Division and a review of ODOT documents. It begins with a review of the motor carrier weight-mile tax audit process, and is followed by a discussion of the effect of Green Light on the auditing process. The report concludes with options for further inquiry.

Exhibit 2-1 describes the weight-mile tax audit process.

EXHIBIT 2-1 OREGON WEIGHT-MILE TAX AUDIT PROCESS



2.1.3 Tax Audit Procedures

The audit procedures, as shown in the above diagram, are as follows:

Process One: The Oregon Department of Transportation's Motor Carrier Audit Manager, annually reviews the records of the motor carrier accounts by general geographic location.

Process Two: The motor carrier records are then arranged by zip codes, and assignments are made by on location. Auditors are assigned to given geographic area. As most carriers are based outside of Oregon (approximately 8,647 of the 23,859 registered carriers are Oregon-based), auditors will travel to other areas of the country, if needed, to conduct the audit.

Process Three: The Pre-Audit Procedure is an initial analysis of the carrier's account information. The accounts are reviewed for errors and discrepancies in their transactions. The pre-audit procedure is described in the Oregon Audit Manual. The pre-audit is conducted using a weighted formula to predict the probability of a substantial recovery. The weighted formula includes five variables; a.) The number of trucks in the fleet; b.) Collection activity; c.) Extended weight, (i.e., operations in excess of 80,000 pounds); d.) Non-reported operations; and e.) Previous audit activities. The formula allows the pre-audit staff to identify those accounts that require greater scrutiny due to either the size or complexity of the account, the history of weight-mile tax discrepancies or obvious discrepancies in the current tax report. Discrepancies such as simple mathematical errors, or some other minor mistakes, may be addressed and corrected via telephone conversation with the carrier officials. The pre-audit consists of comparing the number of miles traveled by the carrier to the amount of weight-mile tax paid by the carrier. The pre-audit also examines any additional permit requests made by the carrier, such as an over-dimensional permit. The pre-audit also obtains records from the weigh stations that indicate which units were weighed at a given weigh station. These weigh station records are then compared to the mileage reports filed by the motor carrier.

Decision One: The pre-audit determines whether the information that is submitted by the motor carrier is complete and accurate. If the account is found to be in order, then the file is sent back to the central office with no further action required. If the account is found not to be in order; if discrepancies and errors are discovered, then further action is required. Examples of some discrepancies are failure by the motor carrier to submit monthly mileage reports, failure to submit quarterly mileage reports, the carrier's mileage reports and Oregon DOT Scale Reports fail to reconcile, mileage rate errors, or overweight operations.

Process Four: If the information in the carrier's file is accurate and complete, the review is complete and the file is sent back to the central office for re-filing. No further action is required on this account.

Decision Two: If the discrepancies in the carrier's mileage reports cannot be readily reconciled, then an audit of the carrier's records is required. The can be one of two types, a Field Audit or a Desk Audit.

Decision Three: A field audit is an audit in which the auditor goes to the carrier's place of business and conducts the audit. A desk audit is one in which the auditor conducts the audit in his or her office. The carrier is requested to submit the necessary records to the auditor.

Process Five: If a desk audit is conducted, the records are reviewed at the auditor's office. The audit is performed by mail, fax, and telephone. This type of audit is usually conducted when it is determined that simple procedural errors occurred in the carrier's report. The audit may determine that the carrier requires some education and technical assistance to reconcile the account. Generally, the carrier is asked to submit a number of records to the auditor. These records may be a sample of the carrier's operations, or it may be a full audit of all operations. Records that can be requested are: drivers' records of duty status (logs), carrier trip reports showing origin and destination, bills of lading, load tickets for shippers, freight bills, and dispatch records, along with the mileage reports.

Process Six: A field audit is required when the carrier's report is found to be complex and requires a more in-depth investigation. The field audit is conducted at the carrier's place of business. The same types of records are examined, but a larger sample of the carrier's operations is reviewed to conduct the audit. Discrepancies that could require a field audit are a large carrier with complex operations, or trips being omitted from the carrier's weight-mile tax filings.

Decision Four: If, during the audit, the records are found to be complete, the review is completed and the file is returned to the central office. If the records are not found to be complete, then adjustments are required to the carrier's tax filings. The carrier may also require assistance and education to complete the tax filing accurately in future.

Decision Five: The adjustments to carrier's tax filing may be in the form of a refund due or the carrier may have to pay the full amount of tax due, based on the auditor's findings.

Process Seven: If it is found that the carrier has overpaid the tax, the carrier is credited the balance. The balance may be credited to the next month's filing, or the Motor Carrier Transportation Division could issue a refund check.

Process Eight: If the carrier has underpaid the tax, the carrier is notified of the balance due, and the carrier must reconcile the amount due. If the carrier disputes the auditor's findings, there are appeals procedures available.

After the auditor completes the audit and writes the report, the audit is sent for billing and the file is returned to the central office.

2.1.4 Preliminary Analysis of the Tax Audit Process

The procedural objective of the Oregon Department of Transportation is to review all motor carriers' weight-mile tax accounts within a three-year cycle. In recent years, other commitments such as meeting the auditing requirements for membership to the International Fuel Tax Administration (IFTA) and the International Registration Plan (IRP) have prevented ODOT's Audit Division from fully meeting this objective. Nevertheless, between 25 percent and 30 percent of accounts are reviewed.

The pre-audit staff consists of eight analysts. For the first six months of Fiscal Year 96-97, the pre-audit staff analyzed 3.5 files per direct labor hour. The average cost per review was $13.01. The goal of the staff is to complete a review of fifty accounts every three days. Between 80 percent and 90 percent of all files reviewed by the pre-audit staff require no further action. These files are returned to records upon completion of the review. Including supervisors, there are 31 field auditors. For the first six months of the '96-'97 biennium, an audit took an average of 32 direct labor hours.

The auditing process was re-examined in 1999 and it has remained essentially unchanged since 1996. Files are arranged and assigned according to location. The auditors must manually and carefully review, analyze, and reconcile the accounts. The average time to audit remains 31.5 hours. It must be stated, however, that Green Light has not been fully deployed at the time of this report.

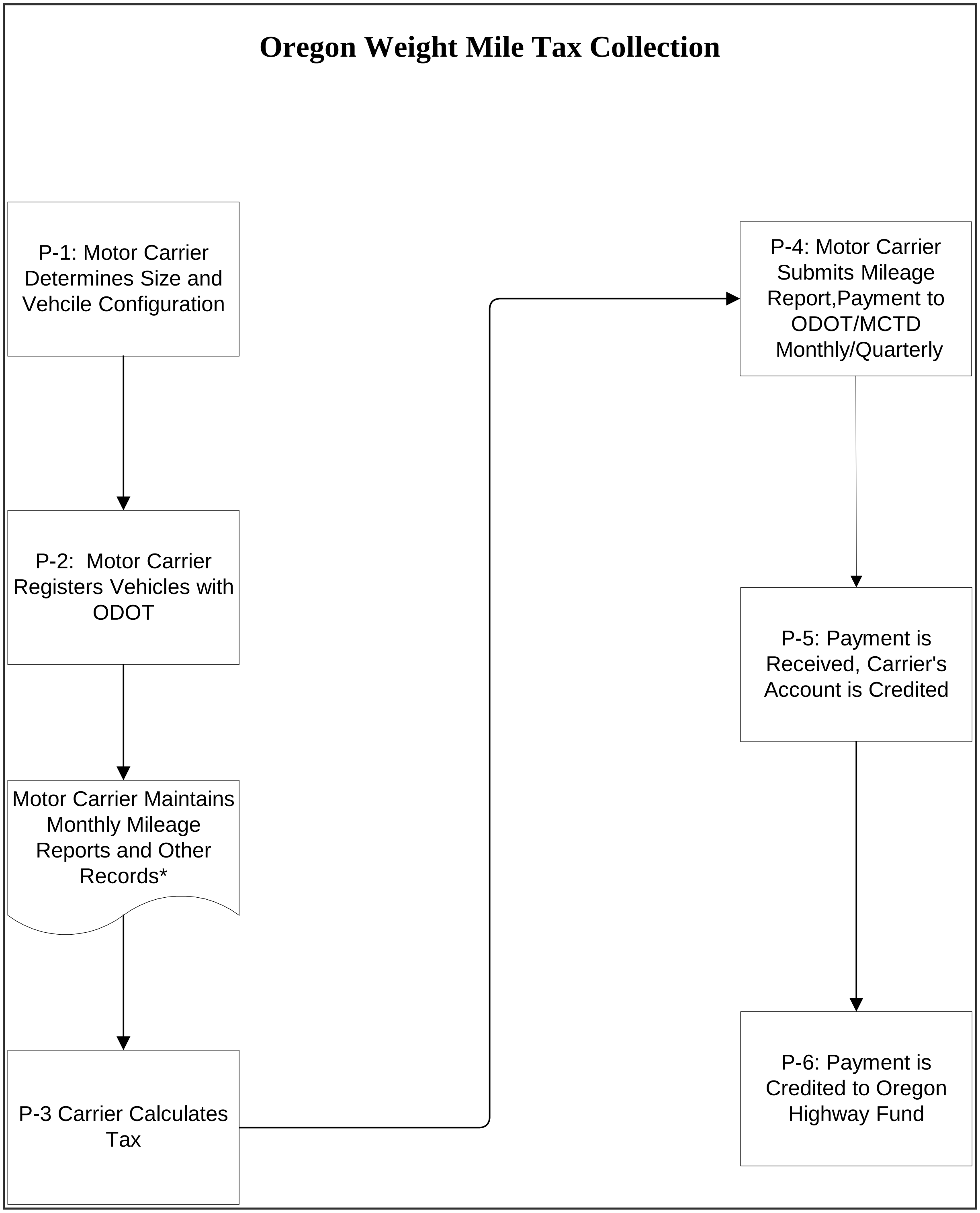
2.2.1 Weight-Mile Tax Collection Procedures

Following the determination of the audit process, the second part of the test was to determine any changes in tax collection. The following measure was examined, as listed in Detailed Test Plan #6:

Determine changes in highway use tax collected and why

The weight-mile tax collection process was first examined in 1996. The following process map describes the weight-mile tax collection process, as it was determined in 1996. The process was re-examined in 1999, and to this point there have been no measurable changes in the collection process

EXHIBIT 2-2 WEIGHT-MILE TAX COLLECTION PROCESS



2.2.1.1 Brief Explanation of Weight-Mile Tax Collection

The Weight-Mile Tax (WMT) in Oregon is a self-reporting tax, which means that the motor carrier determines the amount of tax to be paid to Oregon, based on the miles operated by that carrier, and the declared weight of the vehicles operated by the carrier. The WMT is applicable to vehicles with a declared weight over 26,000 pounds; either solo power units only, or in combination (e.g., tractor-trailer units). Vehicles with declared weights of under 26,000 pounds pay fuel tax at the pump.

2.2.1.2 Collection Procedures

As depicted in the process map on the previous page, the WMT process is as follows:

Process One: The motor carrier determines the size of its fleet, and the configuration of each vehicle that is being operated in the State of Oregon. The motor carrier then makes a declaration to the state of the vehicles' combined weight to be operated in the state. The combined weight is the maximum weight of the vehicle, including its load. Weights are declared in 2,000-pound increments. The tax is then based on the declared weight, plus the amount of miles operated by that vehicle. The carrier must maintain records of each trip operated by that vehicle within the State of Oregon.

Process Two: The motor carrier, whether based in Oregon or outside of Oregon, must register its vehicles that it intends to operate in Oregon with the State of Oregon's Department of Transportation (ODOT). This registration may be done in person, or by mail. ODOT then issues a registration plate for each vehicle registered by the motor carrier.

Records that are to be maintained: The motor carrier must maintain records showing the total miles operated by the vehicle for each month. The records are maintained for each power unit, as well as, any trailer configuration, if the carrier has declared weights for that configuration.

Process Three: The carrier must pay the tax rate applicable to the miles associated with each operation and its declared weight. The tax is compiled based on the amount of Oregon miles operated by the carrier, and each vehicle's declared weight.

Process Four: Depending on the size and extent of the carrier's operations in Oregon, the carrier can submit its reports and payments either monthly or quarterly. The reports are sent to the Motor Carrier Transportation Division of ODOT. These reports show the miles operated by the motor carrier within the State of Oregon. Along with the Highway Use Tax Report, the motor carrier must send the tax payment.

Process Five: Once payment is received, the motor carrier's account is credited with the amount paid.

Process Six: The Weight-Mile Tax is a dedicated tax. All payments made by motor carriers are dedicated to the state's highway fund, less the agency's operating expenses, for improvements, safety enhancements, construction, and maintenance of the highway system.

2.3.1 Test Activities

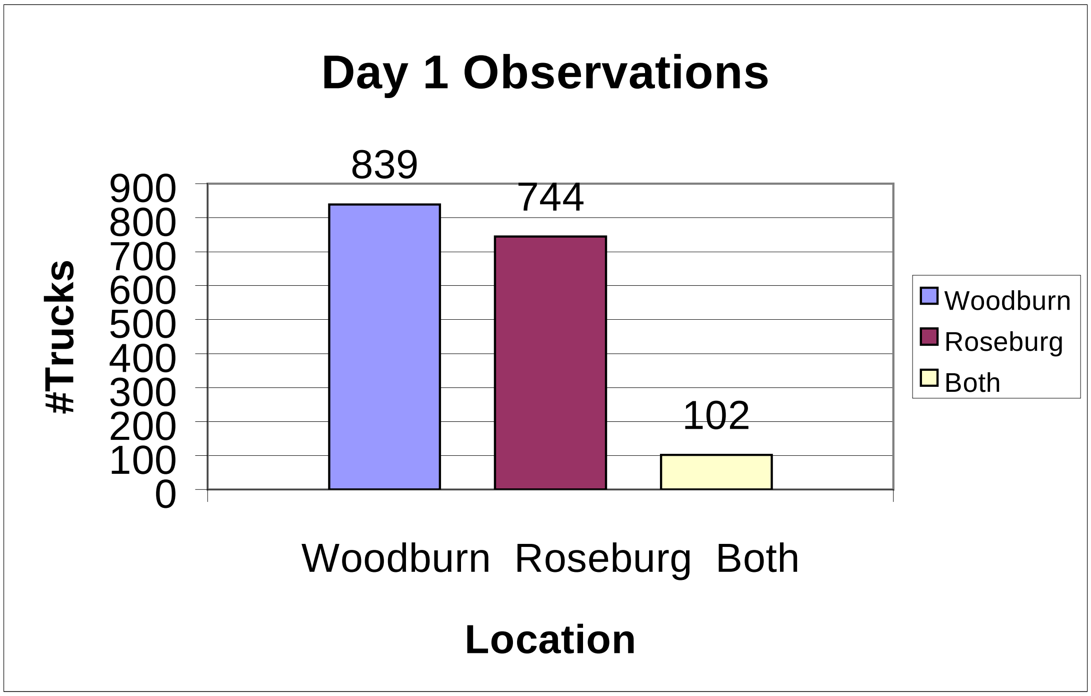
To test the hypotheses that the auditing process would become more automated and the Green Light technology would support those changes, the research team collected field data in 1999 to compare to the baseline data collected earlier.

The field data collection process consisted of recording the plate numbers of the trucks as they passed the Woodburn Port of Entry (P.O.E.), either at the weigh station or on the mainline. A second group of observers recorded the trucks as they entered the Roseburg weigh station located approximately 144 miles to the south of the Woodburn Port of Entry. The recorded plate numbers were then compared and contrasted to determine which trucks passed both stations within the given time frame.

The plate numbers of the trucks that were observed at both weigh stations were then compared to the quarterly tax reports filed with ODOT. This comparison was conducted to determine which of the observed trucks reported at least 144 miles, the distance between the two observation points.

The cursory examination of the tax reports indicated that the trucks had reported at least 144 miles.

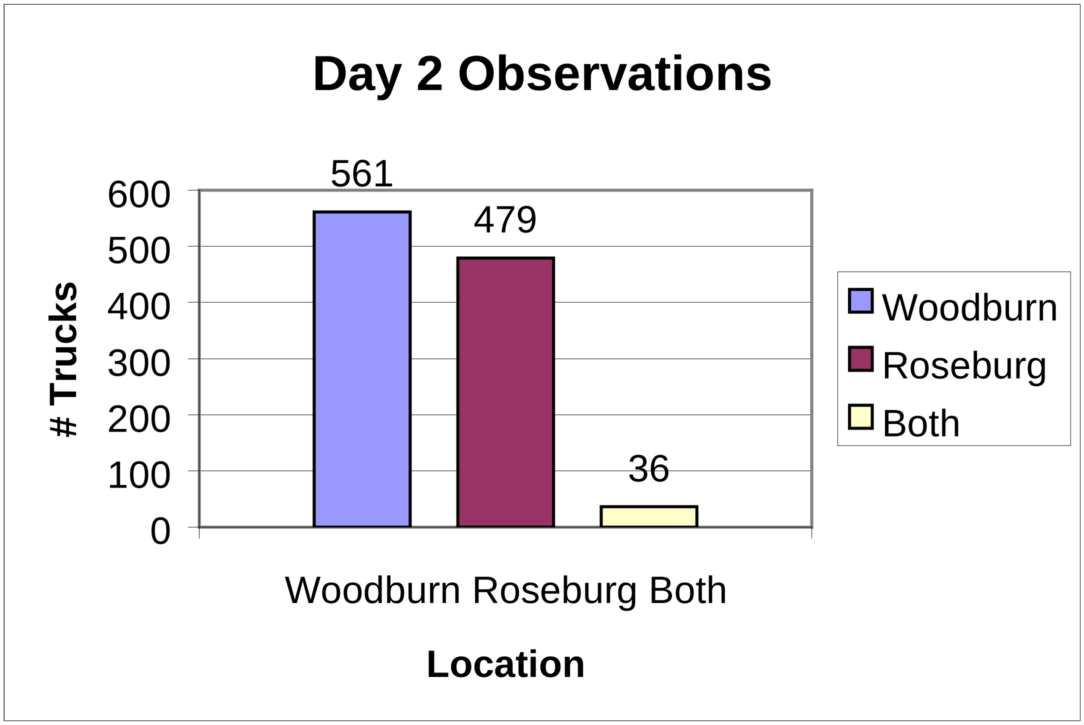
EXHIBIT 2-3 DAY 1 OBSERVATIONS AT WEIGH STATIONS



The graph illustrates the observations made on Day 1 in the fall of 1999. As one can see the graph shows that 839 trucks were observed and recorded at the Woodburn P.O.E. during the data collection period. The next bar shows 744 trucks were observed and recorded at the Roseburg Weigh Station. Finally, after comparing the records of observations, it was determined that 102 trucks passed both weigh stations during the observation period, roughly six percent of the total observations made.

The tax records of the trucks that passed both weigh stations were later examined to determine if at least 144 miles were reported to ODOT. The examination determined that the trucks that were observed at both data collection points had reported at least 144 miles traveled in Oregon for that time period.

EXHIBIT 2-4 DAY 2 OBSERVATIONS AT WEIGH STATIONS



The graph illustrates the observations made on Day 2 in the fall of 1999. As one can see the graph shows that 561 trucks were observed and recorded at the Woodburn P.O.E. during the data collection period. The next bar shows 479 trucks were observed and recorded at the Roseburg Weigh Station. Finally, after comparing the records of observations, it was determined that 36 trucks passed both weigh stations during the observation period, roughly three percent of the total observations made.

The tax records of the trucks that passed both weigh stations were later examined to determine if at least 144 miles were reported. Following an examination of the quarterly tax reports, it was determined that these trucks that were observed at both data collection points had reported at least 144 miles traveled in Oregon for that time period.

EXHIBIT 2-5 MILES REPORTED TABLE

Tax Records of Trucks Observed at Both Scales	At Least 144 Miles Reported in Quarter
Day 1	Yes
Day 2	Yes

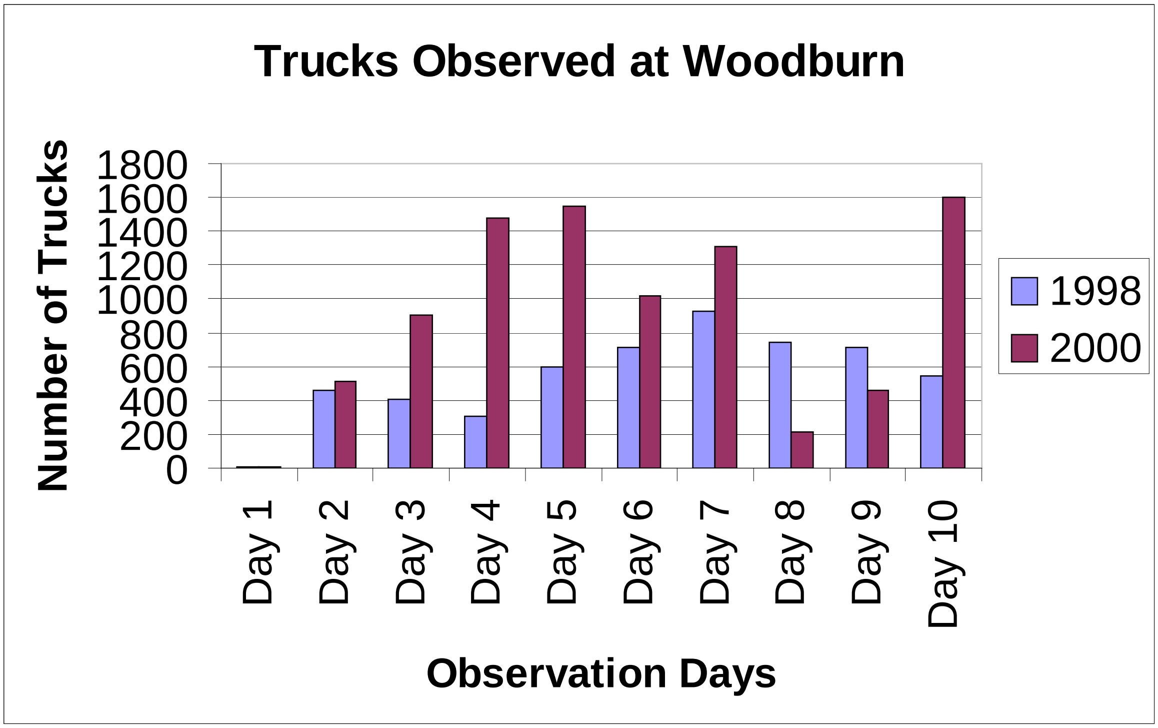
Exhibit 2-6 indicates that the 138 trucks that were observed at both of the Woodburn and Roseburg weigh stations had reported at least 144 miles traveled in Oregon during the observation period.

2.3.2 Study Constraints

Granted, this is a very small sample. Generally, 138 observations are not statistically significant within an infinite population. Time constraints prevented the research team from more completely expanding the sample. It must be emphasized, however, that at the time of this report, Green Light has not been fully deployed. At the time of the data collection, in October of 1999 only approximately 3,000 transponders had been issued. Since that time, however, Oregon DOT has issued approximately 6,500 additional transponders. Therefore, it is recommended that the effects Green Light be analyzed again a year from now when more transponder-equipped vehicles are in service and a larger sample can be examined.

Based on this small sample, however, the data indicate that the observed trucks, observed electronically or otherwise, are likely to report their miles operated in Oregon to ODOT.

EXHIBIT 2-6 VEHICLE INCREASES AT WOODBURN



2.3.3 Truck Volume Increases

The above graph illustrates the increases in the number of trucks passing through the Woodburn P.O.E. during a ten-day observation period. The number of trucks that were observed during the ten days in January of 2000 were then compared to the same ten-day period in 1998. The trend shows a general increase in the number of trucks passing through the Woodburn P.O.E. The most recent traffic data available to the Oregon Department of Transportation's planning office indicate that truck traffic in the vicinity of Woodburn on the south bound lane of Interstate 5 is currently growing at an annual rate of 2.6 percent. If the trend continues, the need for electronic screening will also increase in order to screen more trucks more efficiently. As we indicated in the weigh station simulation report, an average of 270 vehicles (trucks) per hour were observed passing through the southbound Woodburn P.O.E. Assuming that the traffic growth rate remains constant, 340 vph would be realized in the year 2003, 375 vph in 2010, and 410 vph in 2013.

3. FINDINGS

The impact of Green Light increases the capacity of a weigh station to observe motor carriers' operations. For each truck that uses a transponder, a space is created in the weigh station queue. Assuming that the Oregon Department of Transportation (ODOT) maintains the volume of traffic currently processed through the static scales, the total number of observations will increase equal to the rate of growth in transponder-equipped trucks. For trucks that have transponders, observations will be recorded at every pass by the weigh station. For trucks without transponders, the likelihood of having to stop at the static scale, thus being observed will increase.

Observations or third party data are an integral part of the weight-mile tax auditing process. Weight-mile tax reports are generated by the motor carrier on a monthly or quarterly basis. Reported trips are compared to observations within the state. Observations are currently made at the weigh station through vehicle weighing, safety inspections, and traffic citations. Weigh station observations are by far the most prevalent observations.

The use of Green Light technology will increase the number of weigh station observations. The increase in the number of observations will allow the audit unit to more effectively select motor carriers for audit. By having more observations, there is a greater chance of detecting unreported trips. Additional observations will also improve the accuracy of motor carrier audits. The additional information will allow the field auditors to more precisely and assuredly estimate a vehicle's pattern of operation with the boundaries of Oregon.

Observations will also serve as a deterrent to weight-mile tax evasion. Motor carriers that have been audited in the past, or have learned from other's experiences, are quite conscious of the fact that weigh station observations are used by ODOT to verify weight-mile tax reports. In reviewing drivers' records of duty status against tax reports and weigh station observations, it has been observed that drivers will note those trips in which their vehicles have been weighed and report those trips.

Although Oregon Green Light will lead to an increase in the number of observations that will, in turn, result in improved accuracy, and, allows for a better selection of files to be audited, however, it will have little effect on the process of auditing.

The auditing process nonetheless calls for manual review of all files by the Pre-audit staff. A few lines of additional data might add a few seconds to the pre-audit staff review. Conversely, the additional data might allow the pre-audit staff to more quickly identify unreported operations, flag the files for audit, and move along to the next file. If either or both scenarios prove to be correct, the effect on the efficiency of the pre-audit process, measured in the amount of resources that it takes to review a file, will be negligible.

Field auditors use weigh station observations to piece together a vehicle's pattern of operation within Oregon. Because weigh station observations are more easily accessed than motor carrier records, the time that it takes to conduct an audit might be shortened. However, unless a truck is observed in several locations on all trips, review of data from a variety of sources will continue to be the norm. The effect that electronic clearance will have on the efficiency of the desk and field audit processes, measured in the amount of resources that it takes to conduct a desk or field audit, will be negligible.

With regard to tax collection, the “Oregon Weight-Mile Tax Study” of 1996 concluded that the “evasion rate of the weight miles tax is approximately five percent of the total tax liability, or ten million dollars per year." Although the amount of revenue lost to evasion each year is quite significant, it is only a small portion of motor carriers are actually submitting incomplete or inaccurate tax reports. [1] To meet the objectives set forth in Measure 2.2.1 “Determine the changes in highway use tax and why”, the study team focused on the effect that Oregon Green Light technology has on the behavior of these motor carriers and the ability of the audit branch to detect and adjust inaccurate and/or incomplete tax reports. For example, the Woodburn Port of Entry currently allows all vehicles that weigh less than 62,000 lbs. on the ramp weigh in motion scale to take the ramp bypass lane and thus avoid direct observation. Consistently, 60 percent of trucks that pass through Port of Entry are not directly observed. Assuming that the number of transponder-equipped vehicles increases as is expected, a substantial percentage of trucks will be checked electronically on the mainline and the static scales will no longer be operating at or near capacity. The weigh station will then be able to lower the threshold weight of the ramp bypass and pull in a higher percentage of non-transponder equipped trucks for static scale weighing and observation.

According to Motor Carrier Auditors, motor carriers are quite cognizant of the fact that the audit branch uses weigh station observations. For those motor carriers that are tempted to report only those trips in which they are observed, the additional observations will serve as a direct deterrent resulting in greater tax receipts per registered motor carrier.

[1] Oregon Weight Mile Tax Study (Cambridge Systematics, Inc., Sydec Inc., and Pacific Rim Resources, Inc. February 20th, 1996.)

Deterrence alone will not eliminate tax evasion. As one auditor stated during the group interviews, “Tax evasion is more often an act of omission than an act of commission.” Poor record keeping and/or a lack of understanding of reporting procedure results in inaccurate or inadequate tax filings. The increase in the number of observations resulting from the introduction of electronic clearance will allow the pre-audit team to detect and adjust inaccurate and/or incomplete tax reports. By having more observations, there is a greater chance of catching unreported trips in both in pre-audit and field audit. While Green Light will provide more observations to assist auditors, this analysis did not determine significant changes in the processes.

Oregon Green Light

CVO Evaluation

FINAL REPORT

DETAILED TEST PLANS 7 and 9

Simulating the Impact of Electronic Screening on Travel Time, Fuel Consumption and Weigh Station Efficiency

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The authors are indebted to the personnel of ODOT's Motor Carrier Transportation Division, who have provided information and data to the evaluation team throughout the project. We are particularly indebted to Ken Evert, Gregg Dal Ponte, Randal Thomas and David Fifer. Ken's untimely death in 1998 meant that he did not see his vision completed. The evaluation team is forever indebted to him for his support and for the opportunity to participate in the deployment.

DISCLAIMER

The contents of this report reflect the views of the authors who are solely responsible for the facts and accuracy of the material presented. The contents do not necessarily reflect the official views of the Oregon Department of Transportation or the Federal Highway Administration. The report does not constitute a standard, specification or regulation. The Oregon Department of Transportation does not endorse products or manufacturers. Trademarks or manufacturer names appear herein only because they are considered essential to the subject of this document.

PREFACE

This is the combined final report for Detailed Test #7, System Simulation and Detailed Test #9, Fuel Test. Because the methodologies for these two test plans are closely related, it was appropriate to describe the effort and document the findings in a single report.

This report follows the outline provided in Exhibit 3-4 on page 31 of the Oregon Green Light Evaluation Plan (*Document Gleval -96.01)*. Chapter I, Introduction, places the report in the context of the overall evaluation, summarizes the role of electronic screening at weigh stations, and briefly introduces the evaluation methodology. Chapter II, Individual Test Summary includes a description of the field data collection at the Woodburn Port of Entry and the development and validation of the simulation models. Chapter III, Overall Evaluation Results, presents the output of the simulation model for selected scenarios. Chapter IV, Conclusions and Recommendations summarizes the findings and recommends additional applications of the simulation models.

Appendix One contains the field data collection forms. Appendix Two is a narrative description of the challenges faced in developing a weigh station model using CORSIM traffic simulation software. Appendix Three is the user's manual for the weigh station model developed in Arena. The User's Manual was given to the Oregon Department of Transportation along with a user's version of the model. Appendix Four contains the findings of 12 simulation runs in table format.

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EXECUTIVE SUMMARY

The objective of this portion of the Oregon Green Light evaluation is to quantify the benefits of electronic screening in terms of travel time and fuel consumption savings for motor carriers and improved efficiency of the weigh station. Because the evaluation was conducted concurrently with the deployment of the technology, it was not practical to measure the actual impact of electronic screening. Simulation was selected as the means for meeting the evaluation objective.

Computer simulation is a powerful technique for testing the impact of changes in systems where the effect of such changes cannot be determined analytically. Simulation models are distinctly different from analytical models. Simulation models are "run" where analytical models are "solved". Where analytical models are often used to prove or disprove relationships among variables based on empirical evidence, simulation models are used to explore and prepare for theoretical future events based on observed system dynamics. The comparison of the field data with the model's outputs establishes a level of confidence that the model is capable of simulating the existing conditions of the weigh station. The confidence in the simulation model yields a similar level of confidence in the model outputs obtained under the electronic screening strategy. In other words, once it has been established that the model replicates the dynamics of the actual system with an acceptable level of confidence, it can be used to analyze operating procedures, decision rules, and changes in physical layout without disrupting ongoing operations.

Simulation models are thus an appropriate tool for traffic analysis, such as that required in the evaluation of electronic screening at a weigh station, in which field experiments would be impractical. Using simulation software, it is possible to compare and contrast different operational scenarios. The animation features of the simulation make it possible to illustrate the functionality of the weigh station and electronic screening to a broad audience.

The Woodburn Port of Entry (Woodburn) is the focus of this evaluation. Woodburn, which is located 20 miles south of Portland on Interstate 5, is the busiest weigh station in Oregon. According to the 1998 Annual Summary for Motor Carrier Services, 887,780 vehicles entered the Port of Entry. The Woodburn Port of Entry is also significant in that it is the first weigh station in Oregon to complete installation of an electronic screening system.

Two simulation models were used in combination to measure the effectiveness of electronic screening at the Woodburn Port of Entry. Measures of effectiveness include the number of unobserved bypasses, travel time-savings for electronically screened vehicles, percent of vehicles screened both electronically and manually, and changes in fuel consumption. The first of the two weigh station simulation models was developed using Arena simulation software. The model calculates the number of trucks forced to bypass a weigh station due to a full queue (unobserved bypasses), determines the percent of the overall southbound truck traffic screened both electronically and manually, and determines the travel time saved when compliant trucks are screened electronically at mainline speed. A second simulation model was developed using CORSIM, a traffic simulation software. It was used in combination with Arena to predict fuel consumption.

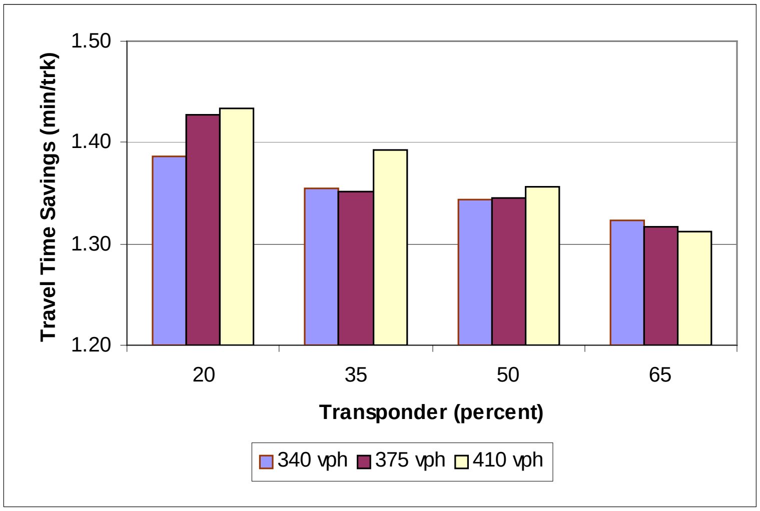
The simulation findings indicate that electronic screening will reduce travel time and fuel consumption for trucks participating in the electronic screening programs, or transponder equipped trucks. Findings also indicate that electronic screening will also decrease the occurrence of unobserved bypasses resulting from full queues and increase the percentage of trucks being screened for safety and compliance. The effectiveness of electronic screening will be situational. Several variables, including truck traffic volumes at the weigh station, the percentage of motor carriers participating in the electronic screening program, and Oregon's commercial vehicle enforcement policies and procedures will determine the degree to which the electronic screening program meets its objectives.

To better understand the future impact of electronic screening, the simulation models were used to compare and contrast several scenarios, each with a different combination of truck volumes and transponder rates (the transponder rate is defined as the percentage of truck traffic participating in the Oregon Green Light program or, in other words, the percentage of trucks equipped with a transponder). Once it was verified that base simulation model replicated the actual system at an acceptable level of confidence, simulation runs were conducted for vehicle per hour (vph) rates of 340, 375, and 410. To put this in context, the data collection crew observed an average of 270 vehicles (trucks) per hour in May of 1997. The most recent traffic data available to the Oregon Department of Transportation's planning office indicate that truck traffic in the vicinity of Woodburn on the south bound lane of Interstate 5 is growing at an annual rate of 2.6 percent. Assuming that traffic growth rate remains constant, 340 vph would be realized in the year 2003, 375 vph in 2010 and 410 vph in 2013. The Oregon DOT’s planning office recently made projections that truck traffic may be increasing at a more rapid rate of seven percent annually. At a seven percent annual growth rate in truck traffic, the vehicles per hour rate at Woodburn would be 403 vph in 2003, 644 vph in 2010 and 788 vph in 2013. The model, however, was run using the more conservative projections.

For each truck traffic volume scenario, simulation runs were made with transponder rates of 20 percent, 35 percent, 50 percent, and 65 percent. The simulation output is included in table format as Appendix Four.

Travel Time

The following bar chart summarizes time-savings for bypass vehicles in each scenario. For all scenarios, time-savings for electronically screened vehicles fell within a range of 1.43 minutes at 410 vehicles per hour and a 20 percent transponder rate to 1.31 minutes at 410 vehicles per hour and a 65 percent transponder rate.



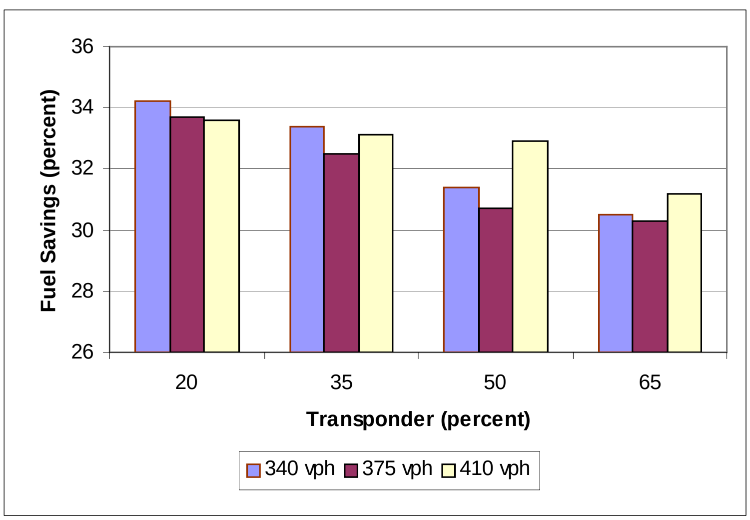
Reduced travel time is an incentive for trucks to participate in an electronic screening program. There is no singularly accepted estimate for the value of travel time saved for commercial vehicles. If one accepts the estimate put forth by Waters, Wong, and Meagle (7), the value of time saved for motor carriers, in 1998 dollars, is $34.00 per hour. The value of one pass for an electronically screened vehicle at the Woodburn weigh station in the scenarios examined, would range from $.74 to $.81.

Electronic screening improves the efficiency of the entire Port of Entry system. Even trucks that do not participate in the screening program stand to benefit. As more vehicles are electronically screened on the mainline, the queue and therefore the delay within the weigh station subsides. The cumulative time savings for all commercial vehicles will be quite significant. Using the 340 vehicles per hour scenario as an example, the cumulative time savings for all trucks passing the weigh station within any given hour, ranges from 1 hour and forty two minutes with the transponder rate at 20 percent, to five hours and twenty three minutes with the transponder rate at 65 percent.

Fuel Consumption

The CORSIM simulation model is used to predict the fuel consumption at Woodburn. For the scenarios selected, the CORSIM weigh station model indicates that electronic screening systems reduce relative fuel consumption for the electronically screened vehicles.

The fuel consumption values drawn from the CORSIM simulation model were reported in relative terms. The relative fuel savings for the twelve scenarios that were simulated, are illustrated on the following bar chart.

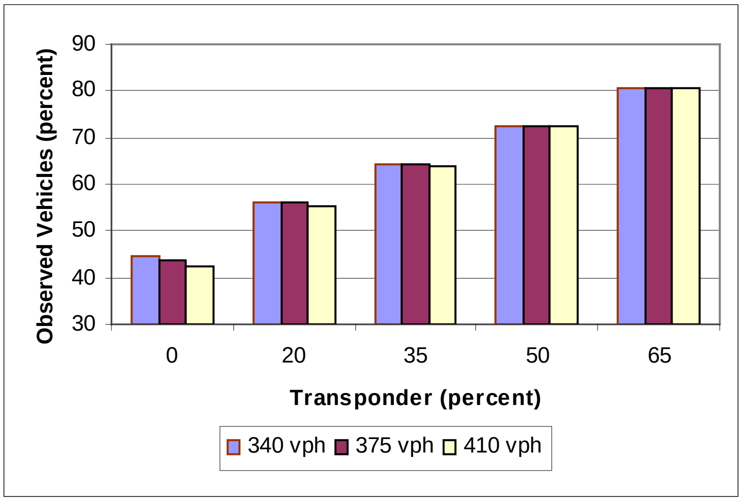


In the CORSIM model, the mainline and weigh station segments have common beginning and ending points. The fuel savings are reported in terms of percentage of fuel saved from the beginning point to the end point for a truck remaining on the mainline as compared to a truck of equal dimensions passing through the weigh station. For example, the first bar on the chart shows that an electronically screened truck in the scenario in which there are 340 vehicles per hour and 20 percent of the vehicles are equipped with transponders, uses 35% less fuel within the segment.

Percentage of Commercial Vehicles Screened -Electronically and Manually

Currently, as trucks enter the Woodburn Port of Entry, they pass over a slow speed weigh in motion scale. Based on a predetermined weight threshold (i.e. 75% of the legal limit), trucks are automatically sorted and directed to, either continue along the bypass lane and return to the mainline, or proceed to one of the two static scales. The trucks that stop at the static scales can be visually checked for obvious safety problems. Commercial vehicle enforcement personnel can also identify the vehicle by plate number and check compliance and safety records.

With the slow speed ramp WIM, all entering trucks are at least screened for weight. By diverting a portion of the truck traffic away from the static scales, congestion within the Port of Entry is minimized. However, from an enforcement perspective, a static scale weighing



is of greater value as it allows for weight, safety and regulatory compliance checks. With the exception of the visual inspection, mainline electronic screening is similar to the static scale or manual screening as it allows for weight, safety, and regulatory compliance checks. The simulation model was used to predict the percentage of overall truck traffic that would be either electronically screened on the mainline or stopped at the static scale.

With a sufficient percentage of vehicles participating in Oregon's electronic screening program, the Woodburn Port of Entry will be able to process, (i.e. screen vehicles, both electronically and manually for safety, regulatory compliance, and weight) a substantially higher percentage of the truck traffic. By increasing capacity, electronic screening extends the design life of the facility.

Unobserved Bypasses

Unobserved bypasses are most often the direct result of commercial vehicle traffic exceeding the capacity of the Port of Entry. When the Port of Entry reaches capacity and the queue begins to spill out onto the mainline, the commercial vehicle enforcement officers temporarily close both the static scales and the ramp weigh-in-motion scale and direct additional commercial vehicles to entirely bypass the Port of Entry. The facility remains closed until the queue subsides. Because electronic screening diminishes the queue within the weigh station, as participation in the electronic screening program increases, the number of unobserved bypasses will decrease.

Commercial vehicle enforcement personnel consider the elimination of unobserved bypasses a major benefit of electronic screening. Because it is the objective of the Oregon Department of Transportation to weigh all vehicles that pass by the Woodburn Port of Entry, a one percent unobserved bypass rate is not acceptable. As the following table illustrates, with sufficient transponder rates, the occurrence of unobserved bypasses that are the direct result of lack of storage capacity within the Port of Entry will be eliminated. It should be noted, however, that congestion within the Port of Entry is not always the result of lack of capacity. Electronic screening will not resolve congestion that results from an incident within the queue or at the scale house.

Unobserved Bypasses %	340 Vehicles Per Hour	375 Vehicles Per Hour	410 Vehicles Per Hour
@ 0% Transponder Rate	1	3	6
@ 20% Transponder Rate	0	0	2
@ 35% Transponder Rate	0	0	1
@ 50% Transponder Rate	0	0	0
@ 65% Transponder Rate	0	0	0

The table reflects the output of the weigh station simulation model. It is the predicted performance of the Woodburn Port of Entry under 15 different scenarios. The third column, for example, shows the percentage of vehicles that would bypass unobserved with the truck traffic volume at 410 vehicles per hour. With no transponders, the model predicts that 6% of the overall truck traffic would be allowed to bypass unobserved as a direct result of a full queue. With 20% of the trucks equipped with transponders, the queue would be diminished to the point where only 2% of the overall truck traffic would be allowed to bypass unobserved as a result of a full queue. If the transponder rates were to reach 50%, the model predicts that unobserved bypasses that could be attributed to lack of capacity would be eliminated.

1. INTRODUCTION

The Oregon Department of Transportation (ODOT) is in the process of implementing the state's Intelligent Transportation System for Commercial Vehicle Operations (ITS/CVO) plan. Through the Green Light project, Oregon is installing 22 mainline preclearance systems featuring weigh-in-motion (WIM) scales and automatic vehicle identification (AVI) at the major weigh stations and ports-of-entry throughout the state. As part of the evaluation component of the Green Light project, a series of detailed test plans were developed. These test plans document the objectives as well as the procedures and methodologies of the evaluation.

This report outlines the data collection activities, methodology and findings for the Detailed Test Plan #7, System Simulation, which includes performance measures;
Predict total vehicles processed.
Predict number and length of service interruptions
Predict average travel time savings by vehicle.

and Detailed Test Plan #9 Fuel Test, which includes performance measure;
Estimate changes in fuel use.

These are four of the nine measures of effectiveness that make up evaluation goal #2; Assessment of Efficiency.

The objective of this portion of the evaluation was to quantify the benefits of electronic screening realized by participating motor carriers in terms of travel time and fuel consumption savings and by the state realized through the improved efficiency of the weigh station. Because the evaluation was conducted concurrently with the deployment of the technology, it was not practical to measure the actual impact of electronic screening. Simulation was selected as a means to meet the evaluation objective.

The impact of electronic screening will be affected by several variables, including truck traffic volumes at the weigh station, the percentage of motor carriers participating in the electronic screening program, and Oregon’s commercial vehicle enforcement policies and procedures. Using simulation models of the weigh station, it is possible to compare and contrast different operational scenarios. In addition, the animation feature of one of the two simulation software programs used in this evaluation makes it possible to illustrate the functionality of the weigh station and electronic screening to a broader audience.

The Woodburn Port of Entry (Woodburn), located thirty-five miles south of Portland on Interstate 5, is the focus of this evaluation. Woodburn is the busiest weigh station in Oregon, and was the first to complete installation of an electronic screening system.

Two simulation models were used in combination to measure the impact of electronic screening for a set of 12 scenarios. Each scenario has a different combination of assumptions regarding transponder usage rates and overall traffic volume. The first weigh station model, developed using Arena simulation software, was used to predict the number of trucks forced to bypass a weigh station due to a full queue (unobserved bypasses) and determines the travel time saved when compliant trucks are screened electronically at mainline speed.

Because Arena is not a simulation software specifically designed for traffic engineering, by itself it was not capable of predicting fuel savings resulting from electronic screening. CORSIM, perhaps the most widely used traffic simulation software in the United States, is capable of measuring fuel consumption. However, CORSIM does not allow for dynamic assignment of vehicle characteristics, which is necessary for simulating the process of electronic screening. Both models were used in combination to take advantage of Arena's dynamic assignment capabilities and CORSIM's ability to simulate fuel usage.

This report documents the application of the simulation models at the Woodburn weigh station. The simulation results indicate that electronic screening would substantially reduce travel time, and fuel consumption for motor carries, increase the percentage of vehicles being screened, and reduce the number of unobserved bypasses. One of the advantages of simulation is that it allows for the analysis of hypothetical scenarios. Each of these performance measures can be predicted for a variety of scenarios, assuming different growth rates in truck traffic and/or transponder usage. This study concludes that electronic screening is a feasible option for increasing capacity of the weigh station without expanding the physical infrastructure

Along with this written report, the Oregon Department of Transportation was furnished a copy of the weigh station model developed in Arena, one of the two computer simulation models used in the evaluation. With the model, the Oregon Department of Transportation staff is able to modify the input parameters (traffic levels, motor carrier participation levels) and observe the effect of electronic screening on weigh station efficiency and travel time savings.

2. INDIVIDUAL TEST SUMMARY

2.1 FIELD DATA COLLECTION

Field data were collected at the Woodburn Port of Entry in preparation for the development of the simulation models. The models are based on the existing throughput activity and geometry of the weigh station. Once the simulation models were developed, the field data were also used for validation, or to ensure the functionality of the models was not significantly different than the functionality of the weigh station. This chapter describes the data collection procedures and functionality of the weigh station as observed by the data collection crew

2.1.2 Observed Functionality of the Weigh Station

In May of 1997, the data collection crew observed throughput truck volumes averaging 270 trucks per hour during peak periods. All approaching vehicles weighing over 20,000 pounds must enter the weigh station. When the weigh station reaches capacity and the truck queue begins to extend out into the mainline, a "closed" sign is illuminated upstream from the weigh station. All trucks are then allowed to bypass the weigh station until the queue subsides.

As trucks enter the weigh station they pass over a slow speed weigh-in-motion (WIM) scale. The truck’s weight and axle spacings are recorded. Based on a predetermined weight threshold (i.e., 75 percent of the legal limit), trucks are automatically sorted and directed to either continue along the bypass lane and return to the mainline or proceed to one of two static scales for a more precise weighing and visual inspection. Overhead directional arrows are used to signal drivers to the appropriate lane.

2.1.3 Data Collection Procedures

The traffic data collection was conducted at the Woodburn weigh station on May 5, 1997, to determine the following parameters:
Traffic volume and truck percentage on each mainline lane
Number of unobserved bypasses, (trucks bypassing the weigh station due to a full queue)
Average travel time between designated points inside the weigh station
Truck counts at the weigh station entrance, ramp bypass lane, and static scales

Duration of each truck's stop on the static scale platform (i.e., service time)

The data collection crew consisted of 11 individuals. The crew was made up of students and staff from Oregon State University and staff from the Iowa State University's Center for Transportation Research and Education. Data were collected from five points. Four of the points were inside the weigh station and the fifth was on an overpass, approximately 200 feet upstream of the weigh station entrance and in view of the mainline. Each data collection point had both an observer and a recorder. The data collection points are shown in Figure 1. Points one through four are located at the weigh station's entrance ramp, ramp WIM sorter, static scales, and the ramp back to the mainline, respectively.

With a ramp bypass lane and two static scales, one on each side of the scale house, trucks follow one of three possible routes through the weigh station. The objective of the data collection was to capture the throughput routes and point to point movements during both morning and afternoon peak periods and a non-peak period of early afternoon. A total of six hours of data were collected in three two-hour sessions. Data collection sessions were carefully synchronized using stopwatches and two-way radios. Sample data collection forms are included in Appendix One.

The similarities between traffic movements through an unsignalized intersection and truck traffic movements at a static scale weigh station led to the use of a data collection method suggested for delay study at an unsignalized intersection. In this method, total delay at the intersection is defined as "...the total elapsed time from when a vehicle joins the queue until the vehicle departs from the stopped position at the head of the queue." (1, p.2-9) The same method was used to measure total delay and average travel time between designated points inside the weigh station.

Upon completion of the data collection, each truck's plate number and arrival times at each observation point were entered into a database back at the CTRE office. Concurrent data collection made it possible to determine the travel time for each truck between the designated points inside the weigh station simply by matching plate numbers in the database system. The database also makes it possible to determine the routes of each truck. There were three routes of interest;

> Truck enters weigh station, follows directional arrow to static scale #1, exits weigh station.

Truck enters weigh station, follows directional arrow to static scale #2, exits weigh station.

Truck enters weigh station, is directed to bypass static scales and exits weigh station.

By identifying the points at which each truck is observed, it is possible to trace its route.

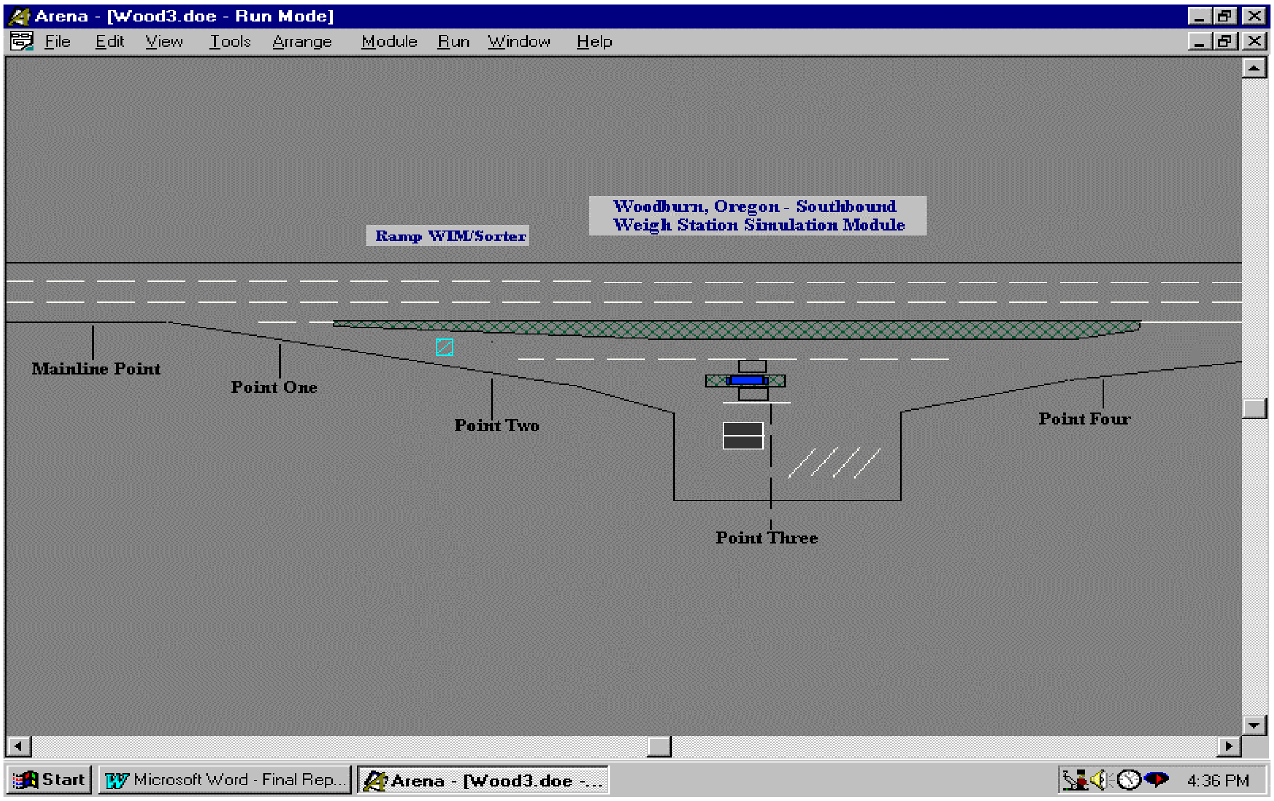


Figure 1. Data Collection Points at the Woodburn Port of Entry

Mainline traffic counts were conducted from an overpass located directly above the deceleration lane upstream from the weigh station entrance. Car and truck traffic volumes were collected for each of the three mainline lanes. Using plate numbers as identifiers, truck arrival times were recorded at each of the data collection points within the weigh station. The data collection team members located at the two static scales recorded both arrival and departure times of each truck. A third individual was stationed at point one to observe and record unobserved bypasses.

The time difference between the arrival and departure of trucks at the two static scales (points 3a and 3b) is referred to as static scale service time. Moreover, the time difference between the truck arrival time at point two and its departure time at point three is referred to as total delay at static scales. This is the total time elapsed from when the truck starts to slow down (point 2) to join the queue leading to static scales until it departs the scale platform (point 3).

The truck traffic volume, traffic counts at designated points throughout the weigh station, and service times are incorporated in the models to simulate traffic operations at the Woodburn weigh station. The other parameters, such as static scale total delay (d_{23}) as well as travel times between points one to two (d_{12}), one to four (d_{14}) and three to four (d_{34}) and the percent of unobserved bypasses, are used in validation processes. The observed travel times are compared to the models' results to establish a level of confidence in the models.

2.2 METHODOLOGY: SIMULATION MODEL DEVELOPMENT FOR DETAILED TEST #7

Computer simulation is a powerful technique for testing the impact of changes in systems where the effect of such changes cannot be determined analytically (2). It is an appropriate tool for traffic analysis, such as that required in the evaluation of electronic screening at a weigh station, in which field experiments would be impractical. Although field experiments could be designed to assess the impact of electronic screening on fuel consumption, travel time, total vehicles processed, and unobserved bypasses, the cost and complexity of such experiments make them impractical. Furthermore, the findings of such field experiments would be valid for present traffic conditions only. With simulation, once the field data have been duplicated, it is possible to manipulate the model and simulate other traffic conditions.

Because weigh stations are, in essence, traffic facilities consisting of freeway segments, off and on ramps and connecting street segments, their operations can be simulated using traffic simulation software. A review of existing traffic simulation models, such as CORSIM (3) and INTEGRATION (4), indicated that they are not readily applicable for evaluation of electronic screening at weigh stations. Weigh stations that have been equipped with electronic screening allow enforcement officers to differentiate between individual trucks as they approach the weigh station. Routes are assigned to individual trucks based on a predetermined set of criteria. That is, drivers are signaled to either pull into the weigh station for a static weighing or to remain on the mainline, bypassing the weigh station entirely. These models do not allow for dynamic change in truck characteristics, which would be necessary to simulate the Automated Vehicle Identification (AVI) function of electronic screening

It was determined that modifying existing traffic simulation programs to simulate dynamic change in truck characteristics would be very difficult and expensive. Instead, a weigh station simulation model was built using Arena simulation software (5). Using the weigh station model developed in Arena, it is possible to predict:

total vehicles processed (cleared and not cleared)

number of trucks forced to bypass a weigh station due to a full queue (unobserved bypasses)

average time savings for each vehicle by allowing compliant trucks to be screened electronically at mainline speed

To determine the effect of electronic screening on fuel consumption, the output of the Arena weigh station simulation model is used as input in a second model. The second model was developed in CORSIM, the traffic simulation software. The CORSIM model allows for the simulation of fuel consumption.

To establish a level of confidence, both weigh station simulation models are calibrated against the traffic data collected at the Woodburn weigh station. A summary of the model's input parameters, which were drawn from the traffic data, is included in Table 1. This chapter describes the development and validation processes of these two models in detail.

2.2.1 Arena Weigh Station Model

The Arena weigh station model design is based on the existing geometry and functionality of the Woodburn weigh station. The Arena model is specifically designed to simulate traffic operations in and around the weigh station facility. It simulates truck movement through a weigh station, the weighing of the trucks, and inspection. With Arena, it is also possible to simulate the decision-making logic that is associated with the electronic screening system's assignment of bypass or pull-in flags to the approaching trucks. Figure 2 represents the electronic screening bypass and pull-in logic.

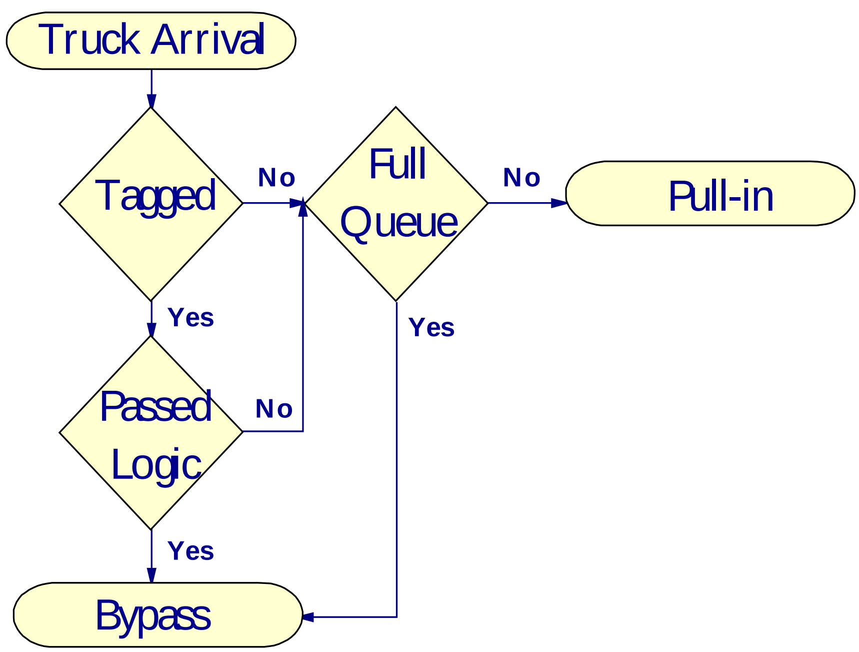


Figure 2. Electronic Screening System Bypass/Pull-in Logic

Based on exponential distribution, the model generates vehicle characteristics and assigns these characteristics to each entity (truck) approaching the weigh station on the mainline. For example, if the user decides to test the implication of having 10 percent of the population of trucks equipped with transponders, the program randomly allocates transponders to 10 percent of the entities. Other attributes are assigned following a discrete or continuous probability function. These attributes could include such vehicle characteristics as classification, axle spacing, and axle weights.

In an electronic screening system, a decision-making engine is triggered when a transponder-equipped truck passes the Advance AVI reader site located on the mainline. Each transponder has a unique identification number. The state motor carrier database, which resides on the roadside server, is automatically queried as the truck passes the AVI reader. The screening decision is based on the information gathered from the motor carrier database and the WIM data (e.g., axle weights and spacing). Dimensional data collected from the mainline WIM is checked against allowable weight and size criteria and to determine the truck's compliance with weight regulations.

If a truck successfully satisfies all the conditions stated in the logic, it is awarded a bypass flag. If not, it must enter the upcoming weigh station (pull-in). All trucks that are not assigned a transponder must also enter the weigh station. The logic used by the simulation is the same as that found in the electronic screening system.

The weigh station model has been verified and the results of the simulation have been validated by comparing the travel time collected in the field to those generated by the simulation without the availability of electronic screening. The validation procedure will be described in more detail later in the section.

2.2.2 Input and Output Data

The Arena weigh station simulation model is based on both actual truck traffic patterns and geometry data collected at the Woodburn weigh station and data obtained from the Oregon Department of Transportation. The default data, shown in Table 1, represent the existing conditions at Woodburn. The model, however, allows the user to modify the default parameters to examine different scenarios.

Table 1. Woodburn Simulation Input Parameters

Parameters	Morning	Noon	Afternoon
Total traffic volume (vph)	2201	1926	3705
Trucks as percentage of total traffic	12%	15%	7%
Ramp bypass rate: Percent of trucks directed to bypass static scales and return to mainline)	54%	57%	52%
Scale (a) utilization rate: Of the two scales, this is the percentage of trucks directed to scale (a).	56%	58%	58%
Safety inspection rate: Percent of trucks pulled over for a safety inspection. *	3%	3%	3%
Average safety inspection time in minutes	20	20	20

Figure 3 presents an example of parameters that can be modified prior to a simulation run at the Woodburn weigh station. The static scale weighing duration is not listed among the changeable parameters in Figure 3. The weighing times are randomly generated according to a statistical distribution which, once programmed, may not be modified by the users.

* The field data provide no good statistical distribution for the duration of a safety inspection as less than four percent of trucks were observed being inspected. The menu screen allows the user to estimate both the average duration of an inspection and the number of inspectors on duty.

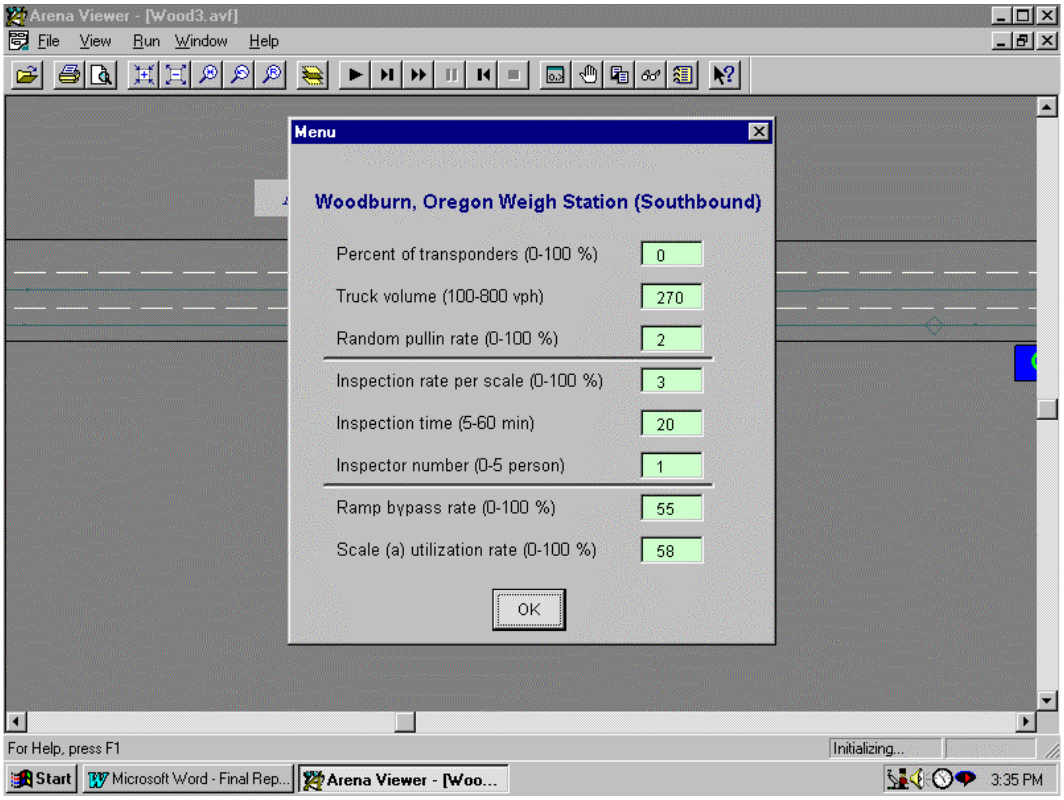


Figure 3. Woodburn Simulation Model Menu

The output data can be displayed during and upon completion of a model run. It includes those performance measures that were of direct interest in our study: the total number of unobserved bypasses, truck travel time savings, percentage of bypass versus percentage of pull-in vehicles. Other output parameters include the queue length, the average time in the system, and total number of trucks processed per hour. Figure 4 shows a summary of the results during a simulation run of the Woodburn weigh station.

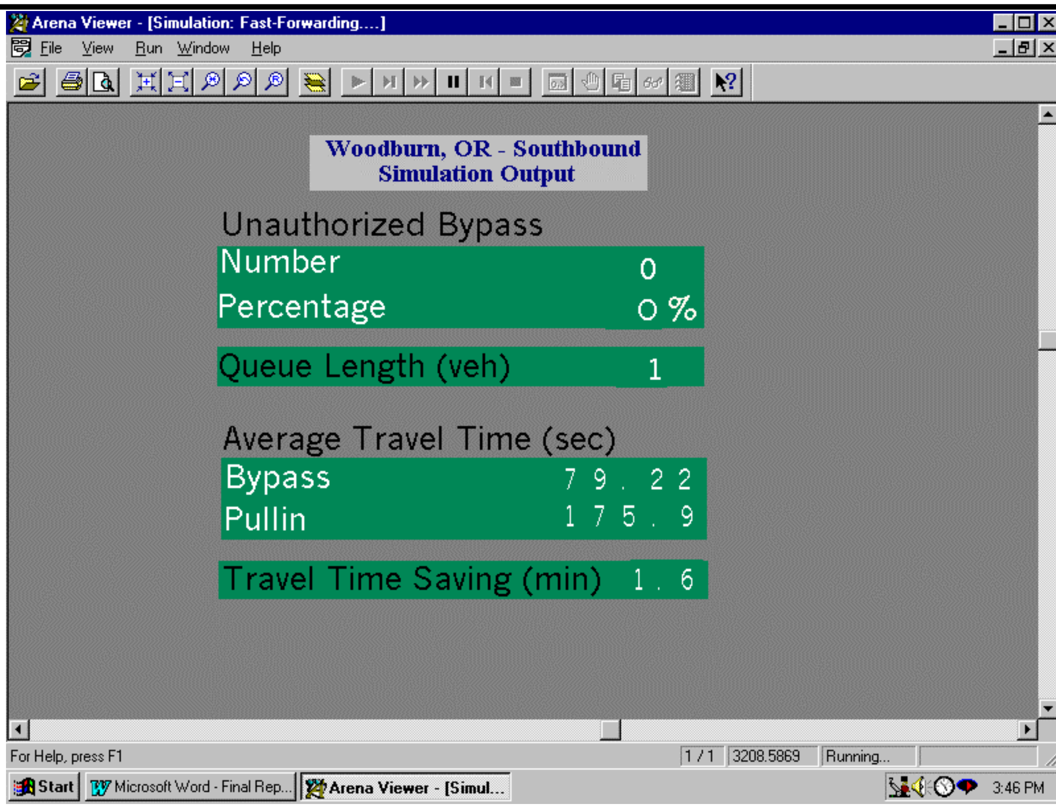


Figure 4. Woodburn Simulation Sample Output

2.2.3 Model Validation

The model will provide results that are not identical to the observed system. The purpose of model validation is to determine if the model replicates the actual system at an acceptable level of confidence (6). The simulation results are compared to the field data to validate the weigh station simulation module.

The static scale total delay (d_{23}) and travel time between designated points inside the Woodburn weigh station (d_{12}, d_{34}, and d_{14}) are available through the field data collection. The collected field data represent the existing conditions at the weigh station (i.e., no transponder-equipped truck participation). No unobserved bypasses were detected during data collection. The simulated static scale total delay and travel times are determined by running the weigh station simulation model, using the traffic volume and service time collected at peak and off-peak periods.

The simulation results are naturally subject to random fluctuations within the model. To account for this variation, interval estimates or confidence intervals are provided along with the point estimate of mean for each of the performance measures. Table 2 compares the field data to the simulation results which were obtained from 10 two-hour simulation runs. This table also includes the 95 percent confidence intervals for evaluation of the generated point estimate of means. These confidence intervals provide lower and upper limits of the true point estimate of averages. Therefore, it can be stated with 95 percent confidence that the true noon average total delay (d_{23a}), for example, is within less than four percent of the average delay (56 seconds).

Table 2. Woodburn Field and Simulation Results

Parameters	Morning			Noon			Afternoon		
	Field	Model		Field	Model		Field	Model	
	Avg	Avg	C.I.	Avg	Avg	C.I.	Avg	Avg	C.I.
Travel time (d_{12}), sec.	49	20	20, 20	19	21	21, 22	17	18	18, 18
Total delay (d_{23a}), sec.	41	43	41, 44	54	56	54, 58	50	52	49, 54
Total delay (d_{23b}), sec.	39	38	37, 38	57	55	52, 58	45	42	42, 43
Travel time (d_{3a4}), sec.	52	51	50, 51	53	56	55, 56	62	57	57, 57
Travel time (d_{3b4}), sec.	56	54	54, 54	58	58	57, 58	57	58	57, 59
Travel time (d_{14}), sec.	75	50	50, 50	64	61	61, 61	62	61	61, 61

It is noted in Table 2 that the observed average travel time from point one to two (d_{12}) during the morning session (i.e., 49 seconds) is more than twice that obtained by the model (i.e., 20 seconds). This discrepancy is due to a lack of synchronization between individuals stationed at point one and those stationed at the other data collection points. The individuals at point one had a late start in recording arrival times and plate numbers of arriving trucks. The inaccuracy of data recording at point one during the morning session also resulted in discrepancy between the average field and model travel time from point one to four (d_{14}). The second and third data collection sessions were successfully synchronized.

The comparison of the field data with the model's outputs establishes a level of confidence that the model is capable of simulating the existing conditions of the weigh station. The confidence in the simulation model yields a similar level of confidence in the model outputs obtained under the electronic screening strategy.

2.3 METHODOLOGY: SIMULATION MODEL DEVELOPMENT FOR DETAILED TEST #9

2.3.1 Developing a Weigh Station Model in CORSIM

Although Arena was effective for measuring travel time savings, the occurrence of unobserved bypasses at an electronically screened weigh station, it was sufficient for simulating fuel consumption. Therefore, a second weigh station model was developed using CORSIM to examine the impact of electronic screening in terms of fuel consumption savings at the Woodburn weigh station. The functionality of the weigh station was simulated using both Arena and CORSIM. The Arena weigh station model simulates electronic screening and determines truck movements through the weigh station. The CORSIM model is used to simulate traffic operations at the weigh station using the traffic flow characteristics produced by the Arena model.

CORSIM is sponsored and supported by the Federal Highway Administration. It combines FRESIM and NETSIM. NETSIM is a microsimulation model that represents the traffic movements on local street networks. Its companion model, FRESIM, follows the same concept in modeling traffic operation on freeways. CORSIM predicts operational performance of an integrated system consisting of local streets and freeways. The integration of the two models enables CORSIM to capture, for example, effects of a freeway ramp spill-over onto a local street and to measure delay on adjacent streets as a result of traffic re-routing due to a freeway incident.

Like the Arena model, the CORSIM model is based on the existing geometry and functionality of the Woodburn weigh station. The weigh station facility is modeled in NETSIM and interfaced with the freeway segment that is modeled in FRESIM. The two static scales inside the weigh station are represented by pre-timed traffic signals. The signal timings are adjusted to account for the trucks' stoppage time on static scale platforms. Also like the Arena model, the static scale stoppage times and the truck traffic flow within the weigh station facility are based on collected field data. The average fuel consumption of trucks that enter the weigh station (pull-ins) was compared with the fuel consumption of those trucks that are electronically cleared on the mainline (bypasses). The difference is the fuel consumption savings attributable to electronic screening.

The CORSIM input file consists of a sequence of "record types." Each record carries a specific set of data that can only be modified within defined boundaries. These records enable CORSIM to model the system's operations and traffic network of the case study weigh station. They do not, however, allow users to change records' data structures or to assign new vehicle characteristics, which would be required for modeling electronic screening systems. These limitations were resolved by incorporating the output of the Arena weigh station simulation model.

As more trucks become equipped with transponders, the queue within the weigh station and thus the number of unobserved bypasses will decrease. This, in turn, changes the traffic patterns and traffic flow within the weigh station. As described earlier, Arena weigh station simulation model is able to determine traffic flow assuming different percentages of trucks participating in the electronic screening program. The simulated traffic patterns from the Arena model (shown in Table 3) are used to develop a weigh station model in CORSIM. Through this unique process, illustrated in Figure 5, it is possible to determine fuel consumption at the electronically screened weigh station for a variety of scenarios.

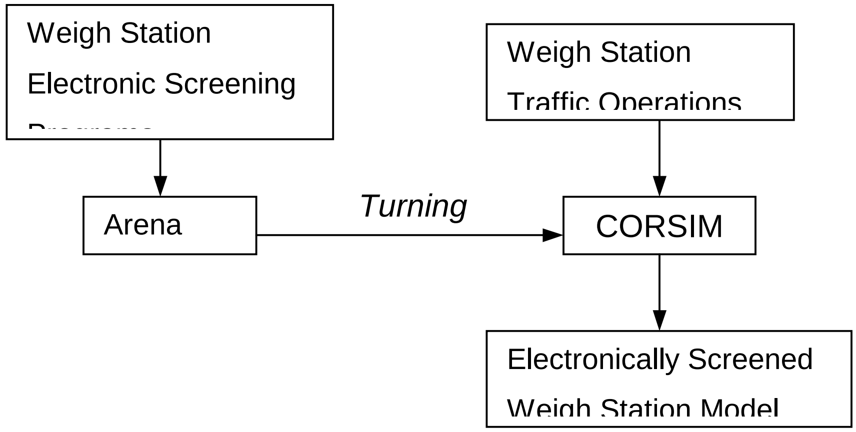


Figure 5. Data Flow Diagram of Electronic Screening Modeling in CORSIM

2.3.2 Model Calibration

CORSIM is an accepted traffic simulation model among transportation professionals. However, because weigh station modeling was a new application, the model was validated and the results' calculation process was verified.

The output of the CORSIM model was compared to both the field data and the output of the Arena model. To determine that the model replicates the actual system at an acceptable level of confidence, the travel times collected in the field are compared to those generated by the CORSIM model. To ensure the fuel consumption calculation procedure is valid, the CORSIM models travel time savings are compared to those generated by the Arena weigh station model.

The CORSIM model consists of a network of segments, nodes and links. To compare fuel consumption, the links were grouped to form the subsegments c_1, c_2, m, and w. These subsegments were then grouped into the weigh station segment and the mainline segment. Sub segments $c_{1,}$ c_2 are common to the mainline and weigh station segment. The mainline also includes sub segment m and the weigh station includes subsegment w. These sub segments are labeled in Figure 7.

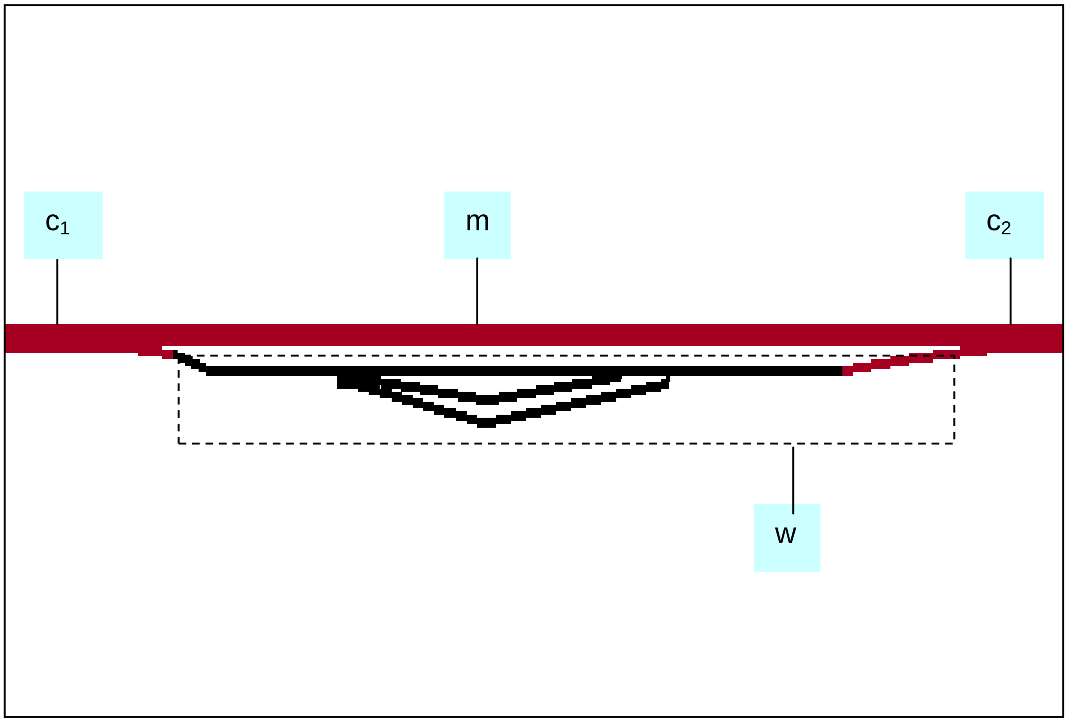


Figure 7. Woodburn Weigh Station Layout in CORSIM

2.3.3 Results Validation

The CORSIM weigh station model validation is based on 10 hours of accumulated simulation time. The input parameters were the existing conditions at the case study weigh station. The CORSIM model's nodes within the weigh station segment are consistent with the field data collection points. Figure 6 compares the simulation results to the collected field data. Links within the weigh station are shown on the x-axis.. For example, d_{23a} is the link from data collection point two to the inner static scale. The corresponding bars represent the observed and simulated travel times for each of these links. This comparison establishes a level of confidence that the model is capable of simulating the traffic operations at the weigh station.

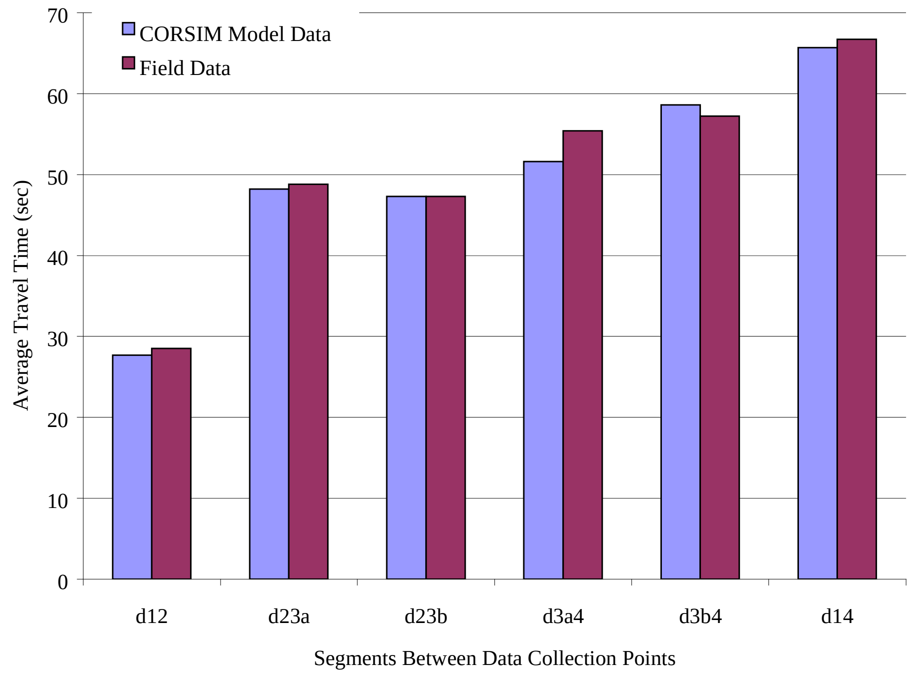


Figure 6. Validation Results – Field and CORSIM Model Data Comparison

2.3.4 Calculation Verification

The output files provide measures of fuel consumption, emission, and travel time of the simulated system by link and for the system as a whole. Within the weigh station segment, nodes are established at each data collection point. The total fuel consumption for both the mainline and weigh station segments are determined by adding the amount of fuel consumed on each of the links within the two segments.

For the common subsegment labeled c_1, which is upstream of the weigh station, it is understood that trucks that pull into the weigh station are able to coast and thus actually use less fuel than those that are allowed to bypass. Because CORSIM provides aggregate fuel consumption by link, a step was added to determine the difference in fuel consumption between bypass and pull-in vehicles in subsegment c_1. To determine the effect of electronic screening, the CORSIM model was run first with a selected transponder rate greater than zero and run again assuming a zero transponder rate, that is, all trucks entered the weigh station. Each run produced 749 vehicles. For purposes of demonstration we use a transponder rate of 20 percent. The output of the first run indicated that total fuel consumption for subsegment c_1 with a 20 percent transponder rate was 212.2 gallons. For the second run with a zero transponder rate, the total fuel consumption for subsegment c_1 was 210.78 gallons. The difference between the two runs, (212.2-210.78=1.42 gallons) was divided by the number of vehicles that bypassed (749*.20=150 vehicles). From this we conclude that the additional fuel consumption per bypass vehicle in segment c1 was 1.42 gal./150 vehicles, or .0095 gallons per truck. This step ensures that trucks that bypass the weigh station are properly assigned additional fuel consumption as they remain at freeway speeds. Link c_1 is unique in that it is the only link in which trucks that bypass use more fuel than those that pull in. The fuel consumption calculation of pull-in and bypass trucks on link c_1 is summarized in the following two equations:

$$PF_{c1} = \frac{f_{oc1}}{n} \tag{1}$$

$$BF_{c1} = \frac{f_{rc1} - f_{oc1}}{(r+u)n} + \frac{f_{oc1}}{n} \tag{2}$$

where:

PF_{c1} = gallons of fuel per pull-in truck on c_1 link

BF_{c1} = gallons of fuel per bypass truck on c_1 link

f_{oc1} = total fuel consumption on c_1 link in all pull-in case; (gal)

n = total number of trucks on c_1 link

r = percent of participating transponder-equipped trucks

u = percent of unobserved bypass trucks

f_{rc1} = total fuel consumption on c_1 link for (r+u) percent of trucks; (gal)

The next common link downstream of the weigh station (c_2) requires that trucks reentering the mainline traffic stream accelerate to freeway speeds. The fuel consumption for this link is calculated in the same manner as the segment located upstream of the weigh station. In segment c_2, as in segments m and w, the pull in vehicle consumes more fuel than the bypass vehicle. Equations 3 and 4 formulate the fuel consumption calculation of pull-in and bypass trucks on the downstream common link.

$$PF_{c2} = \frac{f_{oc2}}{n_{oc2}} \tag{3}$$

$$BF_{c2} = \frac{f_{oc2}}{n_{oc2}} - \frac{f_{oc2} - f_{rc2}}{(r+u)n} \tag{4}$$

where:

PF_{c2} = gallons of fuel per pull-in truck on c_2 link

BF_{c2} = gallons of fuel per bypass truck on c_2 link

f_{oc2} = total fuel consumption on c_2 link in all pull-in case; (gal)

n_{oc2} = total number of trucks on c_2 link in all pull-in case

f_{rc2} = total fuel consumption on c_2 link for (*r+u*) percent of trucks; (gal)

Given the pull-in and bypass fuel consumption in Equations 5 and 6, the total amount of fuel consumed for each truck type in each segment (mainline and weigh station) is determined. The relative fuel consumption savings are calculated by using Equation 7.

$$PF_w = \frac{f_w}{(1-r+u)n} \qquad (5)$$

$$BF_m = \frac{f_m}{(r+u)n} \qquad (6)$$

$$RFS = \frac{\sum_{(c1+c2+w)} PF - \sum_{(c1+c2+m)} BF}{\sum_{(c1+c2+w)} PF} \qquad (7)$$

where:

PF_w = gallons of fuel per pull-in truck inside the weigh station (w)

BF_m = gallons of fuel per bypass truck on *m* link

f_w = total fuel consumption on *w* links for (*1-r+u*) percent of trucks; (gal)

f_m = total fuel consumption on *m* links for (*r+u*) percent of trucks; (gal)

RFS = relative fuel consumption savings; (percent)

$\sum_{(c1+c2+w)} PF$ = gallons of fuel per pull-in truck on the weigh station segment

$\sum_{(c1+c2+w)} BF$ = gallons of fuel per bypass truck on the mainline segment

To determine the relative fuel consumption savings (*RFS*) at, for example, 20 percent transponder rate, equations 1 through 6 must be solved first. Using the following values, obtained from a 10 hour run of the CORSIM weigh station simulation model, Equation 7 indicates that each bypass truck consumes 29.7 percent less fuel than a pull-in truck.

f_{oc1} = 1576 gallons

f_{rc1} = 1630 gallons

n = 5998 trucks

r = 0.20

u = 0.12; obtained from the Arena model output

f_{oc2} = 2946 gallons

n_{oc2} = 5994 trucks

f_{rc2} = 2870 gallons

f_w = 2195 gallons

f_m = 319 gallons

The calculation procedure for fuel consumption is verified by comparing travel times, which are similarly calculated, to those determined by the Arena weigh station model. The Arena weigh station model is programmed to automatically determine the bypass and pull-in travel times. Figure 8 shows that the travel time savings (travel time difference between the mainline and weigh station segments) in both models follow a similar trend. This verifies the validity of the process in the fuel consumption determination at the Woodburn weigh station in CORSIM.

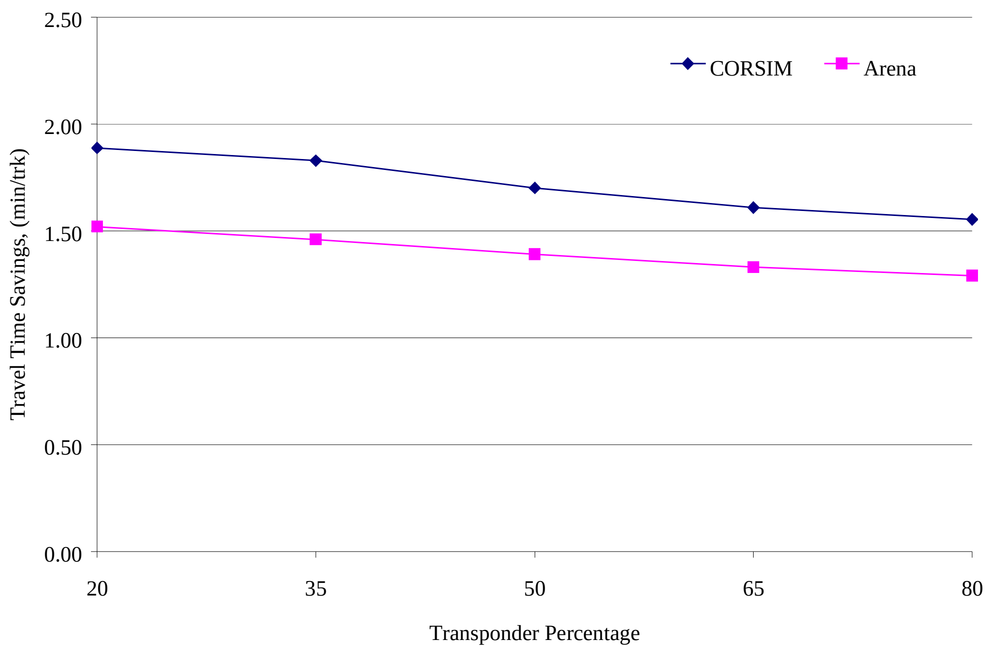


Figure 8. Verification of Fuel Consumption Calculation Procedure

3. OVERALL EVALUATION RESULTS

Electronic screening will reduce travel time and fuel consumption for both participating and, to a lesser degree, non-participating trucks. Electronic screening will also decrease the occurrence of unobserved bypasses resulting from full queues. The impact of electronic screening will be affected by several variables including truck traffic volumes at the weigh station, the percentage of motor carriers participating in the electronic screening program, and Oregon's commercial vehicle enforcement policies and procedures.

To better understand the future impact of electronic screening, we used the simulation models to compare and contrast several combinations of truck volumes and transponder rates (percentage of trucks with transponders). Simulation runs were conducted for vehicle per hour (vph) rates of 340, 375, and 410. To put this in context, the data collection crew observed an average of 270 vehicles (trucks) per hour in May of 1997. The most recent traffic data available to the Oregon Department of Transportation's planning office indicate that truck traffic in the vicinity of Woodburn on the south bound lane of Interstate 5 is currently growing at an annual rate of 2.6 percent. Assuming that traffic growth rate remains constant, 340 vph would be realized in the year 2003, 375 vph in 2010, and 410 vph in 2013.

For each truck traffic volume scenario, simulation runs were made with transponder rates of 20 percent, 35 percent, 50 percent, and 65 percent. The simulation output is included in table format as Appendix Four.

3.1 DETAILED TEST #7, MEASURE 2.3.1 PREDICT TOTAL VEHICLES PROCESSED

Currently, all trucks that enter the Woodburn Port of Entry pass over a slow speed weigh-in-motion scale. Based on a predetermined weight threshold (i.e. 75 percent of the legal limit), trucks are automatically sorted and directed to, either continue along the bypass lane and return to the mainline, or proceed to one of the two static scales. The trucks that stop at the static scales can be visually checked for obvious safety problems. Commercial vehicle enforcement personnel can also identify the vehicle by plate number and check compliance and safety records.

With the slow speed ramp WIM, all entering trucks are at least screened for weight. By diverting a portion of the truck traffic away from the static scales, congestion within the Port of Entry is minimized. However, from an enforcement perspective, a static scale weighing is of greater value as it allows for weight, safety and regulatory compliance checks. With the exception of the visual inspection, mainline electronic screening is similar to the static scale or manual screening as it allows for weight, safety, and regulatory compliance checks. The simulation model was used to predict the percentage of overall truck traffic that would be either electronically screened on the mainline or stopped at the static scale (Figure 9).

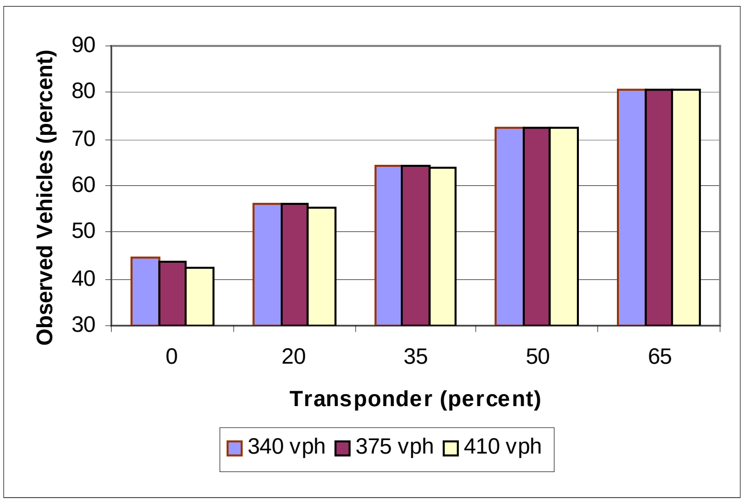


Figure 9: Percent of vehicles screened, manually and electronically

With a sufficient percentage of vehicles participating in Oregon's electronic screening program, the Woodburn Port of Entry will be able to process, (i.e. screen vehicles, both electronically and manually for safety, regulatory compliance, and weight) a substantially higher percentage of the truck traffic. By increasing capacity, electronic screening extends the design life of the facility.

3.2 DETAILED TEST #7 MEASURE 2.3.2 NUMBER AND LENGTH OF SERVICE INTERRUPTIONS (AS MEASURED IN UNOBSERVED BYPASSES)

As participation in the electronic screening program increases, the number of unobserved bypasses will decrease. Commercial vehicle enforcement personnel consider the elimination of unobserved bypasses as a major benefit of electronic screening. Because it is the objective of the Oregon Department of Transportation to screen all vehicles that pass by the Woodburn Port of Entry, a one percent unobserved bypass rate is not acceptable. As the following table illustrates, those unobserved bypasses that are the direct result of the weigh station operating beyond capacity will be eliminated with sufficient transponder rates.

Table 3 Unobserved bypasses

Unobserved Bypasses %	340 Vehicles Per Hour	375 Vehicles Per Hour	410 Vehicles Per Hour
@ 0% Transponder Rate	1	3	6
@ 20% Transponder Rate	0	0	2
@ 35% Transponder Rate	0	0	1
@ 50% Transponder Rate	0	0	0
@ 65% Transponder Rate	0	0	0

As with fuel consumption and travel time savings, the efficient design and operation of Woodburn minimizes the number of unobserved bypasses. One would expect a traditional weigh station, with a single static scale and without a ramp WIM bypass design, would experience a much higher percentage of unobserved bypasses in these traffic volume scenarios.

3.3 DETAILED TEST #7, MEASURE 2.4.1 PREDICT TRAVEL TIME SAVINGS PER VEHICLE

The bar chart in Figure 10 summarizes time savings for bypass vehicles in each scenario. For all scenarios, time savings for electronically screened vehicles fell within a range of 1.43 minutes at

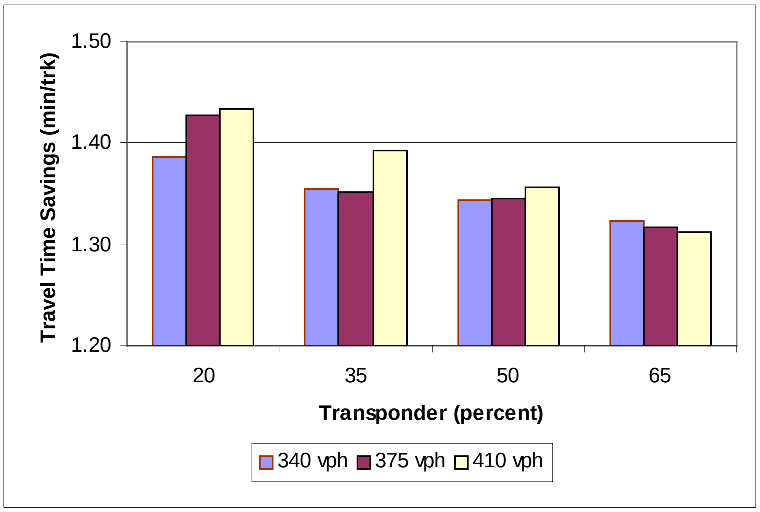


Figure 10: Time savings Realized by Electronically Screened Vehicles

410 vehicles per hour and a 20 percent transponder rate to 1.31 minutes at 410 vehicles per hour and a 65 percent transponder rate.

Reduced travel time is an incentive for trucks to participate in an electronic screening program. There is no singularly accepted estimate for the value of time saved for commercial vehicles. If one accepts the estimate put forth by Waters, Wong, and Meagle (7), and adjusted for inflation using the consumer price index, the value of time saved in 1998 dollars is $34.00 per hour and the value of one pass for an electronically screened vehicle in the scenarios examined, would range from $.74 to $.81.

As more trucks participate in electronic screening, the overall efficiency of the weigh station increases. As a result, time and fuel consumption savings for participating trucks in comparison to non-participating trucks decreases. As more vehicles bypass the weigh station electronically, the queue and therefore the delay within the weigh station subsides. Combining the time-savings for the pull in and bypass vehicles, estimated travel time savings per hour are quite significant. Using the 340 vehicles per hour scenario as an example, the cumulative time savings for all trucks passing the weigh station within any given hour, ranges from 1 hour and 42 minutes with the transponder rate at 20 percent, to five hours and 23 minutes with the transponder rate at 65 percent.

3.4 DETAILED TEST #9, MEASURE 2.5.1 ESTIMATE CHANGES IN FUEL USE

The CORSIM simulation model is used to predict the fuel consumption at Woodburn. For the scenarios selected, the CORSIM weigh station model indicates that electronic screening systems reduce relative fuel consumption for the electronically screened vehicles.

The fuel consumption values drawn from the CORSIM simulation model were reported in relative terms. The relative fuel savings for the 12 scenarios that were simulated,are illustrated on the following graph.

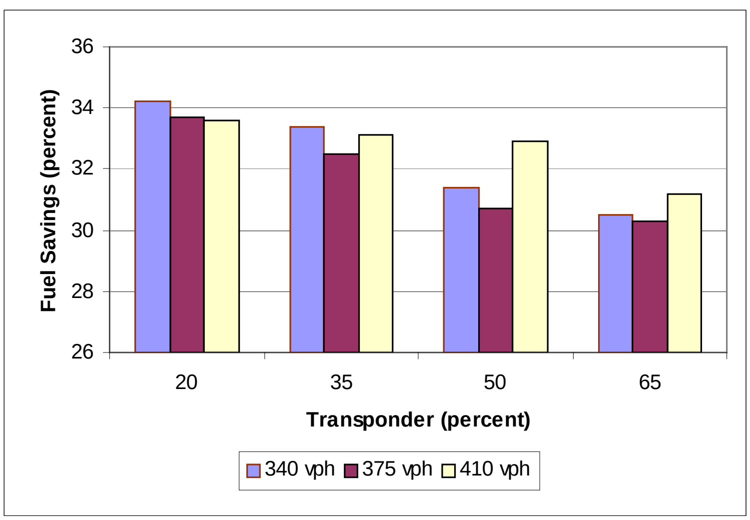


Figure 11: Relative Fuel Savings for Electronically Screened Vehicles

CORSIM fuel consumption rates are synthesized from passenger vehicle fuel tests. Therefore, the direct reporting of CORSIM's fuel consumption output was not recommended. Instead, the fuel consumption values drawn from the CORSIM simulation model were reported in relative terms. In the CORSIM model, the mainline and weigh station segments have common beginning and ending points, *(.See Figure 7*). The fuel savings are reported in terms of percentage of fuel saved by the vehicle passing along the mainline segment (electronically screened) with a the vehicle of equal dimensions passing along the weigh station segment. So, looking at Figure 11, the first bar in the chart represents the percent of fuel saved by a bypassing truck in a scenario in which there are 340 vehicles per hour and 20 percent of the vehicles are equipped with transponders.

To assess the value of electronic screening in terms of fuel savings at Woodburn, it is more helpful to convert savings back to volume of fuel. It was estimated that for a weigh station with attributes like Woodburn's, a truck passing through the weigh station segment will consume, on average, .one half gallon of fuel. The estimate is based on the motor carrier fuel consumption tests conducted as part of the evaluation of Advantage I-75 Mainline Automated Clearance System. The fuel test was based on guidelines set forth by the Society for Automotive Engineers.

For the scenarios examined, fuel savings per pass ranged from .1525 gallons (30..5 percent * .5 gallons) to .171 gallons (34.2 percent * .5 gallons) for electronically screened vehicles.

4. CONCLUSIONS AND RECOMMENDATIONS.

4.1 CONCLUSIONS

The simulation findings indicate that electronic screening will reduce travel time and fuel consumption for trucks participating in the electronic screening programs, or transponder equipped trucks. Findings also indicate that electronic screening will decrease the occurrence of unobserved bypasses resulting from full queues and increase the percentage of trucks being screened for safety and compliance. The effectiveness of electronic screening will be situational. Several variables, including truck traffic volumes at the weigh station, the percentage of motor carriers participating in the electronic screening program, and Oregon's commercial vehicle enforcement policies and procedures will determine the degree to which the electronic screening program meets its objectives.

4.1.1 Recommendations- Continued Application of the Simulation Model

One of the advantages of the weigh station simulation model developed in Arena is that the Oregon Department of Transportation is not limited to the analysis of the scenarios selected for this report. The Oregon Department of Transportation (ODOT) staff was given user copies of the Woodburn model that can be run on any personal computer with the Windows 95 operating system. (see Appendix III, User's Manual). With the Arena Viewer, users are able to alter input parameters such as traffic level, transponder rate, and number and length of inspections, to perform "what if" scenarios. ODOT can also analyze the impact that changes in operational procedure and/or staffing levels would have on the functionality of the weigh station. For example, using the Arena model, ODOT could examine the impact of changing the threshold weight for the bypass lane or closing the ramp bypass lane entirely. If, for example, the Oregon Department of Transportation were to close the ramp bypass lane, electronically screened vehicles would realize greater time savings benefits relative to vehicles that were not participating in the program.

To demonstrate the impact of closing the bypass lane, we simulated a closed bypass ramp for the last scenario, 410 vehicles per hour and a 65 percent transponder rate. For this scenario, the average travel time savings for electronically screened vehicles was predicted to be 1.31 minutes per vehicle. With the ramp bypass lane closed, the average travel time savings is predicteded to increase to 2.0 minutes per vehicle.

In the scenario described above, closing the ramp bypass lane would also serve the objectives of ODOT's motor vehicle enforcement objectives. At the time of data collection, the ramp bypass lane allowed vehicles weighing less than 75 percent of the legal limit to bypass the static scale and return to the mainline. By bringing all vehicles to a stop at the static scale, the Woodburn staff would have the opportunity to visually check all vehicles not participating in the electronic screening. The ramp bypass lane serves the purpose of reducing congestion within the weigh station and thus minimizing unobserved bypasses, while maintaining weight screening on all vehicles that enter the weigh station. With enough vehicles participating in the program, electronic screening will give ODOT more flexibility in setting operational procedures. The simulation model will assist ODOT in assessing the impact of proposed changes in procedures.

Although closing the ramp bypass lane would result in the most dramatic changes in travel time savings for participating vehicles and would allow for a visual check of all vehicles, it is more likely that operational procedures would change incrementally. The simulation package gives the end user the ability to vary the percentage of vehicles and determine the threshold weight that would bring the greatest number of vehicles to the static scale without resulting in unobserved bypasses.

For this evaluation of weigh station efficiency, the Arena Viewer software "packed" with the Woodburn model is considered a deliverable equal in and of itself. Not only does the simulation provide a robust medium for evaluation but the powerful animation capability makes it possible to demonstrate the functionality of the weigh station and the impact of electronic screening to a broader audience.

5. REFERENCES

1. Highway Capacity Manual, Special Report 209. *Transportation Research Board, National Research Council*, Transportation Research Record, October 1994.
2. Inose, H., and T. Hamada. *Road Traffic Control*. University of Tokyo Press, Tokyo, Japan, 1975.
3. Kaman Science Corporation. *Traffic Software Integrated System 97 User's Guide-Version 4.01*. Prepared for FHWA, Colorado Springs, CO, June, 1997.
4. Van Aerde, M. *INTEGRATION Release 2: User's Guide-Volume I: Fundamental Model Features*. Transportation Systems Research Group, Queens University, Kingston, Ontario, Canada, March 1997.
5. Systems Modeling Corporation. *Arena User's Guide*. Sewickley, PA, 1996.
6. Pegden, C.D., R.E. Shannon and R.P. Sadowski. *Introduction to Simulation Using SIMAN-Second Edition*. McGraw-Hill, Inc., 1995.
7. Estimate provided by ODOT Transportation Development Branch via fax on 9/3/98.
8. Waters, W.G., C. Wong, K. Meagle. The Value of Commercial Vehicle Time Savings for the Evaluation of Highway Investments: A Resource Savings Approach.
9. Center for Transportation Research and Education *Advantage I-75 Mainline Automated Clearance System: Final Evaluation Report.* August 1998

APPENDIX

Truck Bypass Form

Weigh Station Name:		Traffic Direction: (circle) North South			
Observer Name:		Date:		Session Start Time: ________	
Point One-Point Three Mainline Distance: ________________ (ft.)					
Minute	Number of Truck Bypasses		Minute	Number of Truck Bypasses	
0			30		
1			31		
2			32		
3			33		
4			34		
5			35		
6			36		
7			37		
8			38		
9			39		
10			40		
11			41		
12			42		
13			43		
14			44		
15			45		
16			46		
17			47		
18			48		
19			49		
20			50		
21			51		
22			52		
23			53		
24			54		
25			55		

26			56	
27			57	
28			58	
29			59	

Mainline Bypass Speed Form

Weigh Station Name:		Traffic Direction: (circle one) North South		
Observer Name:		Date:		
Observation Time	Bypass Speed (mph)		Observation Time	Bypass Speed (mph)

Vehicle Approach Speed Form

Weigh Station Name:		Traffic Direction: (circle one) North South			
Observer Name:		Date:			Obs. Point: 1 2 3
Observation Time	Approach Speed (mph)		Observation Time		Approach Speed (mph)

Vehicle Approach Speed Form

Weigh Station Name:			Traffic Direction: (circle one) North South	
Observer Name:			Date:	Obs. Point: 1 2 3
Observation Time	Approach Speed (mph)		Observation Time	Approach Speed (mph)

Static Scale Service Time Form

Weigh Station Name:		Traffic Direction: (circle one) North South		
Observer Name:		Date:		
Observation Time	Service Time (seconds)		Observation Time	Service Time (seconds)

Static Scale Service Time Form

Weigh Station Name:		Traffic Direction: (circle one) North South		
Observer Name:		Date:		
Observation Time	Service Time (seconds)		Observation Time	Service Time (seconds)

Vehicle Arrival/Identification Form Page One:

Weigh Station Name:		Traffic Direction: (circle one) North South
Observation Point: (circle one) 1 2 3 4	Date:	Session Start Time: ____________
Observer Name:		Recorder Name:
Weather Conditions:		Point _____ -Point _____ Distance: _____

Minute		Vehicle Identification and Arrival Time (Seconds)									
0	ID.										
	Secs.										
1	ID.										
	Secs.										
2	ID.										
	Secs.										
3	ID.										
	Secs.										
4	ID.										
	Secs.										
5	ID.										
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14	ID.										
	Secs.										
15	ID.										
	Secs.										
16	ID.										
	Secs.										
17	ID.										
	Secs.										

Developing a traffic model for a weigh station was a new application of CORSIM. Through trial and error, we were finally successful at developing a weigh station model that enabled us to evaluate the impact of electronic screening in terms of fuel consumption savings at the Woodburn weigh station. We started modeling the Woodburn weigh station in the version 4.01 of CORSIM, and ended up completing the project with the latest version of CORSIM; version 4.2. The 4.2 version, of course, eliminated some of the problems with the earlier version. It, however, introduces a new minor problem. This section briefly describes some of our difficulties in modeling the Woodburn weigh station in CORSIM.

CORSIM 4.01 - Incompatible Fuel Tables

In our first attempt, we used FRESIM and NETSIM, the two components of CORSIM, to model the traffic operations at the Woodburn weigh station. The entire mainline section was modeled in FRESIM. The off-ramp, bypass lane, scale lanes, and on-ramp were modeled in NETSIM. Figure I.1 shows the model. FRESIM is shown in gray and NETSIM in black. The static scale delay was simulated by assigning pretimed traffic signals at the scales.

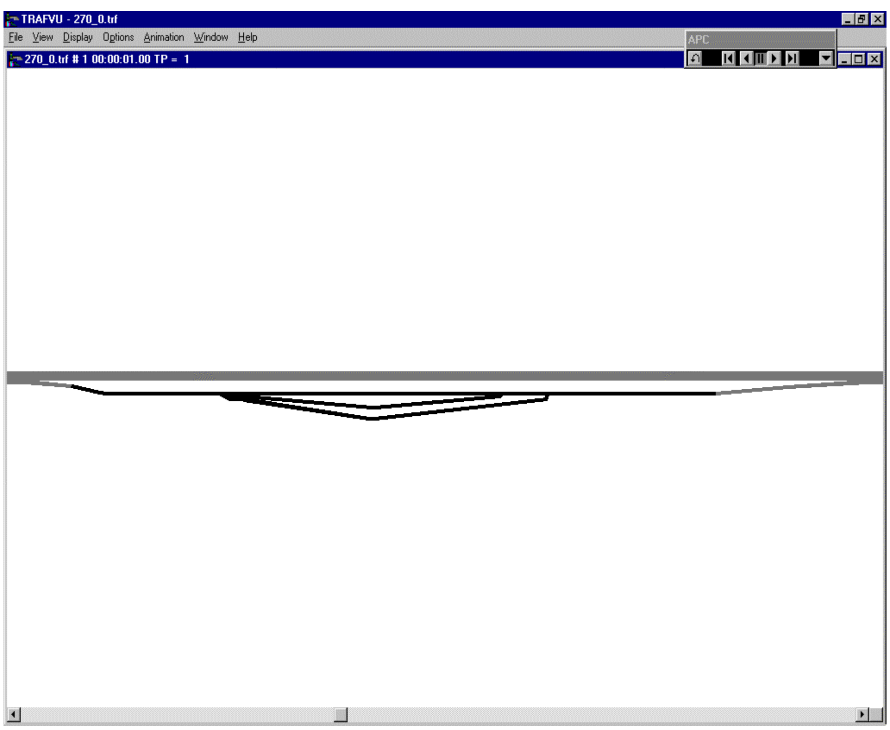

Figure I.1 Woodburn Weigh Station Model 1

In the 4.01 version of CORSIM, NETSIM and FRESIM obtain fuel consumption values from different acceleration tables. It was mentioned earlier in the report that fuel savings are obtained by comparing the fuel consumption results for the mainline segment with that of the weigh station segment, that is, comparing fuel consumption obtained from FRESIM and NETSIM. Therefore, incompatible source of parameters in CORSIM's acceleration table made it impossible to make any meaningful comparison.

The latest version of CORSIM (version 4.2) has been enhanced. Both FRESIM and NETSIM now use the same acceleration and environmental tables. This upgraded version of CORSIM enabled us to measure the fuel savings using this model design, shown in Figure I.1, to measure fuel savings at the Woodburn weigh station.

CORSIM 4.01 – Problems with Transition Nodes and Truck Classifications

Prior to obtaining the newly released version 4.2, we modeled the middle section of the mainline in NETSIM to eliminate the incompatibility problem of acceleration source data. The mainline sections prior to and following the weigh station were modeled in FRESIM. Figure I.2 shows the area modeled in NETSIM in black and the area modeled in FRESIM in gray. The static scale delay was simulated by assigning pretimed traffic signals at the scales.

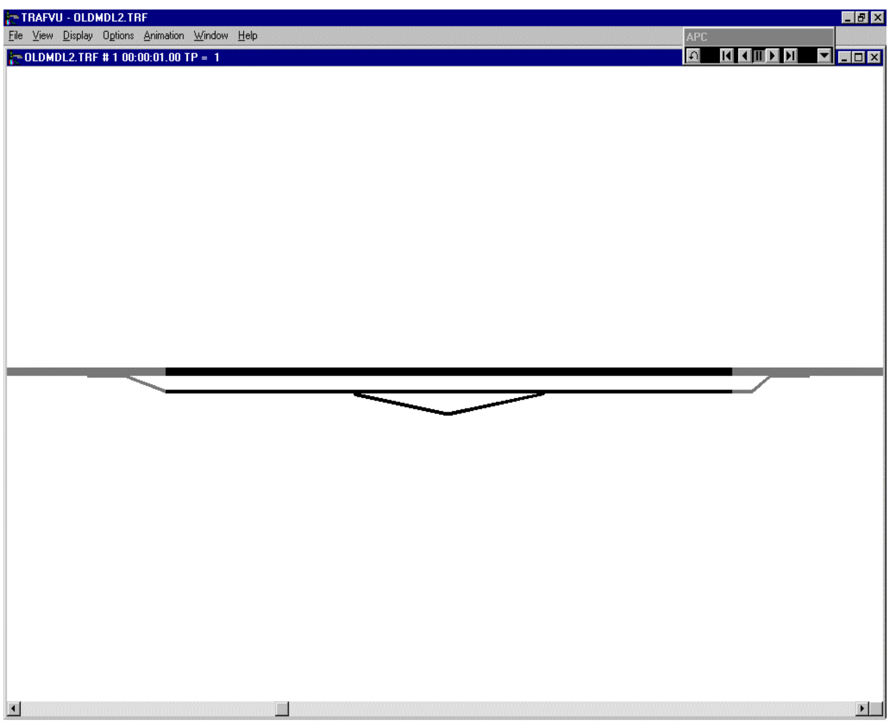

Figure I.2 Woodburn Weigh Station Model 2

This model solved the problem of incompatibility. However, we detected two new problems. FRESIM and NETSIM networks are connected by a node called transition. The transition nodes allow a seamless movement of vehicles between the two components of CORSIM. The first problem detected was that trucks began to disappear at the transition node located at the end of the off ramp. We first noticed that the queue was not extending beyond the transition node to the freeway off ramp. Trucks seemed to be stacking up on top of each other at this point. Obviously, this is contrary to existing conditions and does not accurately simulate the weigh station environment.

The second observed problem relates to CORSIM's inablity to keep the same truck classification in FRESIM and NETSIM. NETSIM models all truck as single unit trucks. The desired truck vehicle fleet generated in FRESIM is composed of medium loaded, heavy loaded, and double-bottom trucks. The trucks entering the weigh station appear as semi trailers. Once the trucks enter the NETSIM portion of the model these vehicles perform as single unit vehicles. The performance of the truck fleet is essential for the correct measurement of the fuel consumption at weigh stations, particularly, the acceleration from a stopped condition at the static scale to freeway speed. This is at which pull-in vehicles would be expected to use a considerably greater amount of fuel than bypass vehicles. Since the scale area was modeled in NETSIM, the performance measurements were inconsistent with the truck vehicle fleet (i.e., a single unit truck will not use as much fuel as a heavily loaded semi trailer to achieve freeway speed from a stopped condition). This problem has been corrected in the 4.2 version of CORSIM.

CORSIM 4.01 – Poor Visual Animation

The third model was built to mitigate the three stated problems. We built the entire network (mainline and weigh station) in FRESIM. The static scale delay was simulated by giving the scale the attributes of a ramp meter rather than an unsignalized intersection. As shown in Figure I.3, the discontinuity of the weigh station and mainline components presented a poor visual animation. The latest version of CORSIM was released while we were in process of improving the model design. Although the new version solved the current problem, it introduced a new, albeit minor, problem.

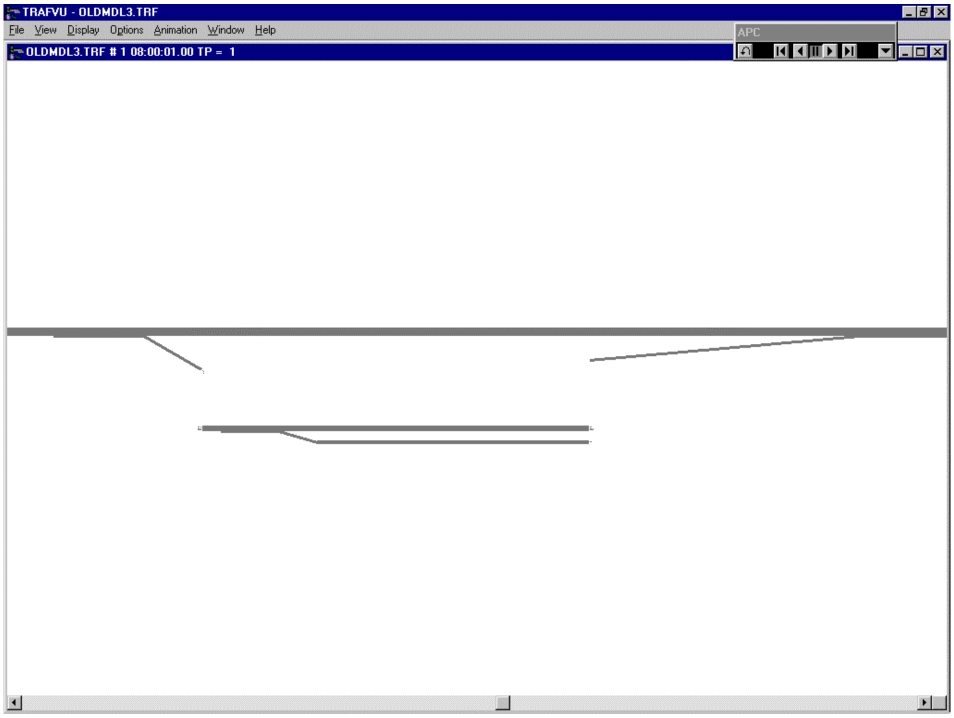

Figure I.3 Woodburn Weigh Station Model 3

CORSIM 4.2 – Inability to Change Seed Numbers

We used our basic design, shown in Figure I.1, to simulate the Woodburn weigh station in the new version of CORSIM. We discovered that the new verision of CORSIM was unable to change seed numbers. Instead, unable to recognize new seed numbers, CORSIM changed the user-assigned seed number back to it's default number. Being able to change the seed numbers in a multiple simulation run is essential for establishing confidence intervals for the obtained results. This incapability of the new CORSIM led us to use a longer simulation run period (10 hours) to at least achieve a more stable average result.

Woodburn Weigh Station Simulation Model

User's Manual

Center for Transportation Research and Education

Iowa State University

Ames, Iowa

October 1997

1. Introduction

As the evaluator of the Oregon Green Light deployment, the Center for Transportation Research and Education (CTRE) was given the task of quantifying the impact of electronic screening in terms of travel time and fuel consumption savings for motor carriers and enhanced efficiency of the weigh station. To conduct our evaluation, we developed simulation models that provide for visual animation of traffic operations approaching, through, and after a weigh station. The simulation provides a robust medium for evaluation as it can quantify the benefits of electronic screening under a variety of operating policy alternatives and display the operation of the system under each alternative using high fidelity animation. The animation allows a broad audience to better understand the analysis and the effect of electronic screening on weigh station throughput.

The simulation model consists of two modules, a weigh station and a mainline module. This user's manual describes the weigh station module which examines the number of trucks forced to bypass a weigh station due to a full queue (unobserved bypasses) and determines the travel time saved by allowing compliant trucks to be screened electronically at mainline speed. The mainline module will measure the reduction in fuel consumption resulting from an increase in the number of trucks equipped with transponders participation.

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. It allows a user to change the model's parameters to perform "what-if" analysis.

The weigh station module is specifically designed to simulate traffic operations in and around a weigh station facility. It simulates truck movement through a weigh station, the weighing of the trucks, and inspection. One of the most important parts of this module is the inclusion of the decision making logic that is associated with the electronic screening system's assignment of bypass or pull-in flags to the approaching trucks. Figure 1 presents an overview of the implemented electronic screening bypass and pull-in logic.

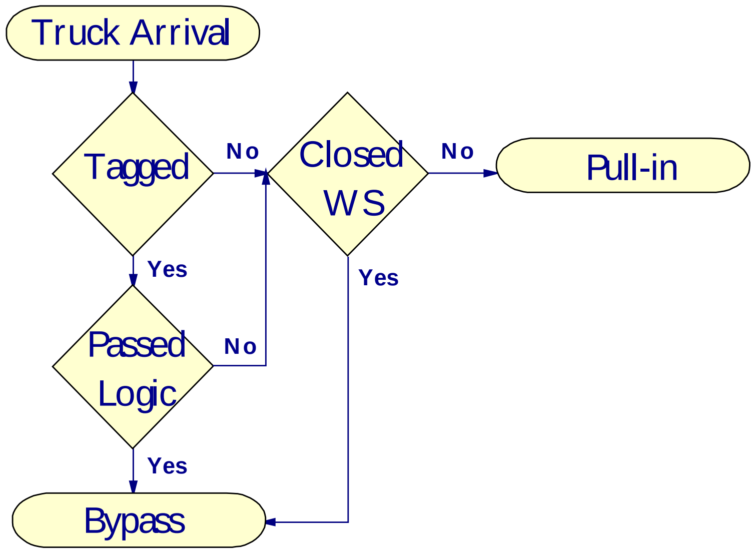

Figure 1. Electronic Screening System Bypass/Pull-in Logic

The simulation generates each entity (a truck) in the simulation and attributes the entity with vehicle characteristics. For example, if the user decides to test the implication of having 10 percent of the population of trucks equipped with transponders, the program randomly allocates transponders to 10 percent of the entities. Other attributes are assigned following a discrete or continuous probability function. These attributes could include such vehicle characteristics as classification, axle spacing, and axle weights. When electronic screening is deployed in a network or a corridor of weigh stations, the simulation also has the ability to take into account information regarding the vehicle which was written to the transponder during prior interrogation.

The decision making engine is triggered when a transponder-equipped truck passes the Advanced Vehicle Identificatin (AVI) reader site, located on the mainline. The transponder data (prior information written to the transponder) as well as weigh-in-motion (WIM) data (e.g., axle weights and spacing), which initially were assigned to each truck, are recorded by the roadside reader. If a truck successfully satisfies all the conditions stated in the logic, it is awarded a bypass flag. If not, it must enter the upcoming weigh station (pull-in). All trucks that are not assigned a transponder must also enter the weigh station.

The allowable weight criteria and the bridge formula are the two main components of the decision making processor. Given a truck's axle weights and spacing information from the WIM, these components determine the truck's compliance with weight regulations.

The logic used by the simulation has been verified and the results of the simulation have been validated by comparing the travel time collected in the field to those generated by the simulation without the availability of electronic screening.

The weigh station simulation module is a microscopic, stochastic model with a powerful animation capability. The simulation module is built in Arena[1] simulation language. The "Pack and Go" feature of Arena enables the end-users to view the model's animation and outputs using Arena Viewer software. The Arena Viewer software, runs the "packed" model on any personal computer running Windows 95.

No prior computer programming skill is required to use this simulation model. This manual intends to assist users to run the simulated models with a minimal amount of effort. Inquiries and suggestions may be forwarded to:

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kmb@iastate.edu

[1]Systems Modeling Corporation, *Arena User's Guide*. Sewickley, PA, 1996.

2. Installation

Arena Viewer software runs the weigh station simulation module on the Windows 95 platform. Arena Viewer is provided in eight diskettes. Insert Disk 1 into the disk drive a: and, using the Windows *Start/Run* command, run the a:/setup program. Follow the instructions on the screen.

To run Arena Viewer, select the Windows' *Start/Programs/Arena Viewer* menu command. Figure 2 shows the first screen after the Arena Viewer is open. This is the basic Arena Viewer window which consists of a menu bar and the toolbars at the top and a status bar along the bottom. The icons, included in toolbars, are the shortcuts of the main menu commands. Placing the mouse cursor over an icon highlights its function. The status bar provides a brief description of the specific function currently being performed.

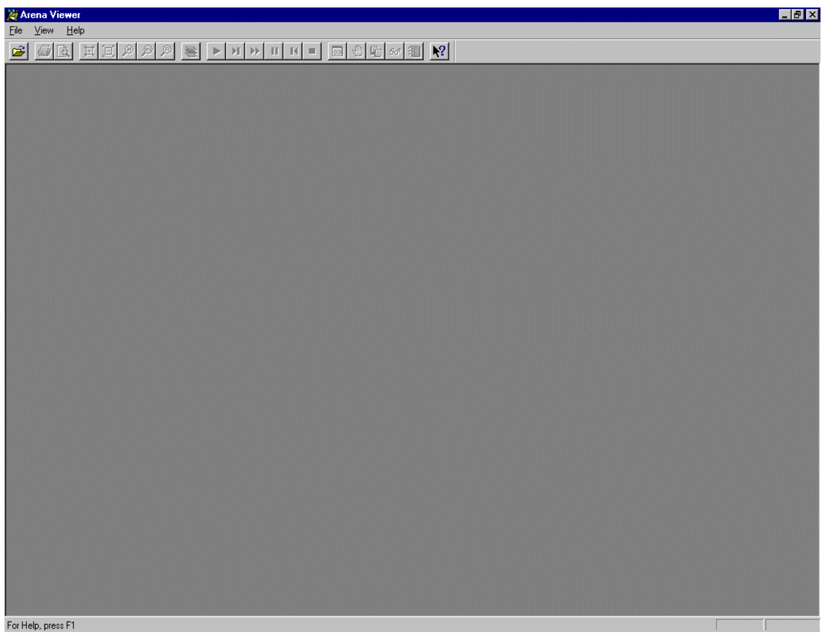


Figure 2. Arena Viewer Basic Window and Toolbars

3. Getting Started

The weigh station simulation module consists of two files: an *avf* file containing animation portion of the model and the program (*p*) file containing data. These two files together (saved in the same folder) enable the Arena Viewer to animate the model and calculate the output results.

To run the simulation model the following step should be taken:

1. Click on *File/Open* from Arena Viewer's main menu (or use the Open toolbar button).
2. Double-click on the folder containing the two simulation files.
3. Select *Woodburn.avf*.
4. Click the Open button.

Figure 3 shows the first screen after the model opens. The simulation title page will close after a few seconds.

5. Explode (maximize) the opened simulation window.
6. Press the shortcut key "a" (will be explained in Table 3) to zoom the Advance AVI/WIM Reader site in the opened window.
7. Click the Go button on the Run toolbar to start the simulation run.

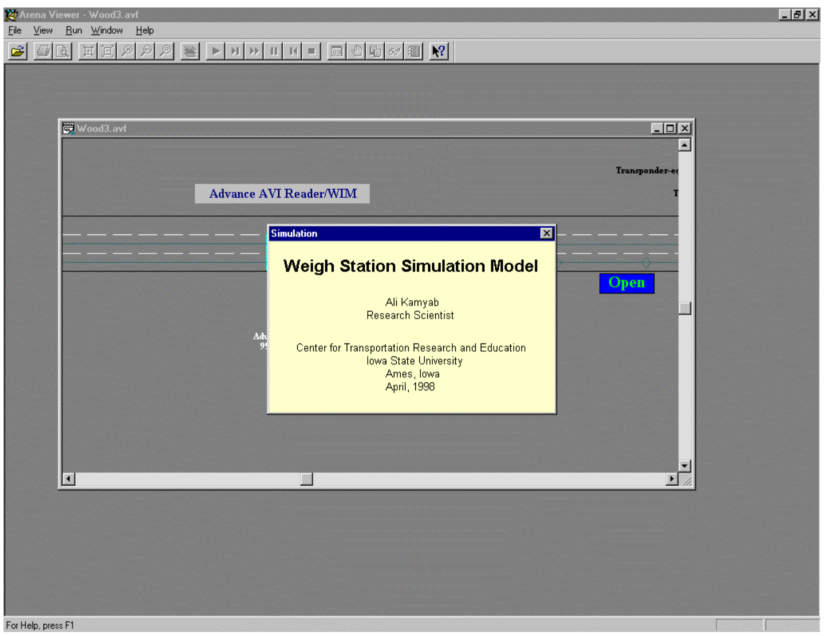


Figure 3. Simulation Title Page

As soon as the Go button is clicked, the users are presented with a menu, shown in Figure 4. This menu allows users to change the default values of the model's parameters, within the specified limits, before starting a run. Click the OK button to start the simulation run or change any of the parameters before clicking the OK button to run a new scenario.

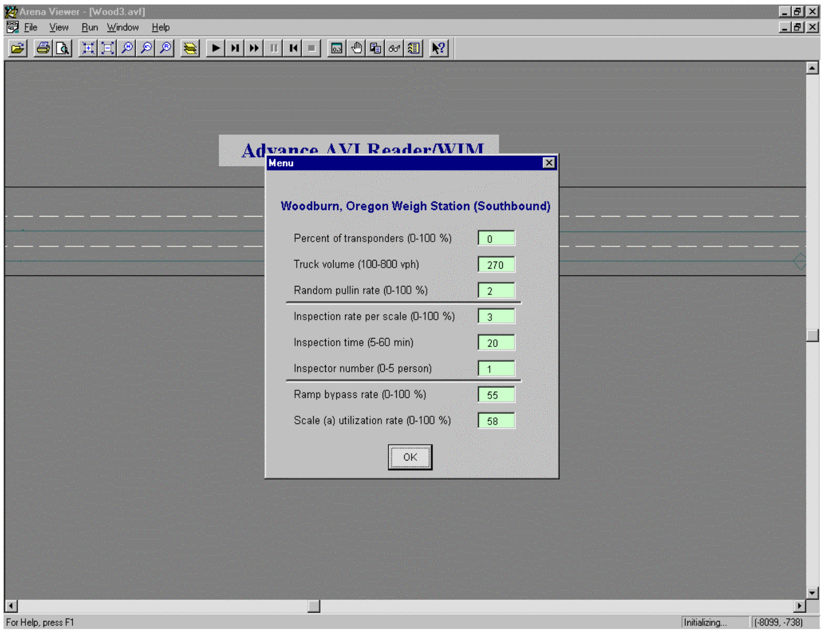


Figure 4. Simulation Model Menu

The status of each simulated truck is represented by its assigned color in the model. For example, a blue colored truck indicates that it carries a transponder. As it passes the AVI/WIM roadside reader, its color changes to green or red indicating a bypass or pull-in flag assignment. A complete list of the assigned colors is included in Table 1.

Table 1. Colors of Animated Trucks

Color	Assignment
White	Non transponder-equipped truck
Blue	Transponder-equipped truck
Green	Bypass truck
Red	Pull-in truck

Tables 2 and 3 include shortcut keys which can be used while the simulation model is running. The shortcut keys, listed in Table 2, can be used to interrupt the simulation run or change the animation speed. For example, in order to interrupt the model execution before the end of the simulation press the Esc key, or click the Pause button on the Run toolbar. To resume the simulation, click the Go button again.

Table 2. Arena Viewer Shortcut Keys

Key	Function
Esc	Interrupt or pause the simulation
+ or -	Zoom in or out from the current view
Arrow keys	Pan from the current view
<	Slow down the animation
>	Speed up the animation

The keys included in Table 3 are specific to the weigh station module. These keys automatically zoom and pan to a specific view. Note that these keys are case sensitive.

Table 3. Weigh Station Simulation Module Shortcut Keys

Key	View
A	Advance AVI/WIM
F	Weigh station off-ramp
W	Inside weigh station
N	Weigh station on-ramp
B	Model overview
O	Results summary
P	Input parameters

When the model run is complete, a dialog appears asking whether a user would like to view the results. Click No to close the dialog box since this data is unlikely to be of much use in the presented form. A likely more useful summary of the results can be viewed by pressing the shortcut key "o" at any time during or after the simulation run, before exiting the Run mode. Figure 5 shows a summary of the results during a simulation run. Click the End button on the Run toolbar to exit the Run mode.

The average CPU time for a two-hour run is about eight minutes on a Pentium computer. The running time can, however, be reduced to three minutes by disengaging the model's animation. This can be done by clicking the Fast-Forward button on the Run toolbar, instead of the Go button, and minimizing the Viewer window.

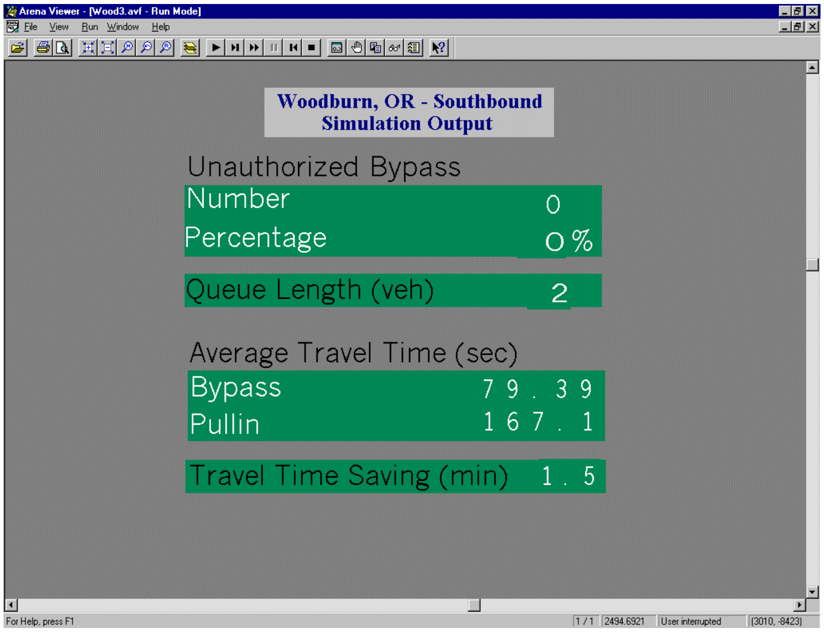


Figure 5. Simulation Sample Output

The weigh station simulation model is capable of assessing the impact of electronic screening at weigh stations. One of the advantages of this model is its ability to simulate hypothetical scenarios. Part of the electronic screening evaluation goal is to extrapolate the obtained results into the future. Thus performance measures (i.e., delay, unobserved bypasses, trucks checked, etc.) can be projected into the future, illustrating the implications of growth in truck traffic or transponder usage.

4. Additional Model Enhancements

With additional programming, the weigh station simulation module can be enhanced to provide additional options and information to the users. Enhancements could potentially assist users in the planning, design and operation of weight stations. The new output screens can be customized to include the following information.

a. Truck travel time by type between designated points
b. Truck count by type at selected locations
c. Scale utilization rate
d. Inspection utilization rate
e. Truck count by inspection levels
f. Inspected truck count
g. Non-inspected truck count due to lack of parking space and/or inspectors
h. Total closing time due to queue overflow
i. Overweight truck count due to closed weigh station

Enhancement of the model would result in more parameters for the users to set before running the simulation. For example, users would be able to modify the inspection level rates and their associated times. The current version of the Woodburn model includes an option for users to change the number of inspectors to examine the feasibility of the input inspection rate and inspection time. This option could become more meaningful in an enhanced version when the functionality of inspection area is defined more clearly.

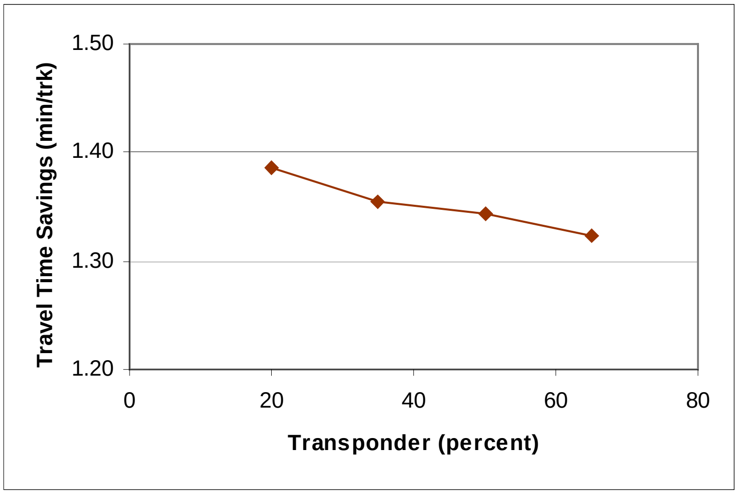
Appendix Four: Simulation Output

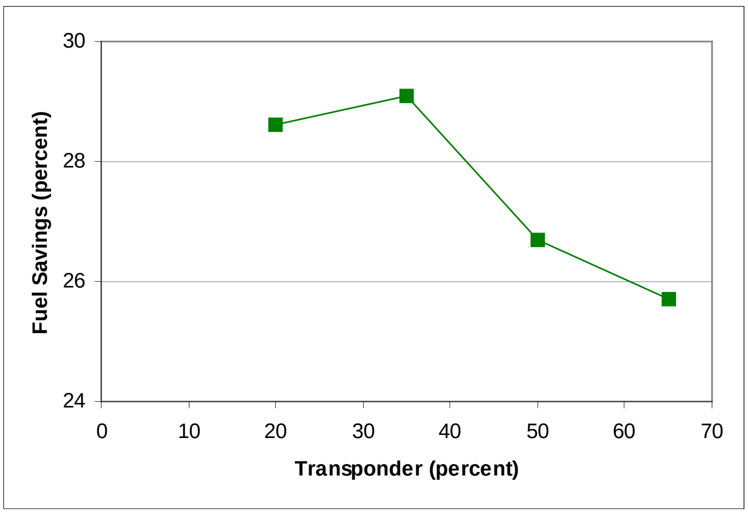
340 Vehicles per Hour-

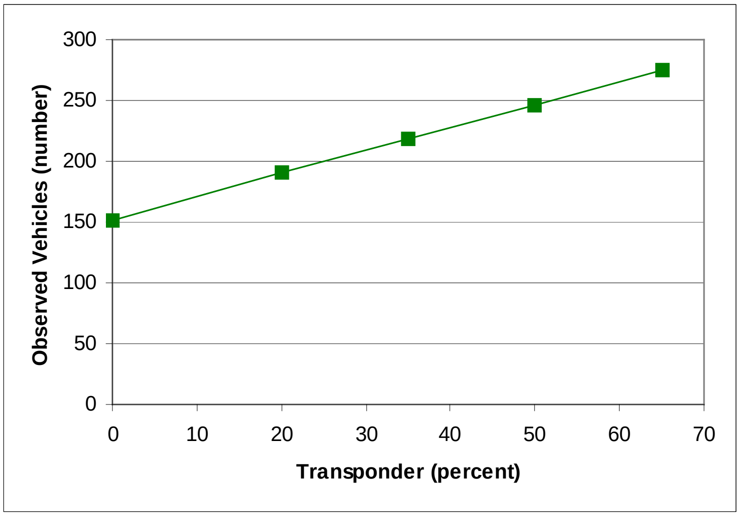
Transponder Rate	Pullin (seconds/truck)	Bypass (seconds/truck)	Travel Time Savings (min/trk)
20%	162.7	79.5	1.39
35%	160.7	79.4	1.36
50%	160.0	79.4	1.34
65%	158.8	79.4	1.32

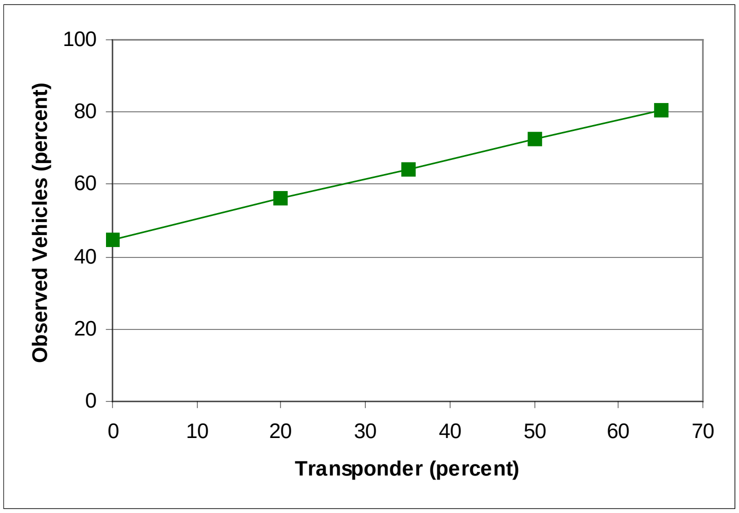
Transponder Rate	Fuel Savings-Mainline Segment v. Weigh Station Segment	Unobserved Bypasses
0%		1
20%	28.6%	0
30%	29.1%	0
50%	26.7%	0
65%	25.7%	0

Transponder Rate	Screened Vehicles- Electronically Screened + Static Scale	
	Number	As Percent of Overall Truck Traffic
0%	151	45%
20%	190	56%
30%	218	64%
50%	247	73%
65%	275	81%


Travel Time Savings (min/trk)
1.50
1.40
1.30
1.20
0
20
40
60
80
Transponder (percent)


Fuel Savings (percent)
30
28
26
24
0
10
20
30
40
50
60
70
Transponder (percent)


Observed Vehicles (number)
300
250
200
150
100
50
0
0
10
20
30
40
50
60
70
Transponder (percent)

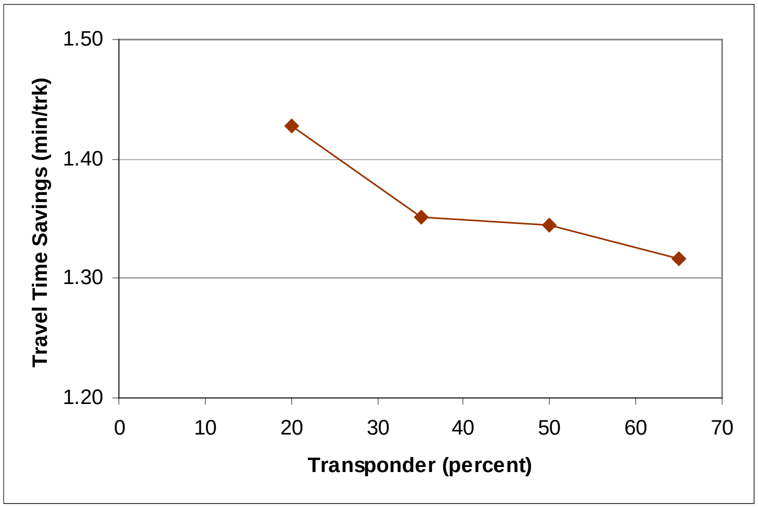

Observed Vehicles (percent)
100
80
60
40
20
0
0
10
20
30
40
50
60
70
Transponder (percent)

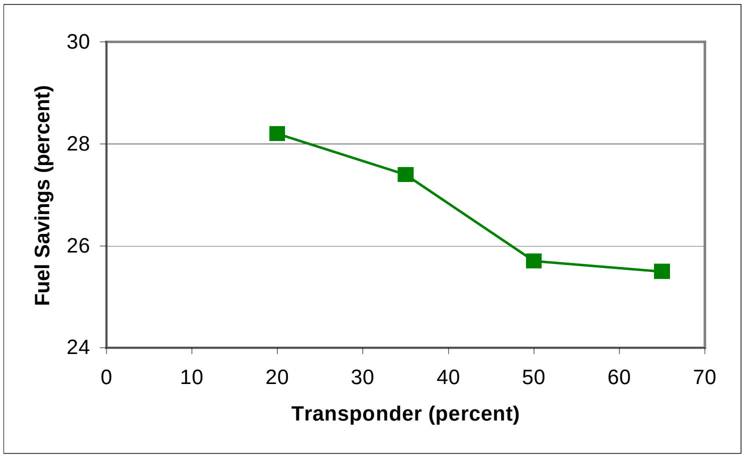
375 Vehicles per Hour-

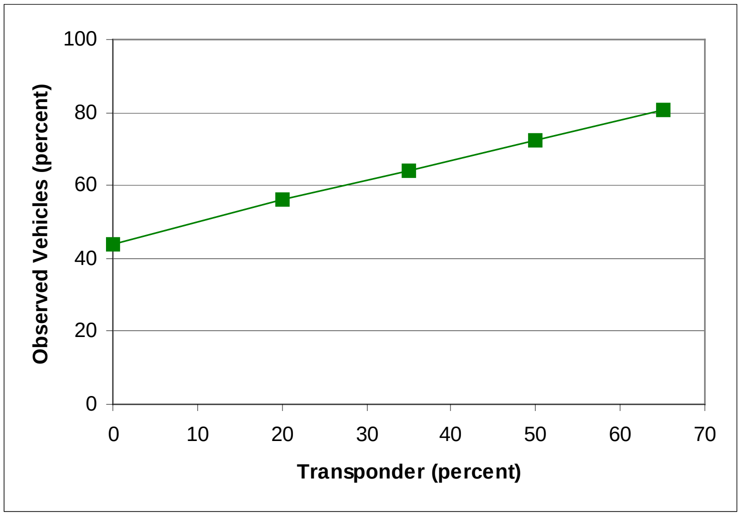
Transponder Rate	Pullin (seconds/truck)	Bypass (seconds/truck)	Travel Time Savings (min/trk)
20%	165.0	79.4	1.43
35%	160.5	79.4	1.35
50%	160.1	79.4	1.34
65%	158.4	79.4	1.32

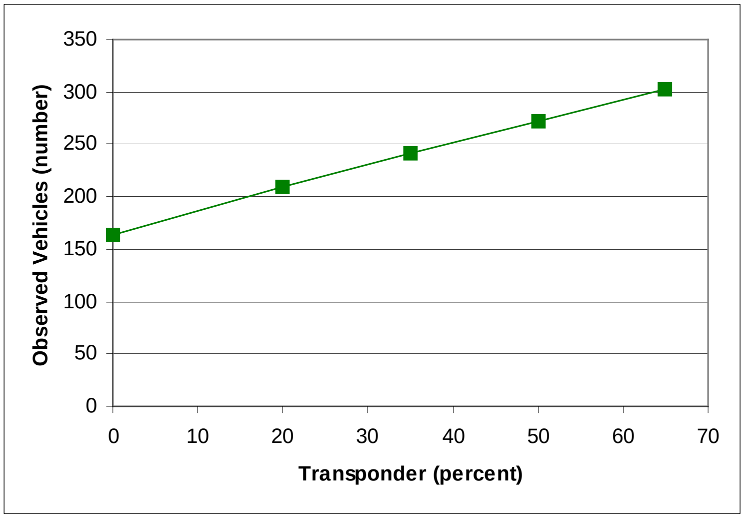
Transponder Rate	Fuel Savings-Mainline Segment v. Weigh Station Segment	Unobserved Bypasses
0%		3
20%	28.2	0
30%	27.4	0
50%	25.7	0
65%	25.5	0

Transponder Rate	Screened Vehicles- Electronically Screened + Static Scale	
	Number	As Percent of Overall Truck Traffic
0%	164	44%
20%	210	56%
30%	241	64%
50%	272	73%
65%	303	81%


Travel Time Savings (min/trk)
1.50
1.40
1.30
1.20
0
10
20
30
40
50
60
70
Transponder (percent)


Fuel Savings (percent)
30
28
26
24
0
10
20
30
40
50
60
70
Transponder (percent)


Observed Vehicles (percent)
100
80
60
40
20
0
0
10
20
30
40
50
60
70
Transponder (percent)

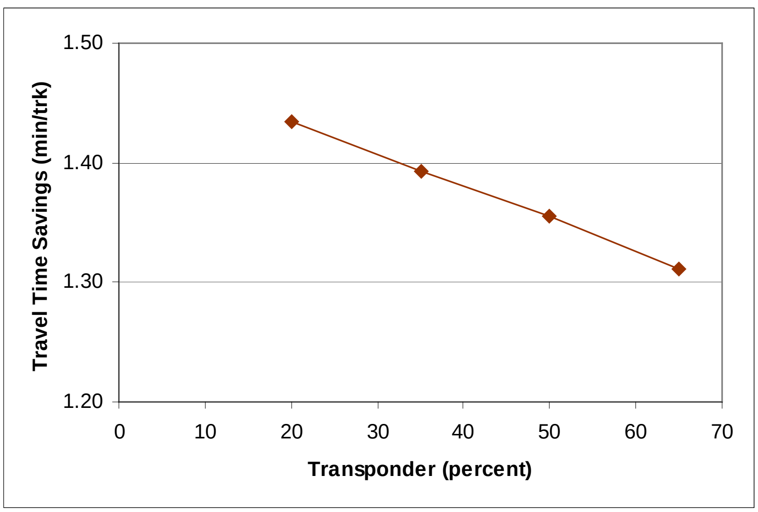


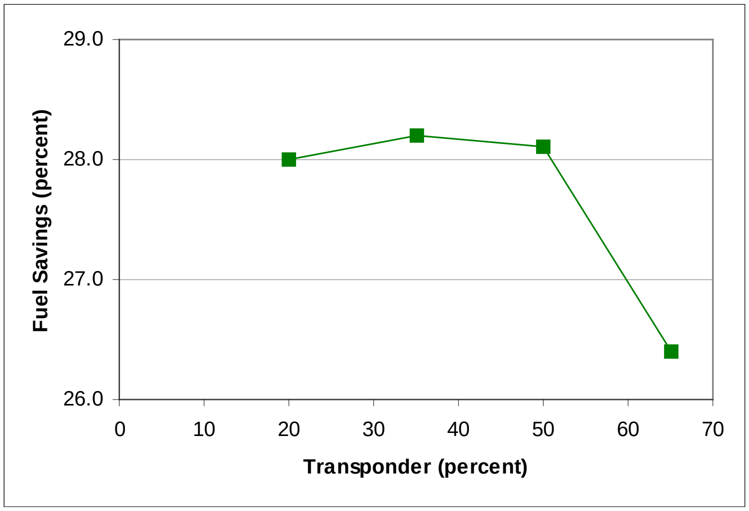
410 Vehicles per Hour-

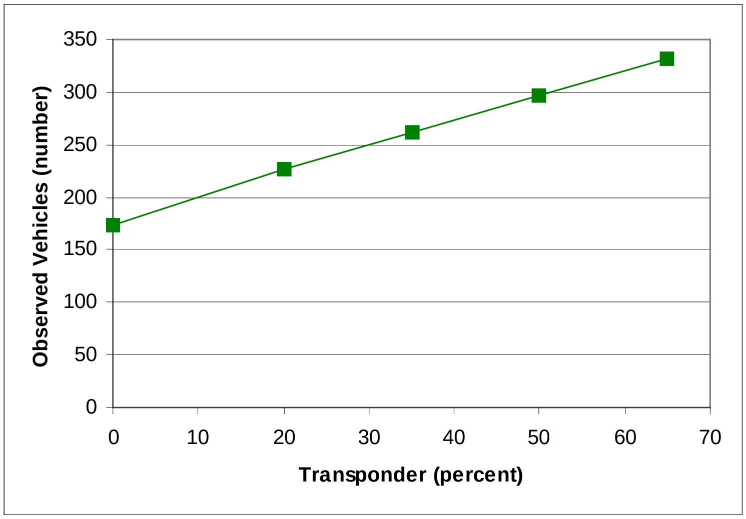
Transponder Rate	Pullin (seconds/truck)	Bypass (seconds/truck)	Travel Time Savings (min/trk)
20%	165.6	79.6	1.43
35%	163.2	79.6	1.39
50%	161.0	79.6	1.36
65%	158.2	79.5	1.31

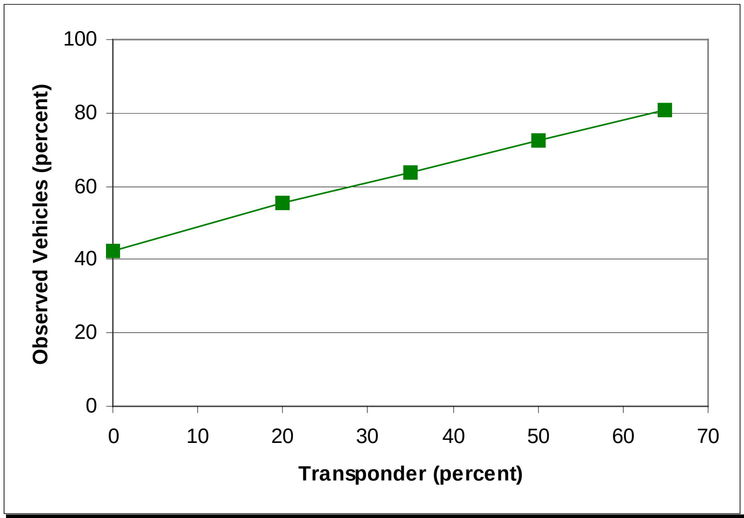
Transponder Rate	Fuel Savings-Mainline Segment v. Weigh Station Segment	Unobserved Bypasses
0%		6
20%	28.0%	2
30%	28.2%	1
50%	28.1%	0
65%	26.4%	0

Transponder Rate	Screened Vehicles- Electronically Screened + Static Scale	
	Number	As Percent of Overall Truck Traffic
0%	173	42%
20%	227	55%
30%	262	64%
50%	297	73%
65%	331	81%




29.0
28.0
27.0
26.0
Fuel Savings (percent)
0
10
20
30
40
50
60
70
Transponder (percent)


350
300
250
200
150
100
50
0
Observed Vehicles (number)
0
10
20
30
40
50
60
70
Transponder (percent)


100
80
60
40
20
0
Observed Vehicles (percent)
0
10
20
30
40
50
60
70
Transponder (percent)

Oregon Green Light
CVO Evaluation

FINAL REPORT

DETAILED TEST PLAN 8

System Availability

Bill McCall

Center for Transportation Research and Education

Iowa State University

Ames, IA 50010

Condcuted by sub-contract for Oregon State University
Transportation Research Institute
Trasnportation Research Report No. 00-017

June 2000

ACKNOWLEDGEMENTS

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The authors are indebted to the personnel of ODOT's Motor Carrier Transportation Branch, who have provided information and data to the evaluation team throughout the project. We are particularly indebted to Ken Evert, Gregg Dal Ponte, Randal Thomas and David Fifer. Ken's untimely death in 1998 meant that he did not see his vision completed. The evaluation team is forever indebted to him for his support and for the opportunity to participate in the deployment.

TABLE OF CONTENTS

1 INTRODUCTION

This result of conducting Detailed Test Plan 8 provides an assessment of the system's availability to both the motor carrier and the weighmasters for an established time period. The Green Light System is very complex and extensive. Exhibit 1-1, Functional Architecture for Oregon Green Light, illustrates the architecture of mainline electronic screening including national interoperability. The architecture has been updated to reflect minor changes. The availability of the system to motor carriers and weighmasters is dependent on each of the databases and connecting links functioning correctly. System availability to motor carriers and weighmasters begins with the roadside subsystem. Exhibit 1-2, Roadside Subsystem Architecture, illustrates this subsystem. The roadside architecture has been updated to include minor changes. System availability to motor carriers and weighmasters depends on each of the elements within the subsystem and connecting links functioning correctly.

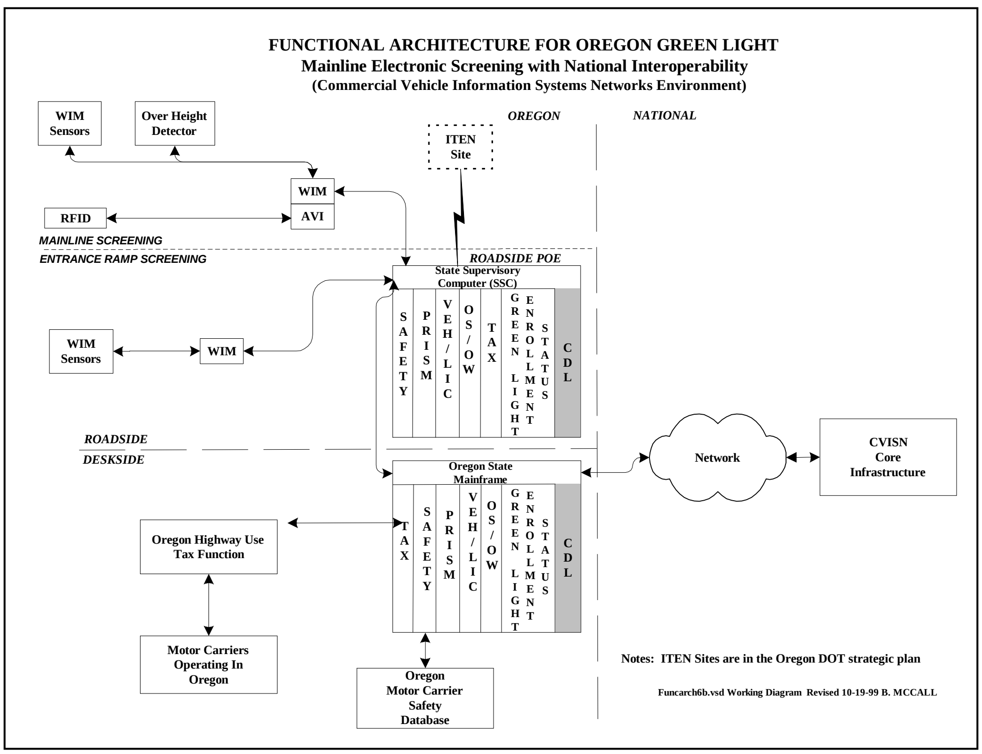


Exhibit 1-1, Functional Architecture for Oregon Green Light

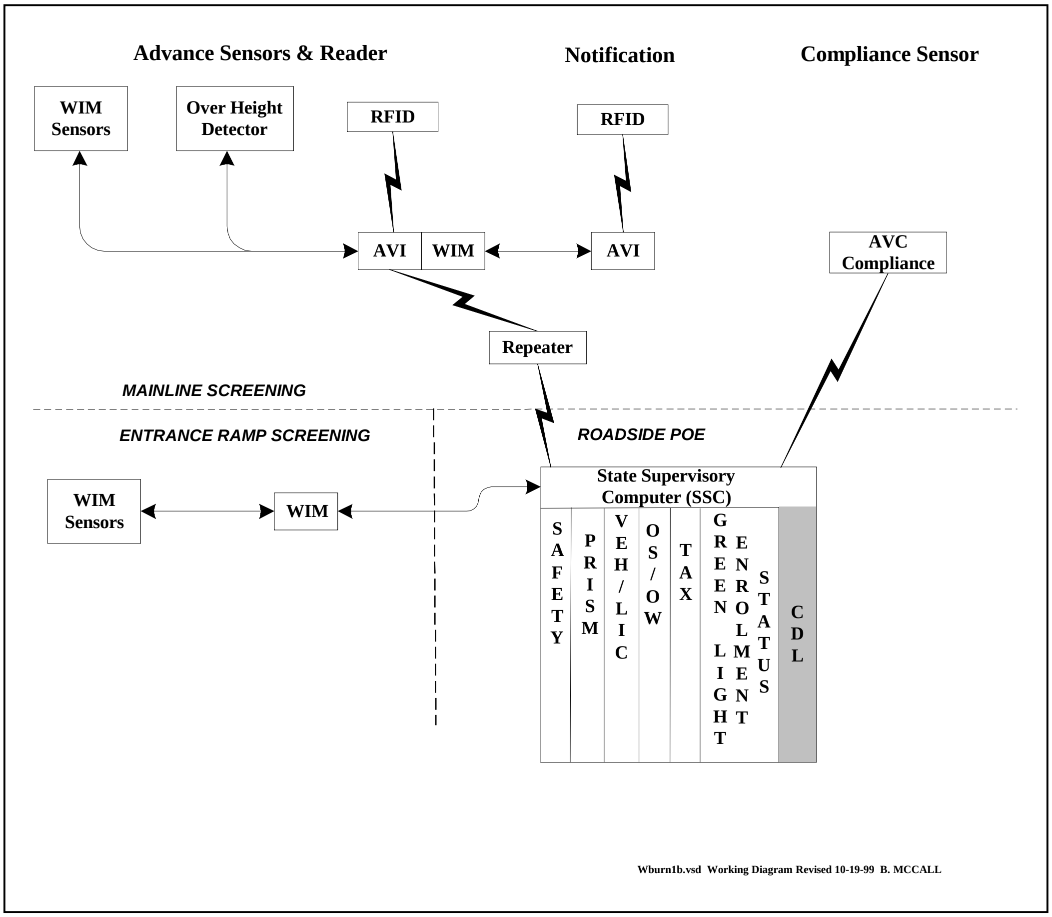


Exhibit 1-2, Roadside Architecture

The scope of this evaluation will include the observation and quantification of “trouble” reports reported motor carriers, the Oregon Department of Transportation (ODOT), and the system integrator, International Road Dynamics (IRD). ODOT assumed the role of transponder administrator in March 2000. The transponder administrator role includes distributing and maintaining the Dedicated Short Range Communications (DSRC) tags.

In addition, ODOT conducts first level failure analysis, First level failure analysis includes checking the physical condition of the tag and battery condition. If the first level failure analysis does not identify the cause of failure, the tag is returned to the manufacture for failure analysis and repair or replacement. IRD is responsible for maintenance of the roadside subsystem for the duration of the operational test.

2 SCOPE

This evaluation will document statewide electronic screening system availability in terms of the percent of time that the roadside system (Automated Vehicle Identification, Weigh in Motion Scale, Automated Vehicle Classification, the connection to state supervisory computer system, and headquarters databases) is available to the weighmasters, and; the percent of distributed transponders functioning for motor carriers as intended. Therefore, the availability of electronic screening to motor carriers and weighmasters is the sum of the time that the transponder is functional and the time that roadside system is functional. In addition to the quantitative analysis, CTRE will also attempt to document the causes for electronic screening system failure and the corrective action taken.

For the second part of this evaluation, the research team will focus on system availability for a specific subgroup of carriers, long combination vehicles (LCV), at a single weigh station. CTRE will track the experience of these long combination vehicles at the Farewell Bend POE, site 2, located on Interstate 84 near the Idaho border. See Exhibit 5-1 for the location of the Farewell Bend POE. The Multi-Jurisdiction Automated Preclearance System (MAPS) that included the states of Idaho, Oregon, Utah, and Washington became a part of NORPASS. Oregon has resigned from NORPASS. However, Oregon continues to work with the states of Idaho and Utah to provide preclearance to LCV's.

The long combination vehicle operators are of interest for two primary reasons. First, long combination vehicles are exceptional in that they do not fit within the State's size restrictions. Their automated exception status will provide a test of the flexibility of the preclearance system. This systems evaluation will allow participants to begin to measure effectiveness of Green Light program.

3 MEASURES OF EFFECTIVENESS AND HYPOTHESIS

The evaluation measures used to make an assessment of the Green Light system are stated below:

- **Observe Overall System Availability to Weighmasters and Motor Carriers**
- **Observe System Availability to Long Combination Vehicles at Farewell Bend Weigh Station.**

The following hypothesis is given in support of the two measures and will be tested according to accepted statistical techniques should it be necessary to utilize them:

- **The overall system availability will be approximately 95%.**
- **The system availability for long combination vehicles at Farewell Bend will be approximately 95%.**

4 DATA SOURCES AND AVAILABILITY

The evaluation was organized according to preclearance sequence primary trouble categories. The evaluation is based on the ODOT, motor carriers, and IRD following trouble reporting communication channels and service requests and corrective actions processes. The results are recorded in the trouble report master log. The following paragraphs will provide discussion on each of the elements.

The preclearance system is divided into the sub-systems shown in Exhibit 4-1, Preclearance Sequence Sub-Systems. This evaluation includes the transponder, automated vehicle identification (AVI) and weigh-in-motion (WIM) sub-systems. The communications, state supervisory computer, and ODOT databases are grouped.

Service requests follow the structure shown in Exhibit 4-2, Service Request Communication Structure. Exhibit 4-2 includes the relationship among the elements in the structure. For example, the relationship between motor carriers and the ITS Specialist – ODOT is a service relationship.

Solutions to service requests follow the structure shown in Exhibit 4-3, Solutions to Service Requests Communications Structure. The ITS Specialist communicates the solution to the Motor Carrier, System Integrator, and Field Offices Motor Carrier Enforcement Officer (MCEO) and registration function depending on the problem identified in the service request. For example, the solution to service request submitted by the MCEO involving a Motor Carrier will be reported to the MCEO, Motor Carrier, and System Integrator. The driver failing to receive and in cab notification is an example.

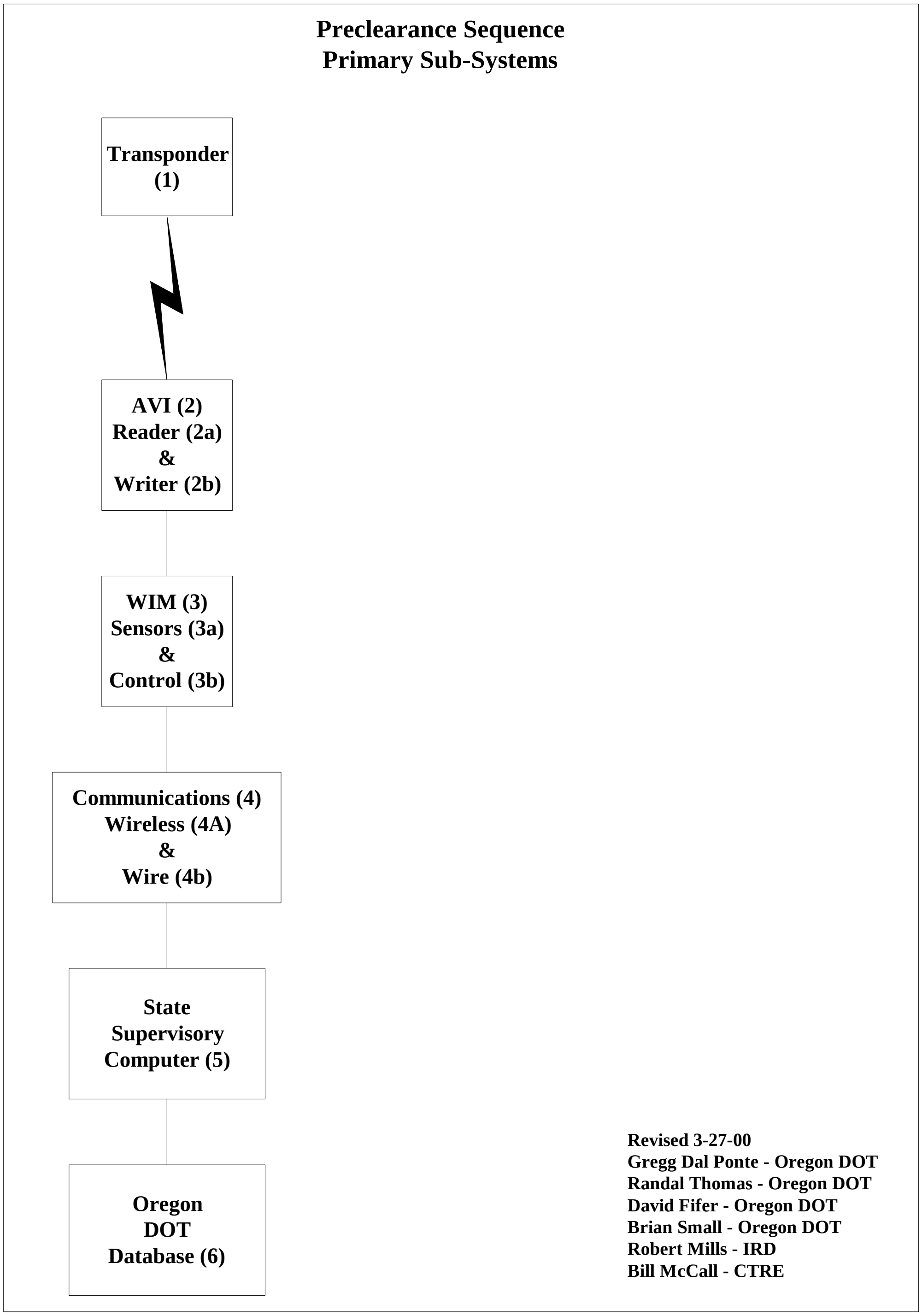


Exhibit 4-1, Preclearance Sequence Primary Sub-Systems

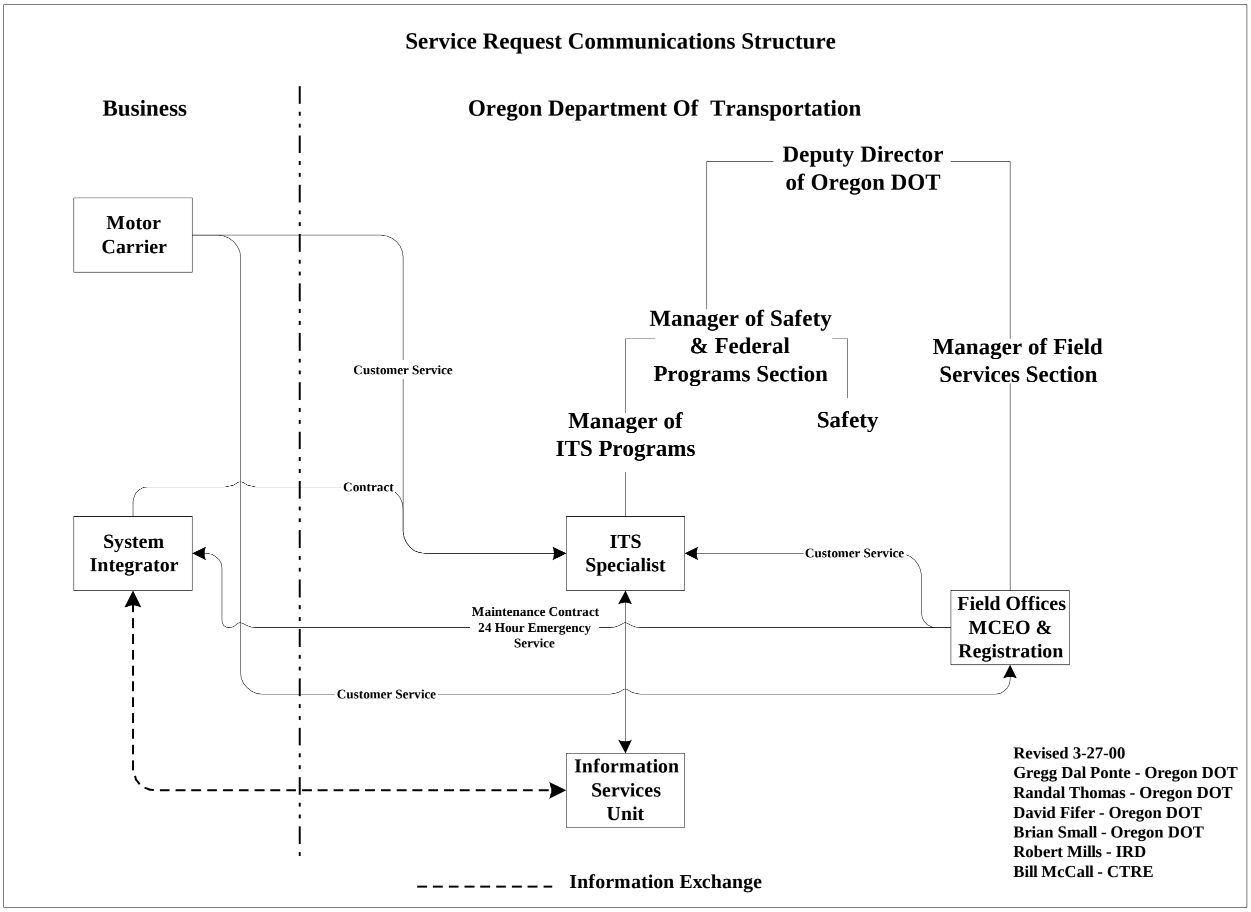


Exhibit 4-2, Service Request Communication Structure

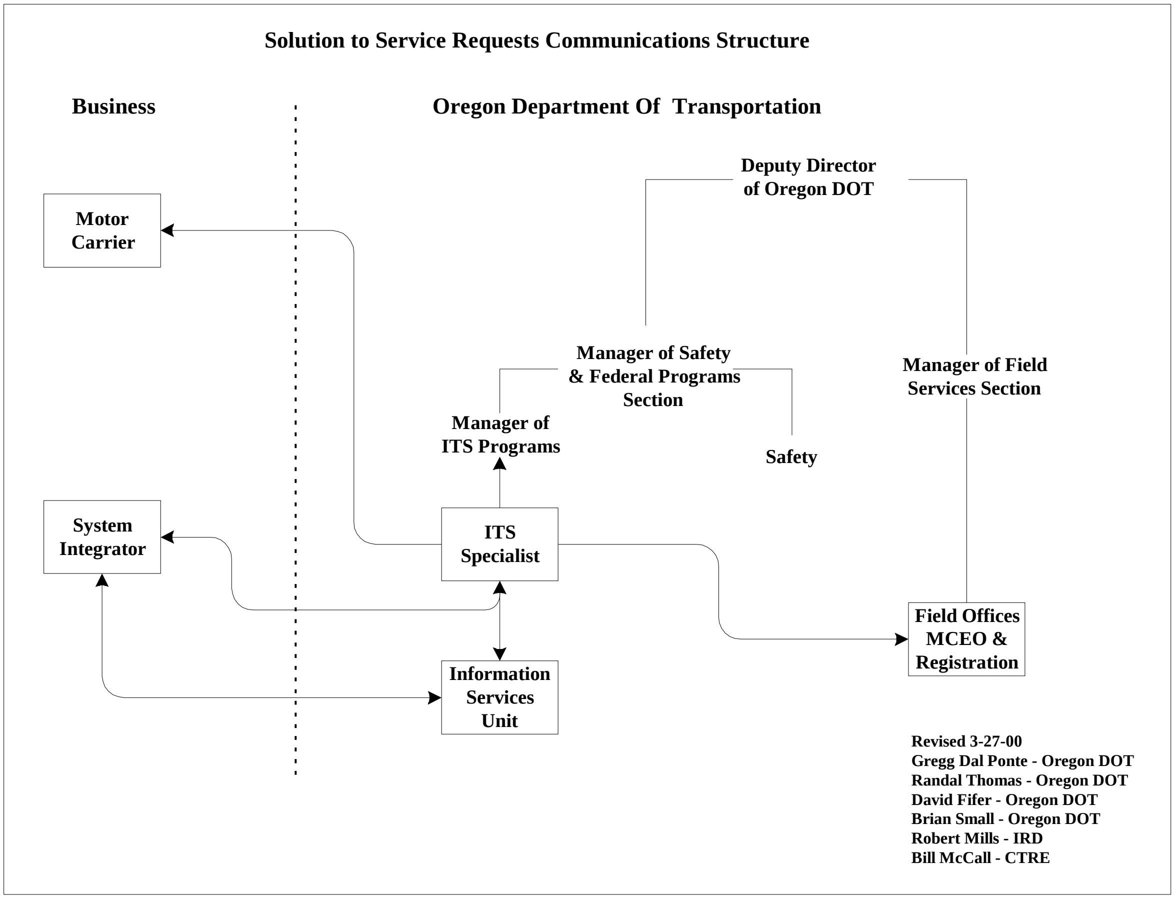


Exhibit 4-3, Solution to Service Requests Communications Structure

The request for service and corrective action follows the process flow shown in Exhibit 4-4, Service Request and Corrective Action Process Flow. Examples of records listed in cases when the Motor Carrier Enforcement Officer (MCEO) replaces a transponder and in cases when the Headquarters Check is conducted are in Appendix A.

The request for service and corrective action requires a log be maintained. An example of the log is shown in Exhibit 4-5, Trouble Report Master Log. The current log is in Appendix B. A list of the error codes used in the Log is in Appendix C.

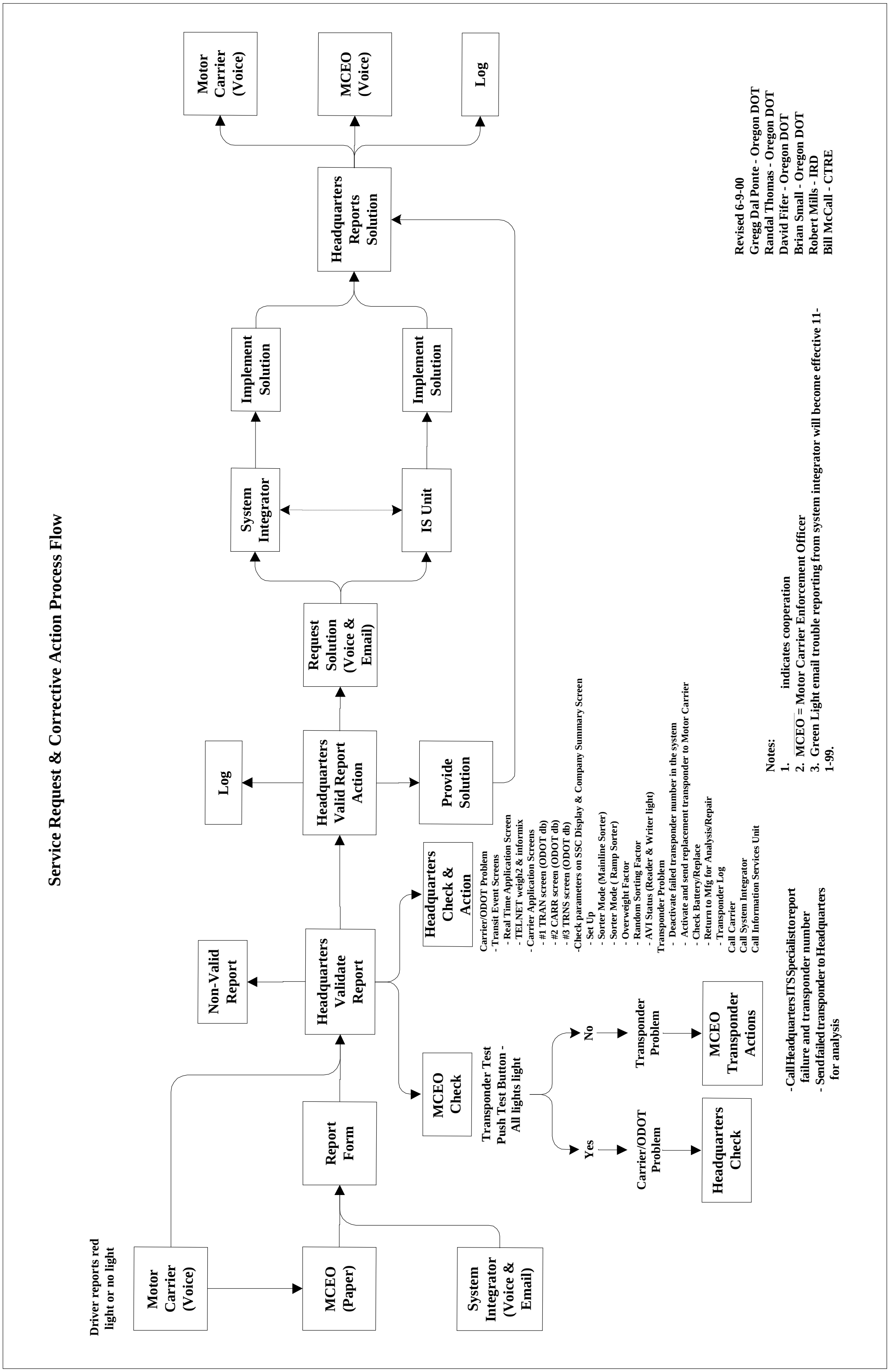


Exhibit 4-4, Service Request and Corrective Action Process Flow

Green Light Administration

Trouble Report Master Log (Accepted Sites)

Report # codes: Ashland S.B. (SBA); Ashland POE (ASH); Booth Ranch (BOO); Brightwood E.B. (EBB); Brightwood W.B. (WBB); Cascade Locks POE (CCL); Emigrant Hill (EMH); Farewell Bend POE (FAB); Juniper Butte N.B. (NBJ); Juniper Butte S.B. (SBJ); Klamath Falls POE (KFA); Klamath Falls S.B. (SBK); LaGrande (EBL); Lowell (LOW); Olds Ferry (OFY); Rocky Point (ROK); Umatilla (UMA); Wilbur (WIL); Woodburn N.B. (NBW); Woodburn POE (WOO); Wyeth (WBW)

Pending - On-going problem, solution still in progress

Report #	Report Type	Report Description	Reported By	Report Date	Solution Date	Down Time (hours)	Received By	Notes/Resolution
WOO 1	Ramp	Sorter not working properly - when set to credential weight, it only sends trucks > 80K. It should be set at 60K.	MCEO	10/25/99	10/25/99	2	ITS Specialist	IRD remotely adjusted parameters of the sorter software
ASH 1	AVI	Motor Carrier received a red light, however the system indicated "WBLOWM," a bypass code	MCEO	11/2/99	11/2/99	0	ITS Specialist	ITS Specialist reviewed the carrier history, and determined that this was an isolated event.
ASH 2	AVI	Motor did not receive an in cab signal	MCEO	11/4/99	11/4/99	0	ITS Specialist	ITS Specialist reviewed the event history for this truck and found that it was at the Woodburn N.B. Weigh Station during the time of the report, NOT at Ashland.

Exhibit 4-5, Example Trouble Report Log

5 PRECLEARANCE SYSTEM LOCATION ACCEPTANCE AND TRANSPONDERS ISSUED

Table 5-1, Site Acceptance and Availability Log provides a list of all the location preclearance will be deployed, the date sites were accepted as operational, and accepted site availability. LaGrande, Ashland SB, and Olds Ferry are open about 34 to 40 hours per week. To calculate hours since acceptance, 37 hours per week is used. All other accepted sites are open 24 hours per day seven days a week. Exhibit 5-1, Green Light Preclearance Sites shows the location of sites.

The number of transponders issued by March 1, 2000 was 4800. 800 motor carriers were participating in Green Light as of March 1, 2000. The number of transponders issued as of April 13, 2000 is 10100. 922 motor carriers are participating in Green Light as of April 13, 2000.

GREEN LIGHT PROGRAM

Site Acceptance and Availability Log

SITE NUMBER	SITE NAME	ACCEPTANCE DATE	HOURS SINCE ACCEPTANCE	DOWN TIME HOURS	HOURS OF AVAILABILITY	% AVAILABILITY
4	Ashland N.B. (POE)	8/1/99	6216	56	6160	99%
5	Ashland S.B.	8/1/99	1628	0	1628	100%
11	Booth Ranch					
20	Brightwood E.B.					
19	Brightwood W.B.					
17	Cascade Locks (POE)					
8	Emigrant Hill					
2	Farewell Bend (POE)	11/1/99	4008	3	4005	100%
12	Juniper Butte N.B.					
13	Juniper Butte S.B.					
14	Klamath Falls N.B. (POE)					
15	Klamath Falls S.B.					
7	LaGrande	10/1/99	1190	72	1118	94%
16	Lowell					
3	Olds Ferry	8/1/99	1628	0	1628	100%
21	Rocky Point					
6	Umatilla (POE)	10/1/99	4752	24	4728	99%
10	Wilbur					
9	Woodburn N.B.					
1	Woodburn S.B. (POE)	2/1/99	10560	153	10407	99%
18	Wyeth					

Table 5-1, Sites Acceptance and Availability Log

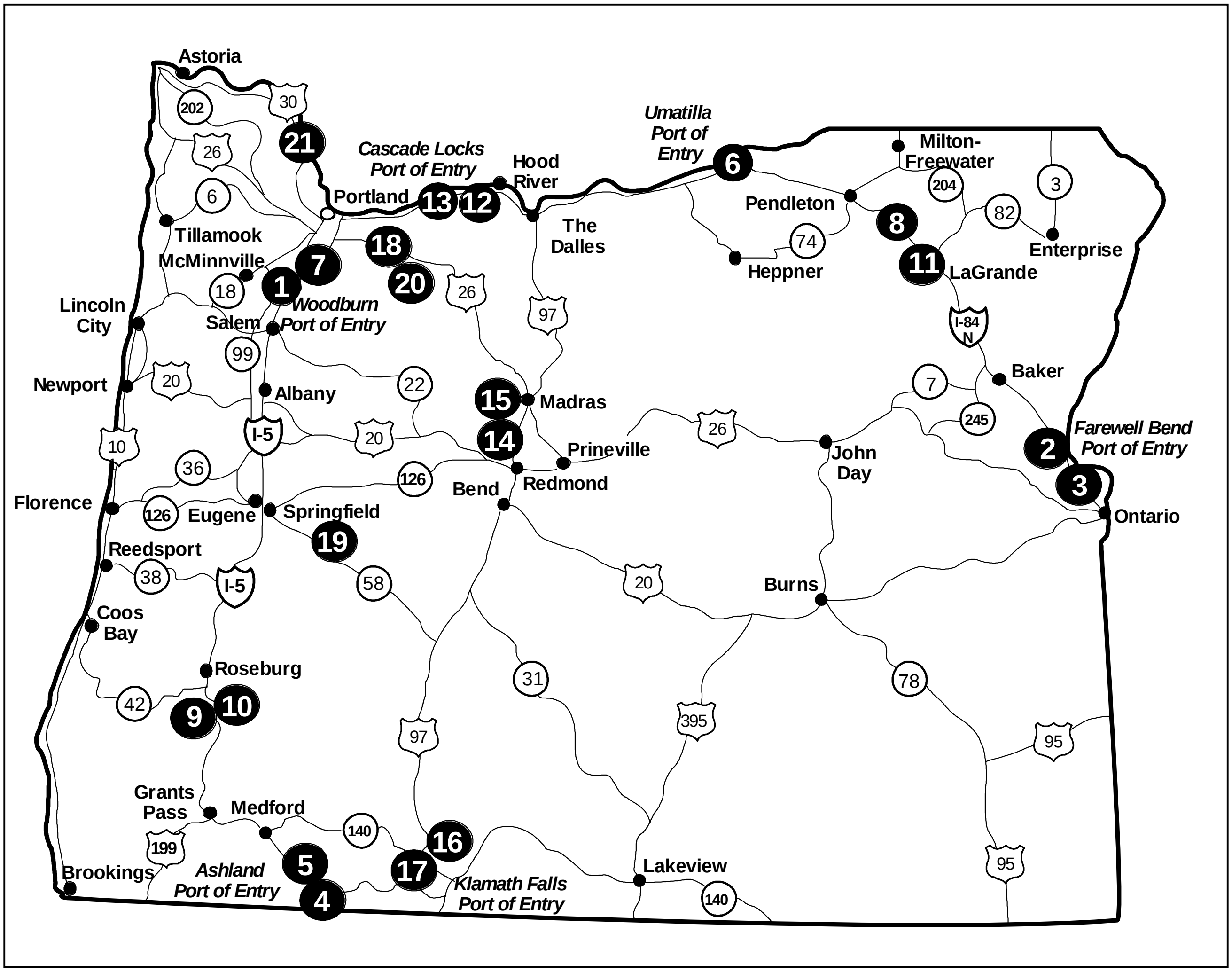


Exhibit 5-1, Green Light Preclearance Sites

6 DATA ANALYSIS

This section will include an assessment of the transponder availability and roadside system availability. The basic data collection sources are the Trouble Report Master Log. Trouble reports and corrective action reports prepared as a deliverable by the Transponder Administrator, the system integrator, International Road Dynamics, and ODOT and recorded in the Trouble Report Master Log. An example is shown in Exhibit 4-5. The Log includes the Report Number, Report Type, Report Description, Reported By, Report Date, Solution Date, Down Time, Received By, and Notes/Resolution. Down Time is defined as an event that interferes with the preclearance process. For example, a driver not receiving the correct in-cab notification or a motor carrier enforcement officer not receiving data enabling the officer to support the preclearance process.

The evaluation was designed to take place for a two-year period after the roadside systems were accepted. However, the deployment of the Green Light preclearance was delayed. Therefore, evaluation cannot be completed as planned. However, based on the data collected for the seven sites that are operational at the writing of this report the following evaluation of the project can be made.

6.1 ASSESSMENT OF TRANSPONDER AVAILABILITY

The transponder availability was to be determined by subtracting downtime from total hours in the two-year period (17520 hours) and then dividing by total hours. A summary of overall transponder availability was to be made by aggregating individual transponder availability. Based on the limited data available observations will be made regarding transponder availability.

6.2 ASSESSMENT OF ROADSIDE SUBSYSTEM AVAILABILITY

The roadside system availability was to be determined by subtracting downtime from total hours in the two-year period (17520 hours) and then dividing by total hours. A summary of overall roadside system availability was to be made by aggregating individual system availability. The roadside system availability is determined by subtracting downtime from total number of hours the site was available following site acceptance. The availability of all roadside sub-systems is determined by aggregating individual roadside subsystem availability. Based on the limited data available observations will be made regarding roadside system availability

6.3 ASSESS TOTAL SYSTEM AVAILABILITY FOR LONG COMBINATION VEHICLES AT FAREWELL BEND

The roadside system availability at Farewell Bend for long combination vehicles was to be determined by subtracting downtime from total hours in the two-year period (17520 hours) and then dividing by total hours. A summary of overall roadside system availability was to be made by aggregating individual system availability. The roadside system availability is determined by subtracting downtime from total number of hours the site was available following site acceptance. Exhibit 6-1, Farewell Bend LCV Log presents the data available regarding LCV activity at Farewell Bend. Based on the limited data available observations will be made regarding roadside system availability at Farewell Bend. System availability data will be extracted from the overall system availability data, using the LCV unit tag numbers.

Farewell Bend LCV Log

Date	Total LCV approaching FB (FAB)	Transponder Equipped	Enrolled in Green Light	Green Light Bypass	Green Light Report	Report Reason Code
April 30 thru May 6, 2000	328	81	46	32	14	HELP, Inc transponder

Exhibit 6-1, Farewell Bend LCV Log

7 RESULTS

The evaluation measures used to make an assessment of the Green Light system are stated below:

- **Observe Overall System Availability to Weighmasters and Motor Carriers**
- **Observe System Availability to Long Combination Vehicles at Farewell Bend Weigh Station.**

The following hypothesis is given in support of the two measures. It is not possible conduct a statistical valid analysis because the data is not available for the full two-year test period.

- **The overall system availability will be approximately 95%.**
- **The system availability for long combination vehicles at Farewell Bend will be approximately 95%.**

Table 5-1, Site Acceptance and Availability Log contains data supporting the observations.

Regarding the hypothesis that overall system availability will be approximately 95%, the observation can be made that based on a limited number of sites (7) being available for less than two years the overall system availability may be approximately 99%.

Total hours since acceptance = 29982

Total down time hours = 309

Total hours of availability = 29673

Regarding the hypothesis that the system availability for long combination vehicles at Farewell Bend will be approximately 95%, the observation can be made that based on the site being available for a relatively short time the system availability may be approximately 100%.

8 CONCLUSIONS

Although the seven sites currently in operation have not been functioning for two years, the trend certainly indicates the system will be available at least 95% of the time.

APPENDIX A

Examples of screens and databases

supporting the Service Request and Corrective Action Process

Real Time Application Screen

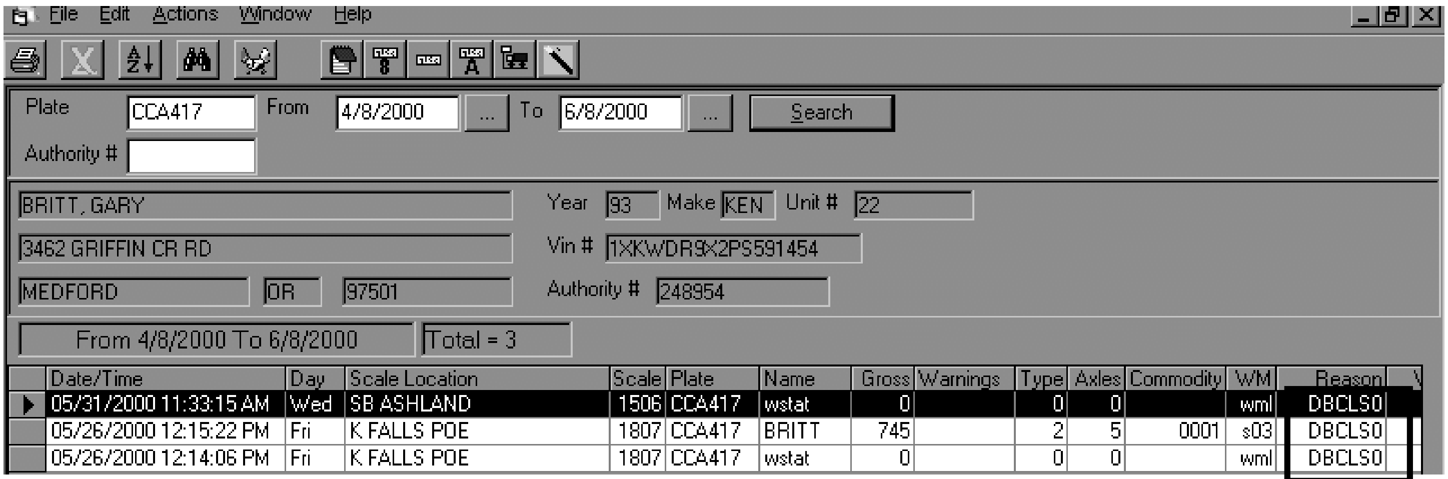

File Edit Actions Window Help

Plate CCA417 From 4/8/2000 ... To 6/8/2000 ... Search

Authority #

BRITT, GARY Year 93 Make KEN Unit # 22

3462 GRIFFIN CR RD Vin # 1XKWDR9X2PS591454

MEDFORD OR 97501 Authority # 248954

From 4/8/2000 To 6/8/2000 Total = 3

Date/Time	Day	Scale Location	Scale	Plate	Name	Gross	Warnings	Type	Axles	Commodity	WM	Reason
05/31/2000 11:33:15 AM	Wed	SB ASHLAND	1506	CCA417	wstat	0		0	0		wml	DBCLS0
05/26/2000 12:15:22 PM	Fri	K FALLS POE	1807	CCA417	BRITT	745		2	5	0001	s03	DBCLS0
05/26/2000 12:14:06 PM	Fri	K FALLS POE	1807	CCA417	wstat	0		0	0		wml	DBCLS0

Verifies red light signals at multiple sites. Note the reason code

TELNET Screens

weigh2 – Each Green Light site can be individually accessed to show the most recent five transit events for a particular truck. Again, note the reason code.

```
Connected to SB Ashland

Plate: CCA417   Auth: 248954    Transponder: 000545264752
Carrier: BRITT, GARY
Level of Status: 4   Safety Rating: S
--------------------------------------------+
                                            |
                                            |
             Last 5 Transit Events          |
              Press <Esc> to Exit           |
                                            |
  Date         Time        Event     Reason |
 [2000/05/31] [11:33:15]  [r---]   [DBCLS0]|
 [          ] [        ]  [    ]   [      ]|
 [          ] [        ]  [    ]   [      ]|
 [          ] [        ]  [    ]   [      ]|
 [          ] [        ]  [    ]   [      ]|
                                            |
--------------------------------------------+
```

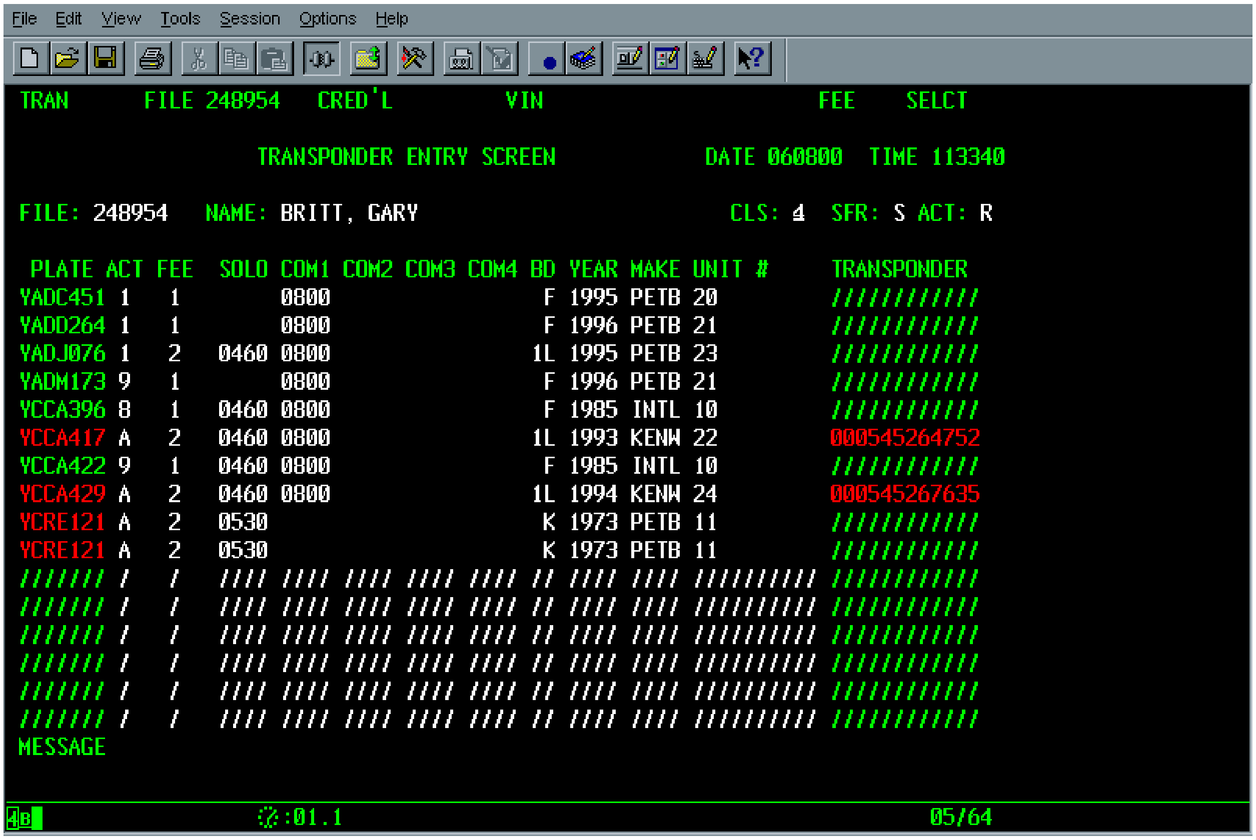
Informix– Each Green Light site computer can be individually accessed to verify truck specific information is properly downloaded to that respective site.

```
Connect  Edit  Terminal  Help
DISPLAY:   Next  Restart  Exit
Display next page of results.

----------------------- weigh@mcekfa


p1_file_id       02
p1_plate_no      CCA417
p1_packet_seq    1
p1_char_time     00724
p1_pak_action
p1_vehicle_id    1XKWDR9X2PS591454
p1_make          KEN
p1_company_no    22
p1_model_year    93
p1_body_type     1L
p1_auth_no       248954
p1_act_code      A
p1_saf_code
p1_owgt_permit   E
p1_transponder   000545264752
p1_saf_date
```

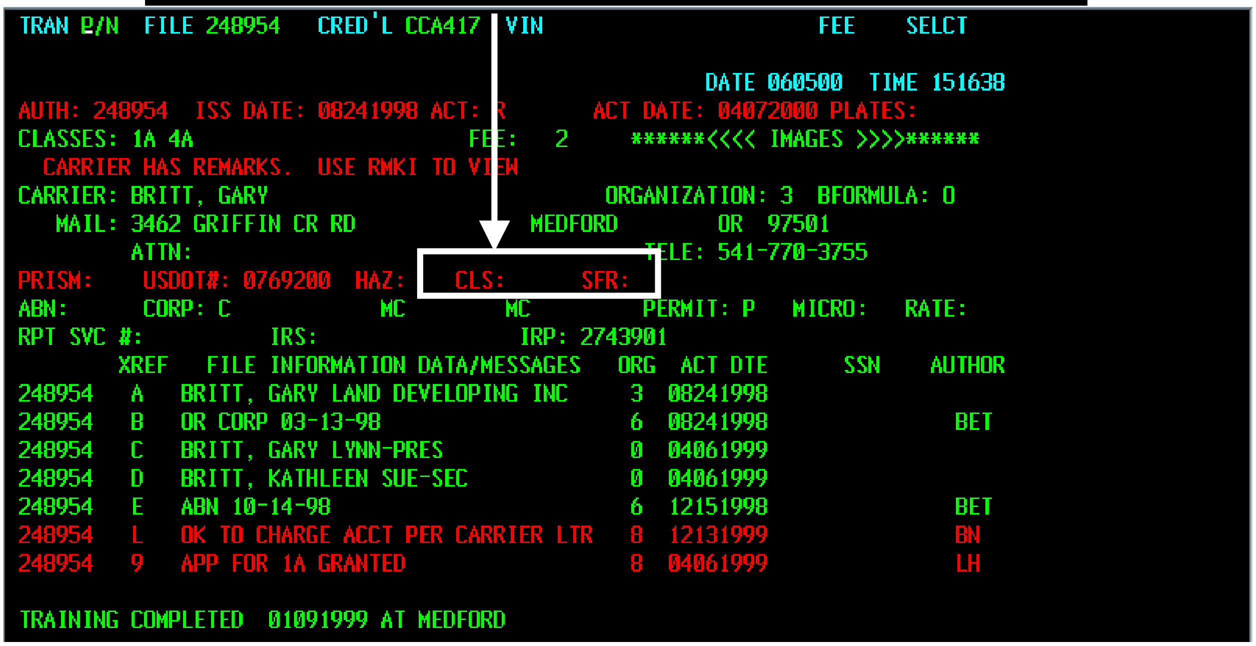
Corrected Database (TRNS) Carrier Information screen



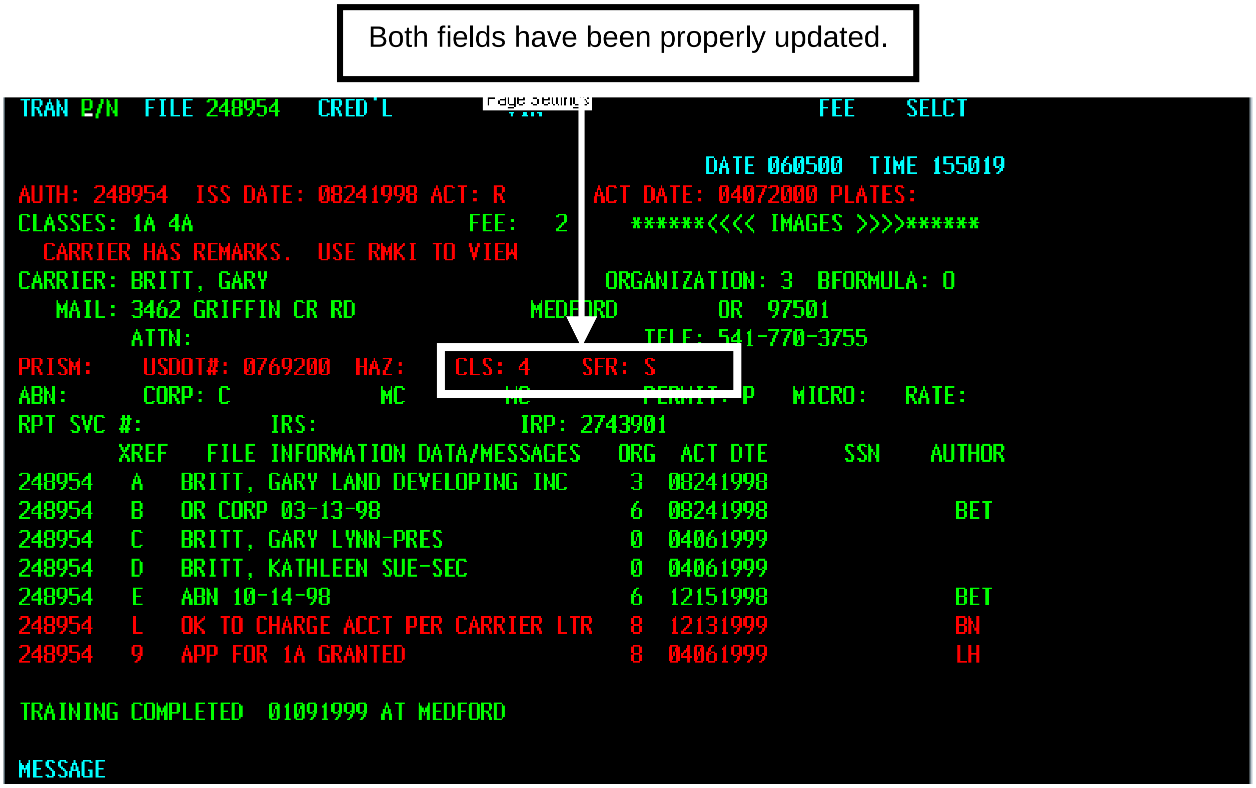
The "RED" highlighted fields indicate active plates/registration.
The "GREEN" highlighted fields indicate inactive plates/registration.
The /////// (any color) indicate blank fields.

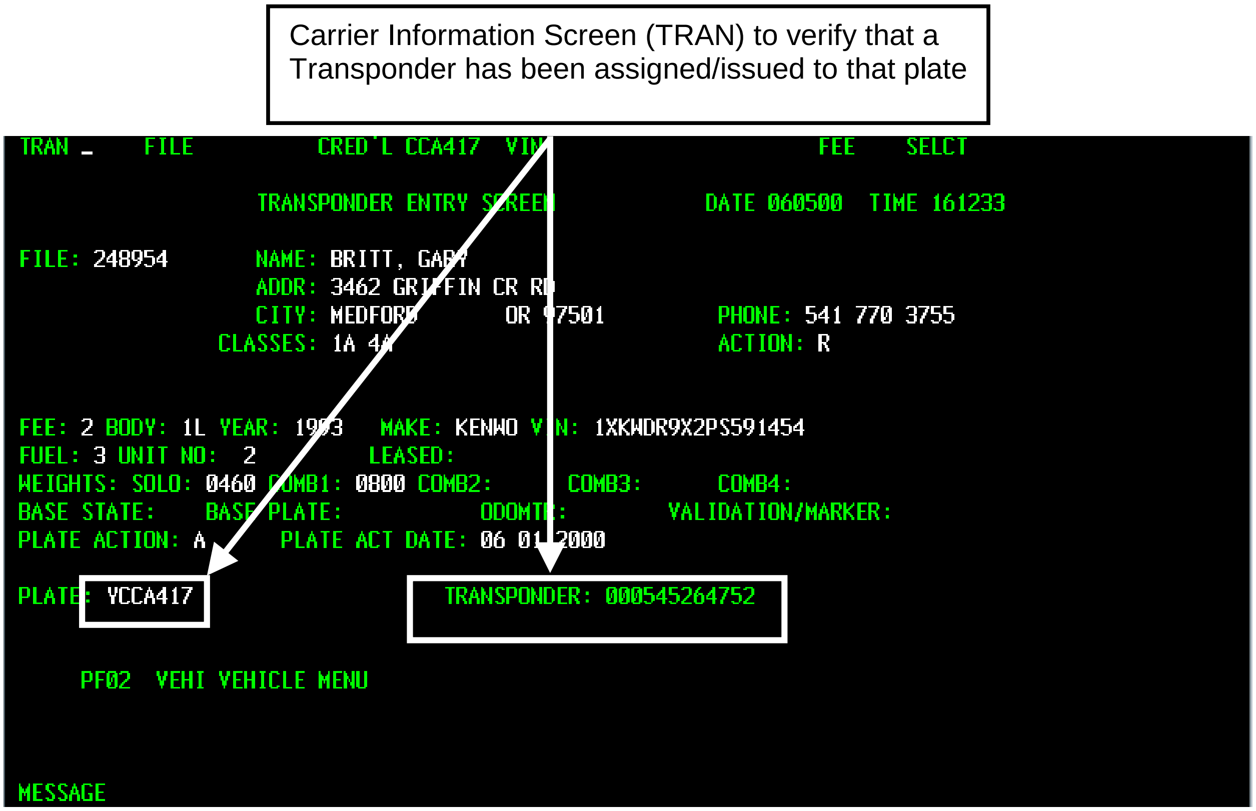
Database Carrier Information (CARR) screen prior to correction

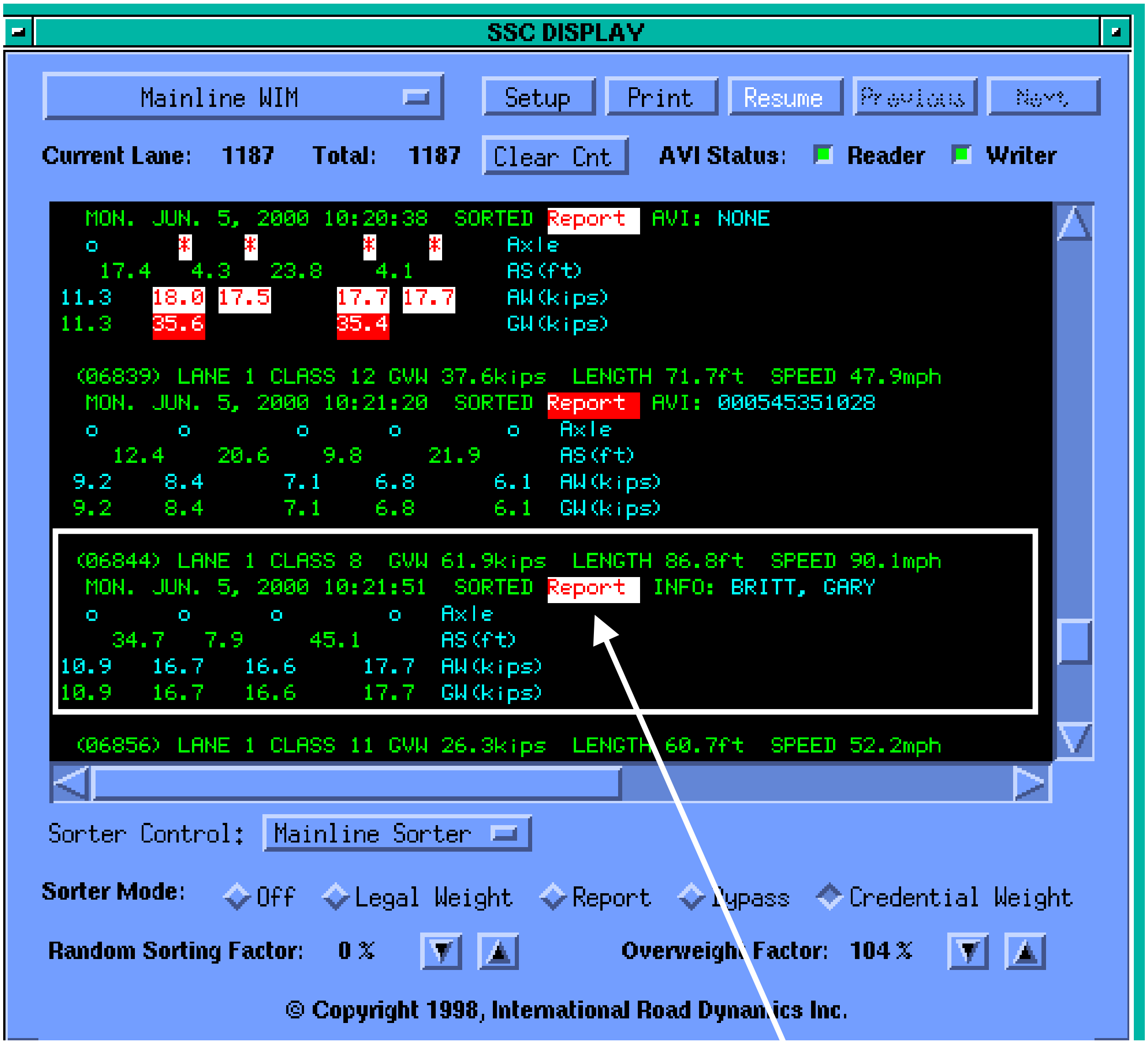
Both the CLS (Carrier Level of Service) and the SFR (Safety Fitness Rating) are blank. Please refer to the Report & Bypass Reason Codes chart for interpretation of these fields.



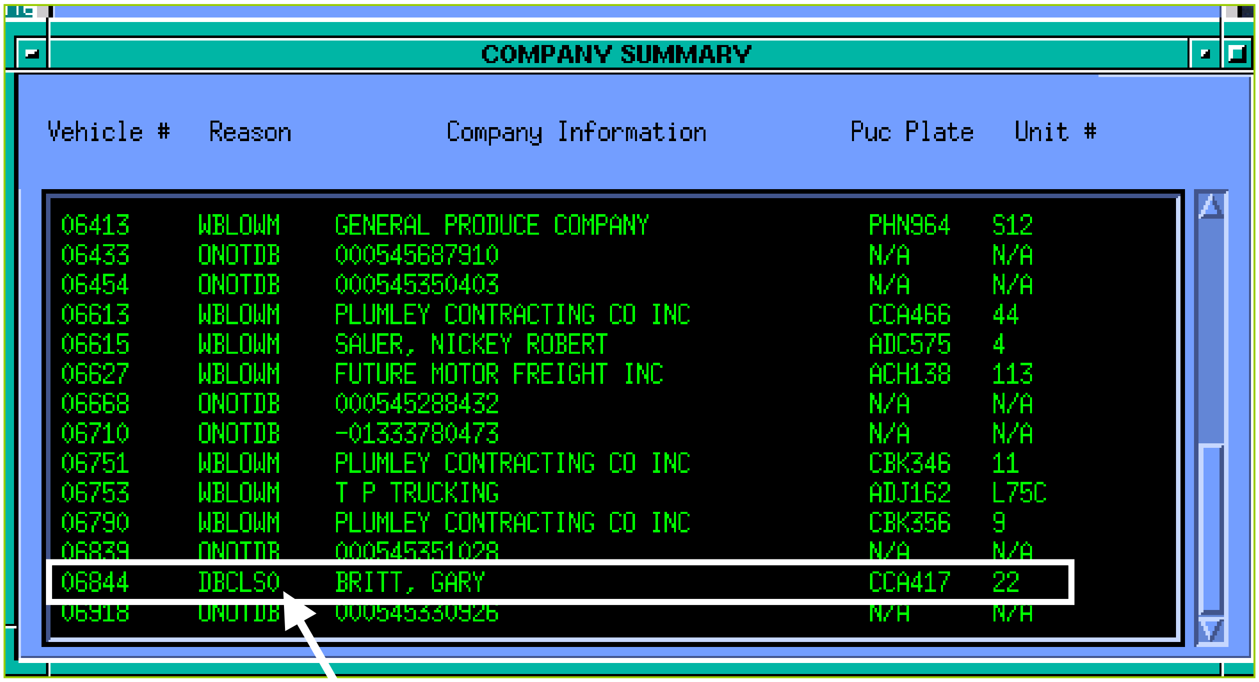
Corrected Database (CARR) Carrier Information screen




Carrier Information Screen (TRAN) to verify that a Transponder has been assigned/issued to that plate
TRAN _ FILE CRED'L CCA417 VIN FEE SELCT
TRANSPONDER ENTRY SCREEN DATE 060500 TIME 161233
FILE: 248954 NAME: BRITT, GARY
ADDR: 3462 GRIFFIN CR RD
CITY: MEDFORD OR 97501 PHONE: 541 770 3755
CLASSES: 1A 4A ACTION: R
FEE: 2 BODY: 1L YEAR: 1993 MAKE: KENWO VIN: 1XKWDR9X2PS591454
FUEL: 3 UNIT NO: 2 LEASED:
WEIGHTS: SOLO: 0460 COMB1: 0800 COMB2: COMB3: COMB4:
BASE STATE: BASE PLATE: ODOMTR: VALIDATION/MARKER:
PLATE ACTION: A PLATE ACT DATE: 06 01 2000
PLATE: YCCA417 TRANSPONDER: 000545264752
PF02 VEHI VEHICLE MENU
MESSAGE



This is a "real time" example of trouble shooting using the SSC Display in conjunction with the Company Summary screen. As you can see, the SSC Display indicates that Gary Britt received a red light signal to report to the weigh station.



Vehicle #	Reason	Company Information	Puc Plate	Unit #
06413	WBLOWM	GENERAL PRODUCE COMPANY	PHN964	S12
06433	ONOTDB	000545687910	N/A	N/A
06454	ONOTDB	000545350403	N/A	N/A
06613	WBLOWM	PLUMLEY CONTRACTING CO INC	CCA466	44
06615	WBLOWM	SAUER, NICKEY ROBERT	ADC575	4
06627	WBLOWM	FUTURE MOTOR FREIGHT INC	ACH138	113
06668	ONOTDB	000545288432	N/A	N/A
06710	ONOTDB	-01333780473	N/A	N/A
06751	WBLOWM	PLUMLEY CONTRACTING CO INC	CBK346	11
06753	WBLOWM	T P TRUCKING	ADJ162	L75C
06790	WBLOWM	PLUMLEY CONTRACTING CO INC	CBK356	9
06839	ONOTDB	000545351028	N/A	N/A
06844	DBCLSO	BRITT, GARY	CCA417	22
06918	ONOTDB	000545330926	N/A	N/A

The Company Summary screen displays the specific reason for the red light sort decision. In this case the “DBCLSO” (Database has a blank or invalid Carrier Level of Service Code) indicates that there is a database problem. The ITS Specialist was able to recognize and correct this problem immediately as it happened by updating the Carrier information in the ODOT database.

APPENDIX B

Green Light Administration

Trouble Report Master Log (Accepted Sites)

Report # codes: Ashland S.B. (SBA); Ashland POE (ASH); Booth Ranch (BOO); Brightwood E.B. (EBB); Brightwood W.B. (WBB); Cascade Locks POE (CCL); Emigrant Hill (EMH); Farewell Bend POE (FAB); Juniper Butte N.B. (NBJ); Juniper Butte S.B. (SBJ); Klamath Falls POE (KFA); Klamath Falls S.B. (SBK); LaGrande (EBL); Lowell (LOW); Olds Ferry (OFY); Rocky Point (ROK); Umatilla (UMA); Wilbur (WIL); Woodburn N.B. (NBW); Woodburn POE (WOO); Wyeth (WBW)

Pending - On-going problem, solution still in progress

Report #	Report Type	Report Description	Reported By	Report Date	Solution Date	Down Time (hours)	Received By	Notes/Resolution
WOO 1	Ramp	Sorter not working properly - when set to credential weight, it only sends trucks > 80K. It should be set at 60K.	MCEO	10/25/99	10/25/99	2	ITS Specialist	IRD remotely adjusted parameters of the sorter software
ASH 1	AVI	Motor Carrier received a red light, however the system indicated "WBLOWM," a bypass code	MCEO	11/2/99	11/2/99	0	ITS Specialist	ITS Specialist reviewed the carrier history, and determined that this was an isolated event.
ASH 2	AVI	Motor did not receive an in cab signal	MCEO	11/4/99	11/4/99	0	ITS Specialist	ITS Specialist reviewed the event history for this truck and found that it was at the Woodburn N.B. Weigh Station during the time of the report, NOT at Ashland.
EBL 1	WIM	Excessive number of "OMANIP" error codes	MCEO	12/9/99	12/12/99	72	ITS Specialist	The problem was with the axle-sensors missing axle hits. IRD configured the sensors out of their current set-up as a short term fix (this will sacrifice some accuracy, but will remain within acceptable threshold limits). These sensors will get replaced during scheduled road maintenance in the Spring of 2000.
ASH 3	AVI	Motor Carrier continually receives red lights at the POE, yet receives green lights at the SB side.	MCEO	12/15/99	12/15/99	0	ITS Specialist	ITS Specialist reviewed the event history of this truck, and site, and found that only 1 green light has been issued. This seems to be happening to this carrier only. Thus the problem may be placement of the transponder.

APPENDIX C

REPORT REASON CODES CHART

Report Categories	Code	Description/Meaning
MANIPULATION	OMANIP	WIM Manipulation Error
	OSPCHG	Excessive Speed change (Accel or Decel)
	O2SLOW	Vehicle travelling too slowly
	O2CLOS	Vehicle too close in front or behind
	ONUMAX	Invalid number of axles
WEIGHT	WAFRNT	Overweight front axle
	WAXn	Overweight single axle (n = position of overweight axle)
	WTAn	Overweight tandem axle (n = position of overweight axle)
	WTRIn	Overweight tridem (n = position of overweight axle)
	WSTRIn	Overweight short tridem, fitting into tandem definition (n = position of overweight axle)
	WCNOP	Overweight combination, without permit
	WCPSTD	Overweight combination, with permit, violating statute
	WCPEXT	Overweight combination, with permit, violating permit
OVERHEIGHT	HOVER	Overheight
SAFETY	SFLAG	Safety Flag set
	STHRES	Safety Inspection Threshold flag
DATABASE	ONOTRN	AVI does not find transponder
	ONOTDB	Transponder number not found within database
	OCRIER	Invalid carrier authority
	OPLATE	Invalid plate not found within database
	DBCLSv	Blank or Invalid Carrier Service Code (v = **Carrier Level Of Status**) ***NOTE 1***
	DBSFTv	Blank or "U" Safety Rating Code (v = **Safety Rating** value) ***NOTE 2***
	DBSRCv	H Report Inspection Status Code (v = **Safety Risk** value) ***NOTE 3***
OTHER	XVNUM	Computer-to-Computer "Packet Collision" or Packet numbering fault
	ORWIND	WIM Independent Mode

NOTE 1: The value "Carrier Level Of Status" is interpreted as shown below.

0, or Blank	No status within Greenlight Transponder Program.
1	Basic Partner, 50% or less of fleet is transponder-equipped.
2	Basic Partner, >50% of fleet is transponder-equipped.
3	Trusted Carrier Partner, <50% of fleet is transponder equipped.
4	Trusted Carrier Partner, >50% of fleet is transponder equipped.

NOTE 2: The value "Safety Rating" is interpreted as:

S	Satisfactory Safety Rating
C	Conditional Safety Rating
U	Unsatisfactory Safety Rating

NOTE 3: The value "Safety Risk" is interpreted as:

H	High Safety Risk
M	Moderate Safety Risk
L	Low Safety Risk

BYPASS REASON CODES CHART

Code	Description/Meaning
OBWIND	WIM Independent Mode
WBLOWM	Vehicle is below maximum gross weight
OBYPAS	Vehicle is OK to bypass
OBNTSL	Vehicle is not in sort classes or sort lanes
OBEMPT	Empty vehicle to bypass

Oregon Green Light

CVO Evaluation

DRAFT FINAL REPORT

DETAILED TEST PLAN 11

Evaluation of Motor Carrier Acceptance

Paul E. Montagne

Sio Meng Ng

Chris A. Bell

Transportation Research Report No. 00-18
Transportation Research Institute
Oregon State University
Corvallis, OR 97331

June 2000

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The authors are indebted to the personnel of ODOT's Motor Carrier Transportation Branch, who have provided information and data to the evaluation team throughout the project. We are particularly indebted to Ken Evert, Gregg Dal Ponte, Randal Thomas and David Fifer. Ken's untimely death in 1998 meant that he did not see his vision completed. The evaluation team is forever indebted to him for his support and for the opportunity to participate in the deployment.

DISCLAIMER

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EXECUTIVE SUMMARY

The Oregon Department of Transportation (ODOT) has been testing several transportation technologies since 1983 designed to improve the efficiency of commercial vehicle operations. The Oregon Green Light Project was initiated in 1995 to fulfill Oregon's vision of creating an automated and intelligent truck transportation system. Green Light consists primarily of mainline pre-clearance systems that were installed at 21 specific sites throughout Oregon.

The assessment of motor carrier acceptance of Green Light technologies was one of the evaluation goals undertaken as part of the Green Light Evaluation. After reviewing several alternatives, a survey was designed as a way to monitor and assess motor carrier acceptance of new technology. Two surveys ("before" and "after") were sent to carriers who operate in Oregon. The first survey was conducted as part of test measure 3.1.1 of the Green Light Evaluation in 1998. The second survey was conducted in February/March of 2000.

The main goal of the questionnaire surveys was used to determine user attitudes in two distinct areas:

- User attitudes toward electronic screening and its perceived impacts on the motor carrier.
- User attitudes toward new services such as Road Weather Information System (RWIS) and Downhill Speed Information System (DSIS).

The first survey is presented in part 1 of this report and the second in part 2. This executive summary compares the results of the two surveys. The results of test measure 3.1.2 – Transponder Penetration, are also summarized.

Comparison of the results of the “before” and “after” surveys presented challenges. Some differences could not easily be measured due to differences in regard to the questionnaires, population size, and number of responses. In addition, there were different carriers questioned in the surveys, though both were sampled from the same population. As the surveys were conducted in different time period, this had a small influence on the result. None the less, a common sampling pool, sampling methodology and survey design allows for some comparison of the results.

The survey design was based on the design method described in the “Mail and Telephone Surveys – Total Design Method” by Don A. Dillman. Mailing included an initial cover letter, the survey itself with accompanying a brief description of Green Light components, a follow-up postcard, and finally a second survey identical to the first, but with a slightly different cover letter.

Questionnaires were mailed to a random sample of carriers registered to operate in Oregon. The population of motor carriers was divided into three strata based on the location of the carriers listed in ODOT’s database. Twelve hundred Oregon carriers made up the first stratum (Oregon carriers). One thousand carriers based in Washington, California, Idaho, and Nevada comprised a second stratum (Pacific Norwest carriers), while 1,000 of carriers of the remaining states and Canadian provinces made up the third stratum (Other carriers).

The percentage of respondents to the survey was about 10 % less in the “after” survey than in the “before” survey. The experience level of the participants is evenly distributed across strata with no significant variations in both “before” and “after” surveys. Nearly half (50%) of the participants filling out the survey had been working in the industry for more than 20 years. Overall, smaller carriers dominated the sample with about three-quarters (75%) having fleet sizes of one to ten trucks. However, the medium fleet size (11 – 99 tractors) showed significant changes in the “after” or second survey.

A summary of findings is listed below:

- About 80% said they had been working in the industry more than 10 years in both surveys.
- 41% of carriers agree (19% disagree) that Mainline Preclearance will benefit their company in the “before” survey while about 32% of carriers agree (25% disagree) with this statement in the “after” survey.
- 60% of carriers agree that the Road Weather Information System (RWIS) will benefit their company in the “before” survey and 52% of carriers agree with this statement in the “after” survey. Approximate 15% disagree with the statement in both surveys.
- Over 50% of carriers agree with the policy of screening trucks for possible inspection based on recent compliance with federal safety regulations (nearly 16 % disagree) in both “before” and “after” surveys.
- Over 60% of carriers rate the overall performance of ODOT’s Motor Carrier Services as “good” (nearly 26% rate it “Fair” and about 4% rate it “poor”) in both “before” and “after” surveys. 9% rate it “Excellent” in the “before” survey while 6% in the “after” survey.

The surveys were successful in documenting that many of Oregon's carriers are not only adopting Oregon's Green Light technology, but are finding it to be a useful resource in the way they conduct business.

The results for test measure 3.1.2 – Transponder Penetration, are presented in part 3 of this report The number of transponders issued has increased steadily since 1997 with a substantial increase in March 2000 when ODOT decided to issue transponders at no cost to carriers. The data show that (with nearly 11,000 transponders issued through March 2000) the motor carrier industry is accepting mainline pre-clearance by installing transponders. At the time this report was prepared specific data were not available for transponders issued in April through June 2000. However, ODOT issued approximately another 1500, and, would have issued many more if their stock had not run out. A new order for 12,500 more transponders was delayed; once delivered it is anticipated that they will be distributed quickly.

The following summarizes the findings:

- Nearly 12,500 transponders were in use by the motor carrier industry by June 2000..
- The number of transponders issued increased slowly until ODOT elected to distribute them free of charge.
- Transponder issuance increased dramatically (over 1,500 %) in March 2000 when the decision was made to distribute them at no cost to carriers.

PART ONE

Motor Carrier Acceptance – First Survey

Oregon State University
Transportation Research Institute
July 1998

1 INTRODUCTION – FIRST SURVEY

1.1 Background

Advances in transportation technology in the next five to ten years will affect time and costs of shipping goods on our nations highways. Satellite tracking, two-way communications, on-board computers, weigh-in-motion (WIM) systems, automatic vehicle identification and other electronic systems are helping to streamline the shipping process, making both the motor carriers and the existing infrastructure more efficient.

The Oregon Department of Transportation (ODOT) has been testing several of these technologies since 1983. With the completion and approval of the Intelligent Highway Vehicle System Strategic Plan for Commercial Vehicle Operations (IVHS/CVO), ODOT has begun to deploy advanced technology such as Oregon Green Light, improving the efficiency of commercial vehicle operations within Oregon.

Green Light consists primarily of mainline preclearance systems which will be installed at up to 22 specific sites throughout Oregon. Consisting of weigh scales embedded into freeways and highways upstream from existing weigh stations, and vehicle identification readers, the system allows trucks to be effectively weighed and checked for appropriate credentials at highway speeds, enabling trucks to bypass scale houses. The resulting network of preclearance sites will serve as a model for national deployment of such technology. Enforcement sites are being developed and installed to monitor truck traffic along by-pass routes around weigh stations. In addition, several safety enhancements are being installed as part of Oregon Green Light. These include highway warning systems for weather related hazards, and downhill truck speed informational systems.

1.2 Purpose

As part of the appropriations grant that funded most of the project, the Federal Highway Administration (FHWA) requested a complete independent evaluation of Green Light. The purpose of the evaluation is to ensure how well the goals of Green Light are being met with respect to safety, operational efficiency of motor carriers and state regulatory authorities, productivity gains, future potential, and the identification of any legal and institutional issues. ODOT contracted the Oregon State University Transportation Research Institute to conduct the evaluation. This report outlines findings from a survey distributed to motor carriers asking their opinions about the components being installed under Oregon Green Light.

Distinct goals were recommended to guide the evaluation, one of which is the assessment of motor carrier acceptance of Green Light technologies. Accomplishment of these evaluation goals directly support relevant ITS National Program Plan goals (i.e., improve safety, increase efficiency, and enhance productivity). In addition, certain test measures were developed in support of these goals, described in a volume of detailed test plans. For more on the overall evaluation goals and subsequent test plans see the compendium Oregon Green Light CVO Evaluation Detailed Test Plans 1 Through 14, revised 3/15/98, available from Oregon State University.

The survey was conducted as a part of test measure 3.1.1 of the Green Light Evaluation. After reviewing several alternatives of how to monitor and assess the acceptance of the motor carrier industry, it was determined that before/after surveys be conducted of carriers who operate in Oregon. The before survey (referred to as the “First Survey”) was conducted between November 1997 and January 1998. The after survey (referred to as the “Second Survey”) was conducted in January and February 2000, as late in the evaluation as possible. The surveys were distributed to include both interstate and intrastate carriers from around the country who operate in Oregon.

The questionnaire surveys were used to determine user attitudes in two distinct areas:

1. User attitudes toward electronic screening and its perceived impacts on the motor carrier
2. User attitudes towards new services such as the RWIS and DSIS technologies and the Integrated tactical Enforcement Network (ITEN), and selecting vehicles for inspection based on inspection and compliance status

1.3 Scope

Part One of this report provides some background into the methodology used for the first survey and highlights some of the key findings in the form of figures and tables. Chapter 2 briefly describes the methodology used in the survey. Chapter 3 highlights results for mainline pre-clearance, road weather information systems, downhill speed information systems, and the integrated tactical enforcement network.

Details about the sampling methodology, sample and population demographics, and response rates are in Appendix A. Appendix B contains figures for all of the survey questions in the form of bar charts. Frequency estimates in the form of data tables for categories of response for each question are found in Appendices C-F. A brief description of how to read the tables is found at the beginning of Appendix C. A copy of the survey and cover letter is in Appendix G.

2 METHODOLOGY – FIRST SURVEY

Oregon keeps records of roughly 60,000 motor carriers who have conducted business at some time in Oregon. These carriers range from small parcel delivery companies (with a fleet of one) to large interstate carriers with hundreds of trucks in its fleet. Any carrier who conducts business in Oregon, even once, is required to get necessary permitting and pay the necessary taxes. The database keeps record of the carriers activity as well as other information such as address, fleet size, and standing within ODOT. From this database a sample universe was defined using the methodology outlined in Appendix A. The resulting population was roughly 20,000 carriers from all over the United States and Canada.

In November-January of 1997 and 1998 a survey was mailed to a random sample of 3200 of these carriers from all over the United States and Canada. The target population included both drivers and owners, taken from names and addresses from ODOT's motor carrier files. Of these, 1552 surveys were returned for inclusion in the study (48.5%).

The survey design incorporated a stratified sampling plan that divided the population into three strata based on the home address of the carriers. Oregon carriers made up one strata, Oregon's neighboring states (California, Nevada, Idaho, and Washington) comprised a second, with the remaining states and Canadian provinces making up the third strata.

3 RESULTS – FIRST SURVEY

This section will highlight some of the key findings from the "before" survey conducted by OSU along with graphical representation of selected questions. The sample population was subdivided into three strata based on the state of residence of the motor carrier. The strata are:

- Oregon carriers
- Pacific Northwest carriers (PNW
- All others

A detailed description of the sampling plan may be found in Appendix A.

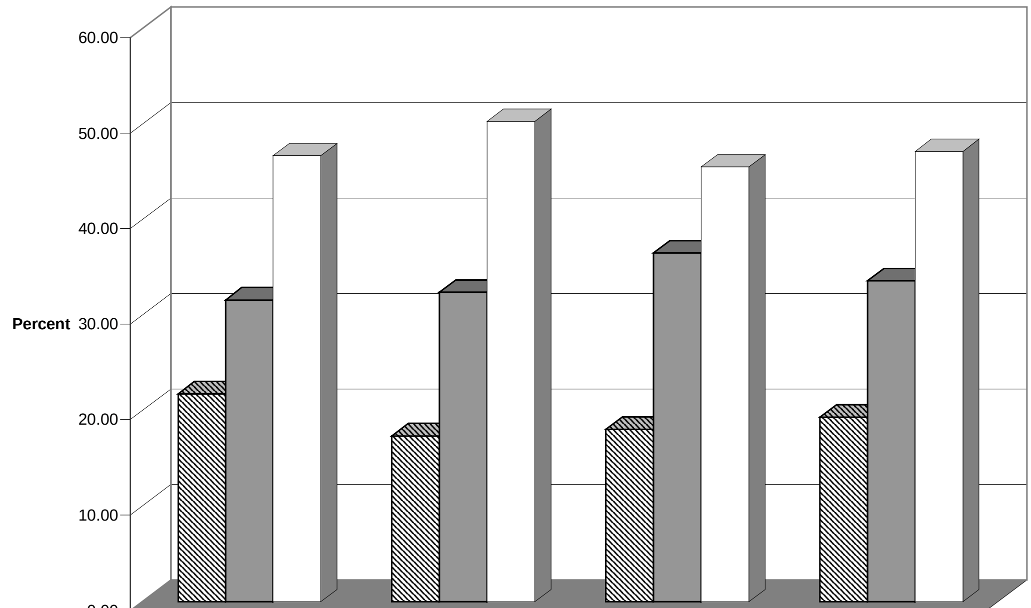
3.1 Population Demographics

Several questions were asked to define the makeup of the survey participants. Included were questions about the experience of the participants in terms of how many years they had been working in the industry (Figure 3-1), and the size of the carrier in terms of fleet size (Figure 3-2).

The experience level of the participants is evenly distributed across strata with no significant variations in the three subcategories. Nearly half of the participants filling out the survey had been working in the industry in some capacity or another for more than 20 years, and approximately one-third having 11 to 20 years of experience.

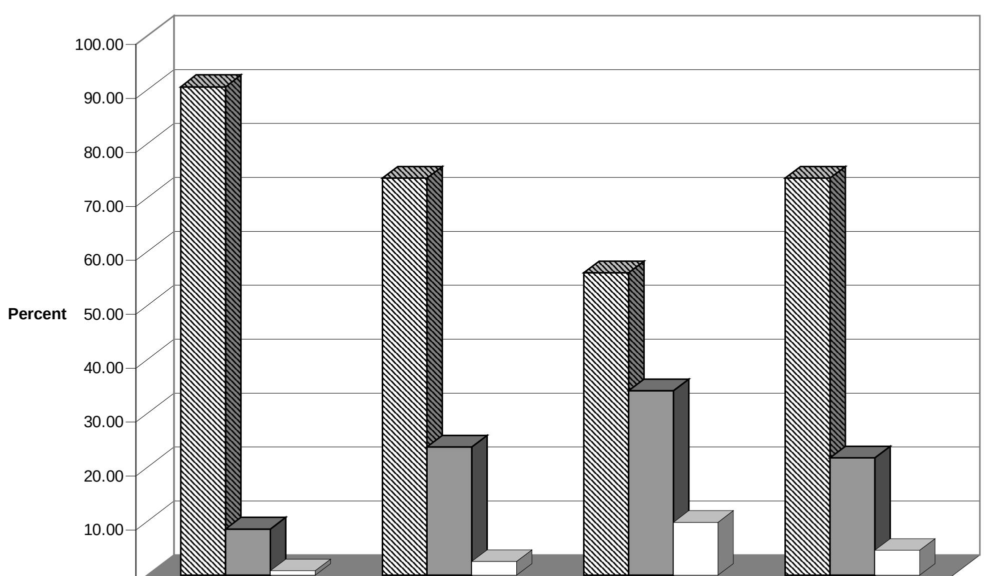
Overall, the sample was dominated by smaller carriers with nearly three-quarters (73.7%) having fleet sizes of one to ten trucks. The fleet size characteristics do show significant effects of stratifying the sample

Figure 3-1 Distribution of Experience Level of Participants



	Oregon Carriers	Pacific Northwest Carriers	Other Carriers	All Carriers
Less than ten years	21.76	17.35	18.02	19.30
11 to 20 years	31.58	32.40	36.49	33.58
More than 20 years	46.66	50.26	45.50	47.12

Figure 3-2 Distribution of Fleet Size of Participants

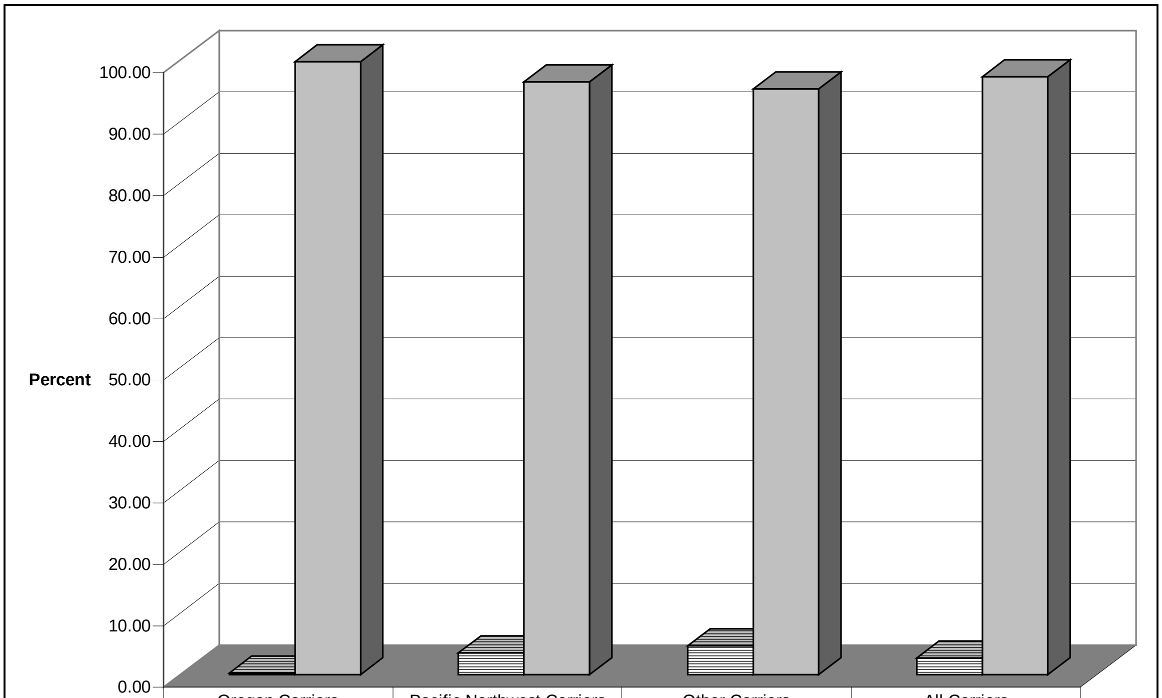


	Oregon Carriers	Pacific Northwest Carriers	Other Carriers	All Carriers
Small (1-10 Tractors)	90.58	73.66	56.03	73.66
Medium (11-99 Tractors)	8.56	23.79	34.15	21.75
Large (100 or more Tractors)	0.86	2.56	9.82	4.59

Very few (less than 9%) medium-sized carriers participating in the survey were based in Oregon. The vast majority were small operations with 10 or less trucks in the fleet. Carriers who were sampled from outside of Oregon contained significantly more medium and large carriers. This reflects the profile of the out-of-state companies who conduct business in Oregon, many of which are larger interstate carriers.

Participants were asked if they had participated in any transponder-based mainline prescreening such Advantage 75 or the HELP-Crescent Project. The distribution of carrier participation is shown in Figure 3-3.

Figure 3-3 Previous Participation in Transponder-Based Mainstreaming



	Oregon Carriers	Pacific Northwest Carriers	Other Carriers	All Carriers
Yes	0.28	3.55	4.70	2.71
No	99.72	96.45	95.30	97.29

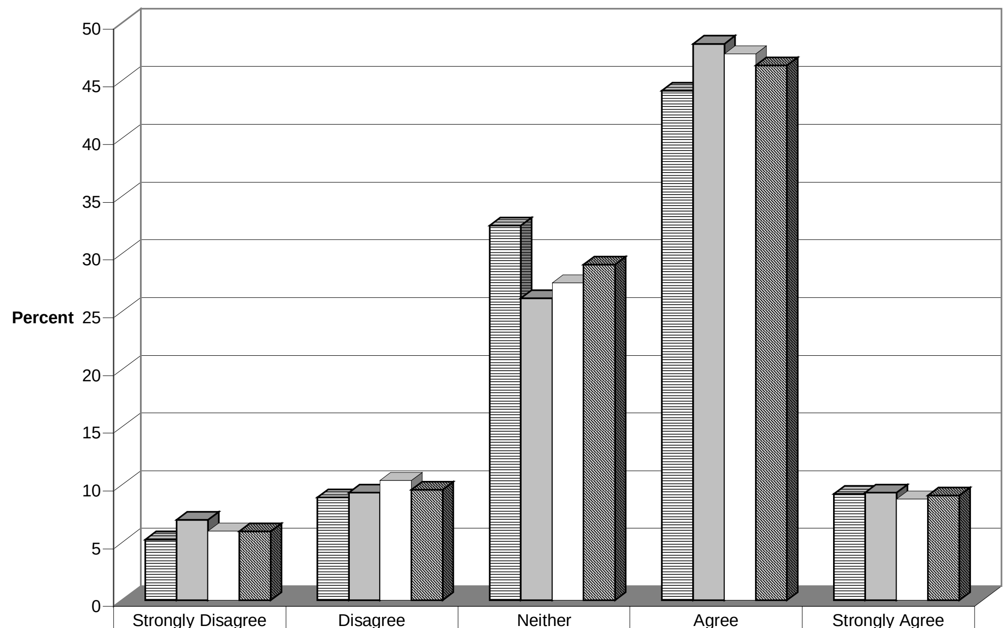
While very few of the Oregon carriers had previously used transponders for pre-clearance, nearly five percent of carriers outside of the Pacific Northwest had participated in some sort of transponder based mainstreaming or pre-clearance.

3.2 Mainline Pre-clearance

In the evaluation, the researchers wanted to measure to what degree carriers saw Green Light as providing benefit for their operations. In addition, it would be useful to know what were the perceived stumbling blocks carriers had with participating in a program such as Green Light. This section presents some of the key findings about how carriers perceive the benefits and liabilities of transponder based mainline prescreening.

The survey asked carriers about how strongly they agreed with the pre-screening of vehicles based on compliance with the Federal Motor Carrier Safety Regulations (FMCSR). The distribution of the responses to this question is shown in Figure 3-4.

Figure 3-4 Pre-screening of Vehicles Based on Compliance With FMCSR

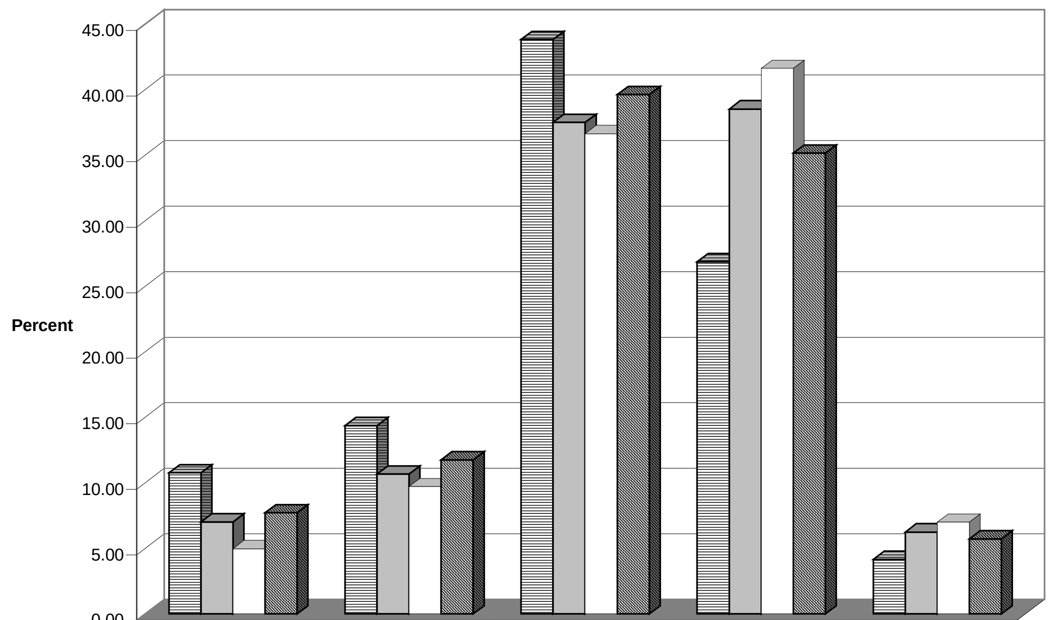


	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	5.26	8.92	32.46	44.15	9.21
Pacific Northwest Carriers	6.99	9.33	26.17	48.19	9.33
Other Carriers	6	10.39	27.48	47.34	8.78
All Carriers	5.96	9.56	29.07	46.32	9.08

Again the responses were evenly distributed across the three strata. Nearly half of the responses agreed with the idea of mainline pre-clearance based on previous inspection result. Approximately 15% of the responses were in disagreement and 30% neither agreed or disagreed.

Figures 3-5 through 3-7 highlight results of questions asking to what extent carriers agree with certain statements about mainline pre-clearance.

Figure 3-5 Will Mainline Preclearance Benefit My Company?

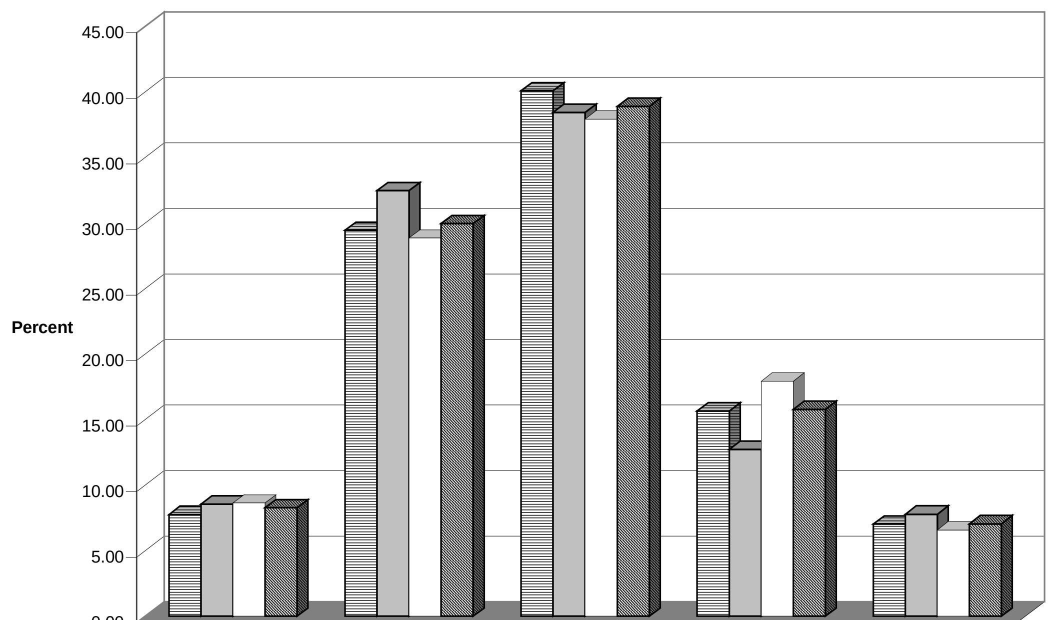


	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	10.78	14.37	43.82	26.87	4.17
Pacific Northwest Carriers	7.03	10.68	37.50	38.54	6.25
Other Carriers	4.98	9.73	36.65	41.63	7.01
All Carriers	7.72	11.76	39.63	35.16	5.73

Overall, carries perceive that mainline pre-clearance will provide a benefit to their commercial vehicle operations. The PNW and others strata had nearly 45% of the responses either in agreement or strong agreement with the statement. Responses for Oregon were slightly lower, with a 43.8% of the responses in the “Neither” category.

Figure 3-6 illustrates responses to how much carriers feel transponder based mainline pre-clearance invades upon their privacy by the state or federal government. Over a third of the responses across strata selected neither, meaning that they had no opinion one way or the other. 38% of the carriers surveyed believed that mainline pre-clearance did not invade upon their privacy, while 22% agreed with the statement.

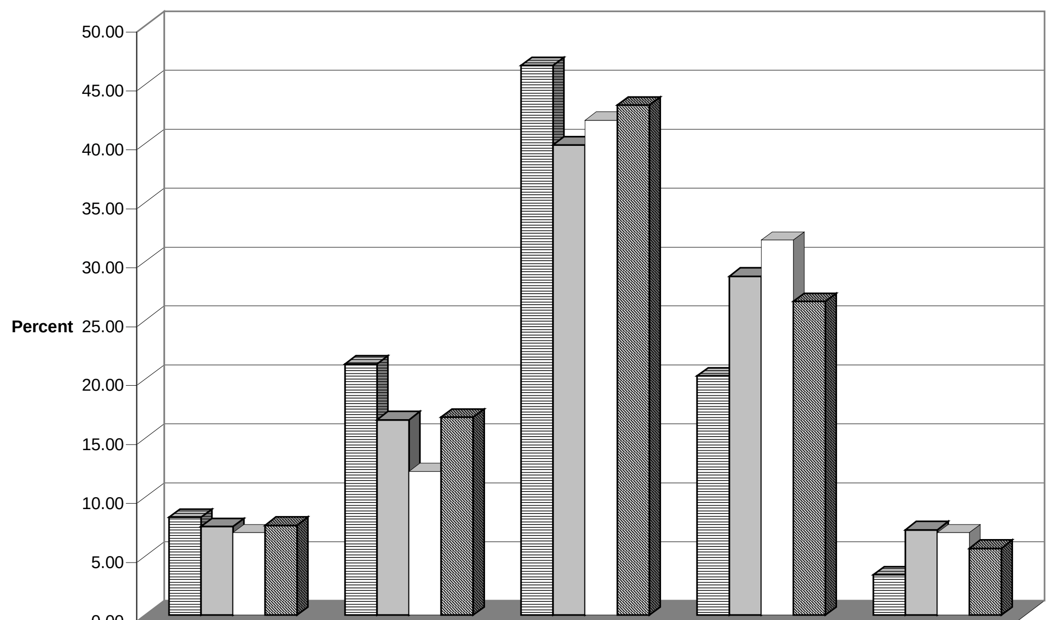
Figure 3-6 Is Mainline Preclearance An Invasion of Privacy?



	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	7.76	29.45	40.09	15.66	7.04
Pacific Northwest Carriers	8.57	32.47	38.44	12.73	7.79
Other Carriers	8.64	28.86	37.95	17.95	6.59
All Carriers	8.28	29.97	38.90	15.79	7.06

Figure 3-7 shows carriers agreement with the statement that mainline pre-clearance will improve the service the carrier is able to provide to their customer. Again the responses were evenly distributed across strata. Nearly 27% of carriers in agreement with the statement while about 17% disagreed with the statement.

Figure 3-7 Will Mainline Pre-clearance Improve Services Provided By Carriers?



	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	8.30	21.32	46.64	20.31	3.43
Pacific Northwest Carriers	7.51	16.58	39.90	28.76	7.25
Other Carriers	7.00	12.19	41.99	31.83	7.00
All Carriers	7.63	16.80	43.28	26.62	5.68

4 SUMMARY - FIRST SURVEY

The first survey was conducted from November 1997 through January 1998. It was designed as a way to monitor and assess motor carrier acceptance of new technology. The researchers sought to check user attitudes toward (1) electronic screening and its perceived impact on carriers, and (2) new services such as the RWIS and DSIS, as well as the ITEN, and selecting vehicles for inspection based on inspection and compliance status. In a "before/after" approach, this initial survey outreach will be repeated in another survey mailed to carriers at some point in the future when Green Light technologies are in place and more carriers are familiar with them.

Questionnaires were mailed to a random sampling of 19,686 carriers registered to operate in Oregon, separating them into three strata so that they reached 1,200 Oregon-based carriers, 1,000 carriers based in Washington, California, Idaho, and Nevada (a "Pacific Northwest" carrier group), and 1,000 carriers based throughout other states and Canada.

Respondents to the survey included more than 700 of the Oregon-based carriers, nearly 400 of the Pacific Northwest carriers, and more than 400 of the other carriers. The respondents described themselves as follows:

81% said they had been working in the industry more than 10 years.

74% operate small fleets (1-10 trucks)

22% operate medium fleets (11-99 trucks)

4% operate large fleets (100 or more trucks)

The survey methodology included the mailing of (1) a "pre-letter" from ODOT announcing that a survey would be arriving soon, (2) a survey form and cover letter, (3) a small postcard reminder to non-respondents, and (4) a second survey form and cover letter to non-respondents. Approximately 400 returned responses from each stratum was needed to be within 10% of the truth, with a 95% confidence level. A higher degree of confidence in the results from Oregon carriers, than from the entire population, was achieved by the moderate oversampling of Oregon carriers.

A summary of highlights is listed below:

- 41% of carriers agree that Mainline Preclearance will benefit their company (19% disagree and 40% have no opinion about the potential for benefit).
- 60% of carriers agree that a Road and Weather Information System (RWIS) will benefit their company (14% disagree and 26% have no opinion).
- 47% of carriers agree that a Downhill Speed Information System (DSIS) will benefit their company (20% disagree and 33% have no opinion).
- 32% of carriers agree that an Integrated Tactical Enforcement Network (ITEN) will benefit their company (24% disagree and 43% have no opinion).
- 55% of carriers agree with the policy of screening trucks for possible inspection based on recent compliance with federal safety regulations (16% disagree and 29% have no opinion).
- 61% of carriers rate the overall performance of ODOT's Motor Carrier Services as "Good" and 9% rate it "Excellent" (26% rate it "Fair" and 4% rate it "Poor").

PART TWO

Motor Carrier Acceptance – Second Survey

Oregon State University
Transportation Research Institute
May 2000

5 INTRODUCTION – SECOND SURVEY

5.1 Background

The Oregon Green Light is a Federal Highway Administration funded operational test of Intelligent Transportation Systems on Oregon's highways. Thus, the Federal Highway Administration (FHWA) requested a complete independent evaluation of the Oregon Green Light. The purpose of the evaluation is to ensure how well the goals of the Oregon Green Light are being met with respect to safety, operational efficiency of motor carriers and state regulatory authorities, productivity gains, future potential, and the identification of any legal and institutional issues. The Oregon State University Transportation Research Institute was contracted to conduct the evaluation. This report outlines findings from the "after" or "Second Survey" distributed to motor carriers around the United States and Canada by asking their opinions about the components being installed under Oregon Green Light.

The assessment of motor carrier acceptance of Green Light technologies is one of the evaluation goals. The accomplishment of this goal directly supports relevant ITS National Program Plan goals that include improving safety, increasing efficiency, and enhancing productivity. In addition, certain test measures developed in support of these goals were described in a volume of detailed test plans. For more on the overall evaluation goals and subsequent test plans see the compendium Oregon Green Light CVO Evaluation Detailed Test Plans 1 through 14, revised 3/15/98, available from Oregon State University Transportation Research Institute.

The survey was conducted as a part of test measure 3.1.1 of the Green Light Evaluation. After reviewing several alternatives of how to monitor and assess the acceptance of the motor carrier industry, an “after” or second survey was mailed to motor carriers who operate in Oregon. The survey was to include both interstate and intrastate carriers from around the United States and Canada. The findings of the “after” survey will be used to compare to those of the “before” or initial survey. Questions on the “after” survey are similar to the “before” survey, so the comparison of the findings are un-biased.

The questionnaire survey was used to determine user attitudes in two distinct areas:

1. User attitudes toward electronic screening and its perceived impacts on the motor carrier.
2. User attitudes towards new services such as the RWIS and DSIS technologies.

5.2 Scope

This part of the report provides some background into the methodology used for the second survey and highlights some of the key findings in the form of figures and tables for the second survey. Chapter 6 briefly describes the methodology used in the survey. Chapter 7 highlights results for mainline pre-clearance, road weather information systems, and downhill speed information systems.

Details about the sampling methodology, sample and population demographics, and response rates are in Appendix A. Appendix B contains figures for most of the survey questions in the form of bar charts. Frequency estimates in the form of data tables for categories of response for each question are found in Appendices C-F. A brief description of how to read the tables is found at the beginning of Appendix C. A copy of the survey and cover letter is in Appendix G.

6 METHODOLOGY – SECOND SURVEY

Over 60,000 motor carriers have conducted business at some time in Oregon. These carriers range from small parcel delivery companies (with a fleet of one) to large interstate carriers with hundreds of trucks in its fleet. Any carrier who conducts business in Oregon, even once, is required to get necessary permitting and pays the necessary taxes. Records of the carrier's activity as well as other information such as address, fleet size, and standing within ODOT were kept in the ODOT's commercial motor carriers database. From this database a sample universe was defined using the methodology outlined in Appendix A. The resulting population was roughly 22,000 carriers from all over the United States and Canada.

In January-February of 2000, the second survey was mailed to a random sample of 3200 of these 22,000 carriers from all over the United States and Canada. The target population included both drivers and owners, taken from names and addresses from ODOT's commercial motor carrier database files. Of these, 1213 surveys were returned for inclusion in the study (37.9%).

The survey design incorporated a stratified sampling plan that divided the population into three strata based on the home address of the carriers. Oregon carriers made up the first strata (Oregon carriers). Oregon's neighboring states (California, Nevada, Idaho, and Washington) comprised the second strata (Pacific Northwest carriers). The remaining states and Canadian provinces made up the third strata (Other carriers).

7 RESULTS – SECOND SURVEY

This section will highlight some of the key findings from the “after” or second survey conducted by OSU Transportation Research Institute along with graphical representation of selected questions. The sample population was subdivided into three strata based on the state of residence of the motor carrier. The strata are:

- Oregon carriers
- Pacific Northwest carriers
- Other carriers

A detailed description of the sampling plan can be found in Appendix A.

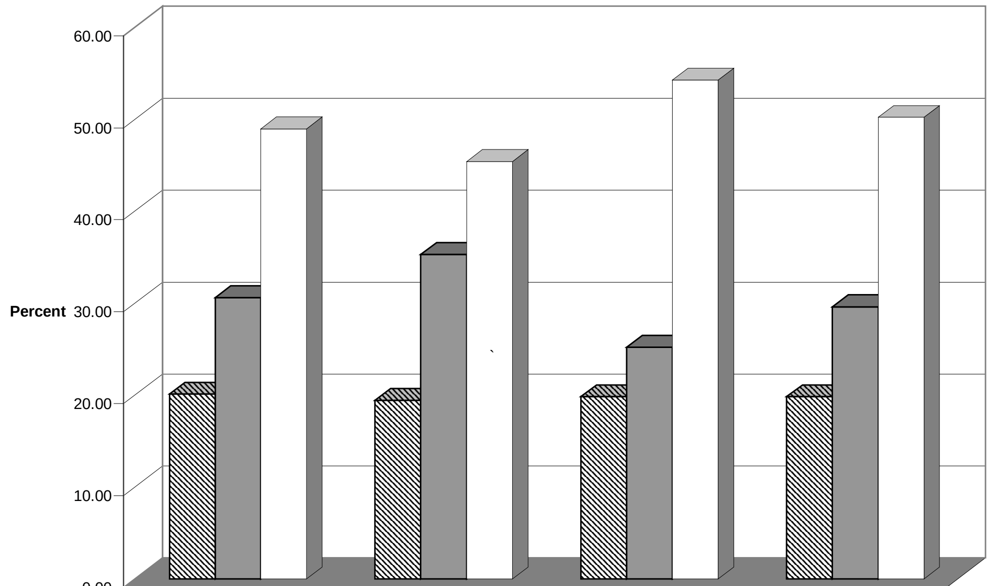
7.1 Population Demographics

Several questions were asked to define the makeup of the survey participants. Included were questions about the experience of the participants in terms of how many years they had been working in the industry (Figure 7-1), and the size of the carrier in terms of fleet size (Figure 7-2).

The experience level of the participants is evenly distributed across strata with no significant variations in the three subcategories. Nearly half of the participants filling out the survey had been working in the industry in some capacity or another for more than 20 years, and approximately 30 % of the participants having 11 to 20 years of experience.

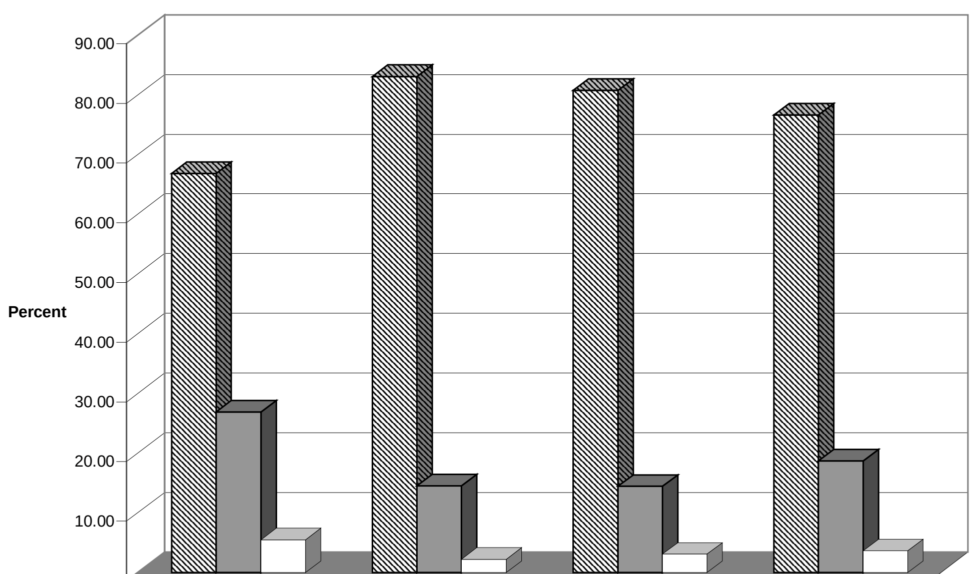
Overall, smaller carriers dominated the sample with over three-quarters (76.8%) having fleet sizes of one to ten trucks. The fleet size characteristics do show significant effects of stratifying the sample

Figure 7-1 Distribution of Experience Level of Participants



	Oregon Carriers	Pacific Northwest Carriers	Other Carriers	All Carriers
Less than ten years	20.09	19.40	19.79	19.79
11 to 20 years	30.57	35.25	25.19	29.58
More than 20 years	48.91	45.36	54.24	50.17

Figure 7-2 Distribution of Fleet Size of Participants

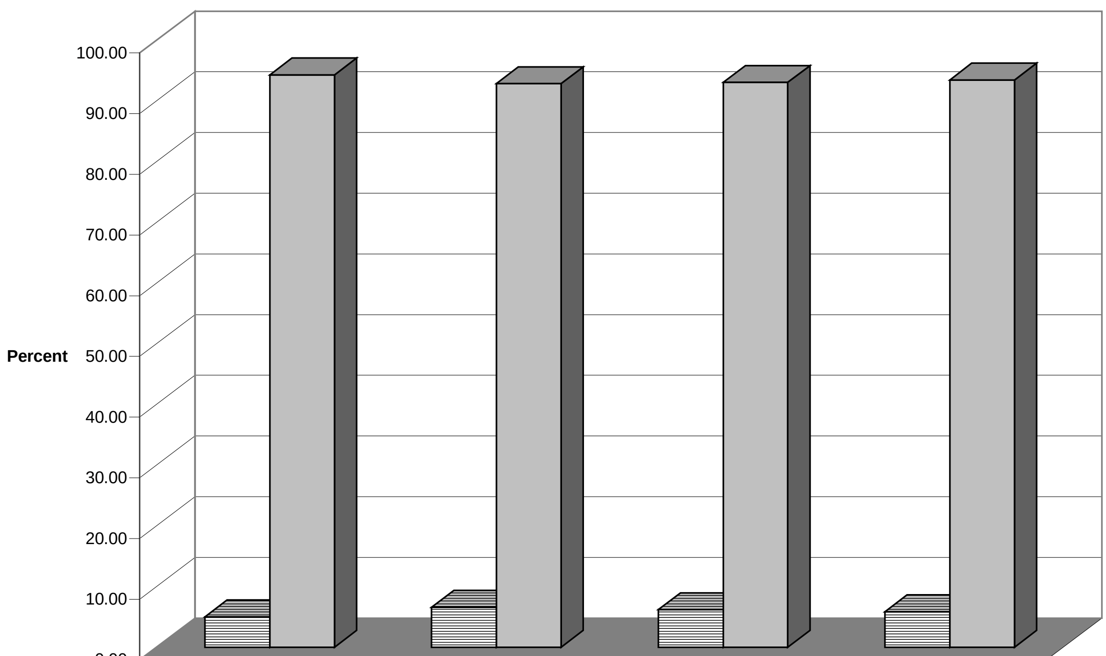


	Oregon Carriers	Pacific Northwest Carriers	Other Carriers	All Carriers
Small (1-10 Tractors)	66.81	83.06	80.72	76.61
Medium (11-99 Tractors)	26.86	14.48	14.40	18.63
Large (100 or more Tractors)	5.46	2.19	3.08	3.66

Oregon has the highest medium-size carriers participating in the survey (over 26.0%). The vast majority were small operations with 10 or less trucks in the fleet. Carriers who were sampled from outside of Oregon contained significantly less medium and large carriers. This reflects the profile of the out-of-state companies who conduct business in Oregon, many of which are smaller interstate carriers.

Participants were asked if they are currently participating in the Oregon Green Light Program. The distribution of carrier participation is shown in Figure 7-3.

Figure 7-3 Current Participation in Oregon's Green Light Program



	Oregon Carriers	Pacific Northwest Carriers	Other Carriers	All Carriers
Yes	5.02	6.56	6.17	5.88
No	94.32	92.90	93.06	93.46

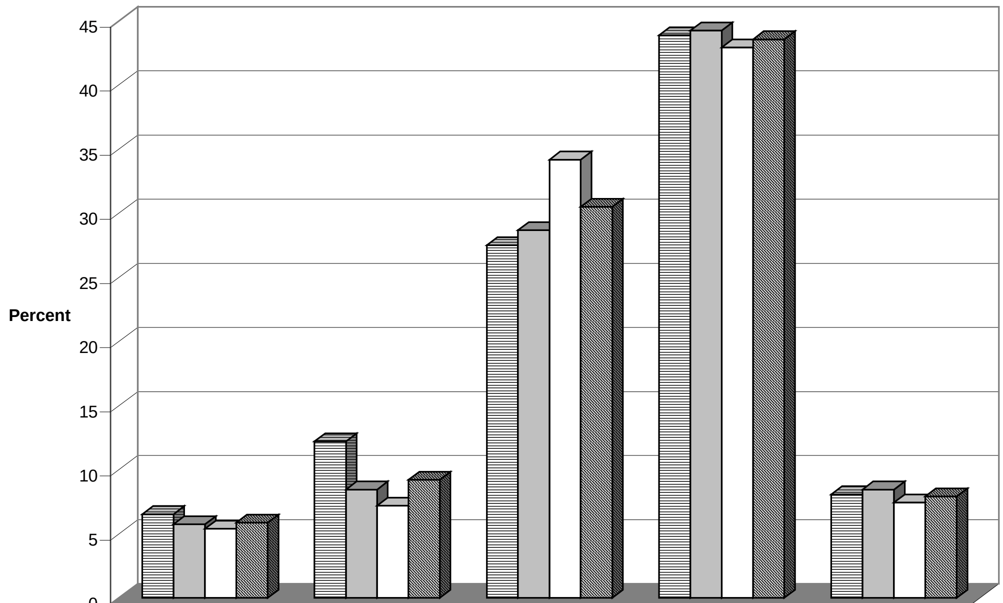
Oregon carriers currently participating in the Green Light Program are less than those from out-of-state. Carriers of the Pacific Northwest are highly participating in the Oregon's Green Light Program (over 6.0%).

7.2 Mainline Preclearance

In the evaluation, the researchers wanted to measure to what degree carriers saw Green Light as providing benefit for their operations. In addition, it would be useful to know what were the perceived stumbling blocks carriers had with participating in a program such as Green Light. This section presents some of the key findings about how carriers perceive the benefits and liabilities of transponder based mainline prescreening.

The survey asked carriers about how strongly they agreed with the pre-screening of vehicles based on compliance with the Federal Motor Carrier Safety Regulations (FMCSR). The distribution of the responses to this question is shown in Figure 7-4.

Figure 7-4 Pre-screening of Vehicles Based on Compliance With FMCSR

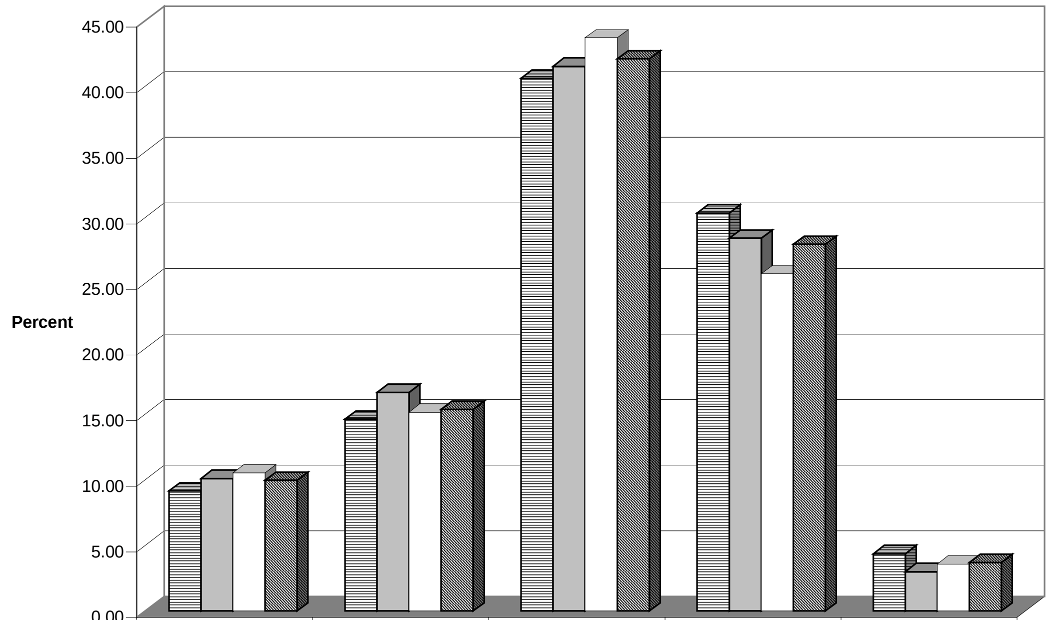


	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	6.55	12.23	27.51	43.89	8.08
Pacific Northwest Carriers	5.74	8.47	28.69	44.26	8.47
Other Carriers	5.4	7.2	34.19	42.93	7.46
All Carriers	5.87	9.22	30.53	43.59	7.93

Overall, the responses were evenly distributed across the three strata. The majority (nearly 44%) of the carriers of the responses agreed with the idea of mainline preclearnce based on previous inspection result. Approximately 15% of the responses were in disagreement and about 30% neither agreed nor disagreed.

Figures 7-5 through 7-7 highlights results of questions asking to what extent carriers agree with certain statements about mainline preclearance.

Figure 7-5 Will Mainline Preclearance Benefit My Company?

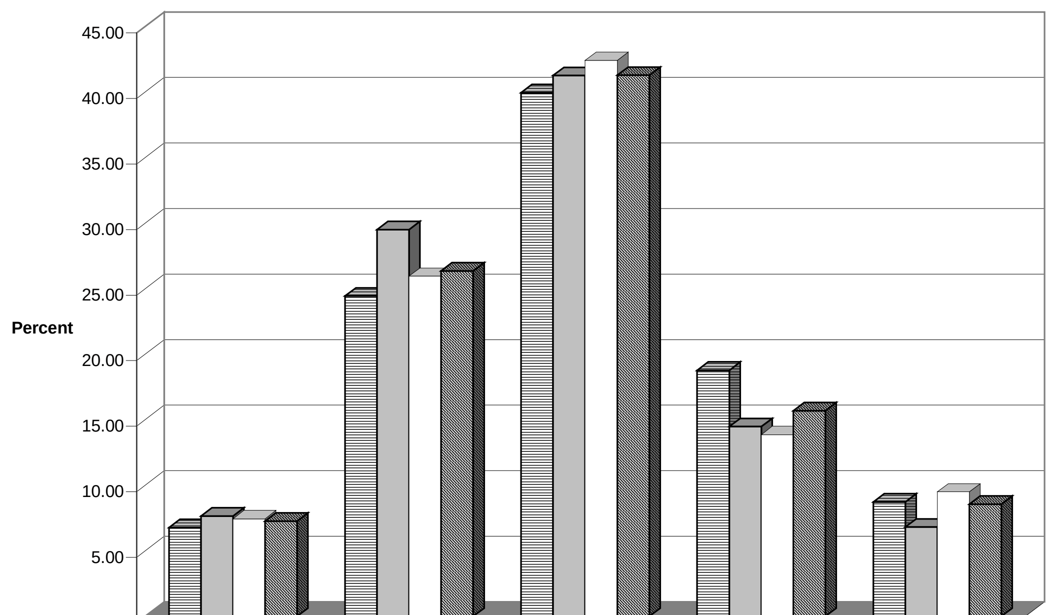


	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	9.17	14.63	40.61	30.35	4.37
Pacific Northwest Carriers	10.11	16.67	41.53	28.42	3.01
Other Carriers	10.54	15.17	43.70	25.71	3.60
All Carriers	9.97	15.37	42.10	27.97	3.71

Overall, carries perceive that mainline preclearance will provide a benefit to their commercial vehicle operations. Over 30% of the responses either agree or strong agree that mainline preclearance will benefit their company. Responses from Oregon carriers were higher than those from out-of-state in agreement or strong agreement with that statement. In addition, approximately 42% of the response fell in the “neither” category.

Figure 7-6 illustrates responses regarding to what degree carriers feel transponder based mainline preclearance invades upon their privacy by the state or federal government. Over 41% of the responses across strata selected neither, meaning that they had no opinion one-way or the other. Over a third (nearly 34%) of the carriers surveyed believed that mainline preclearance did not invade upon their privacy, while about 24% agreed with the statement.

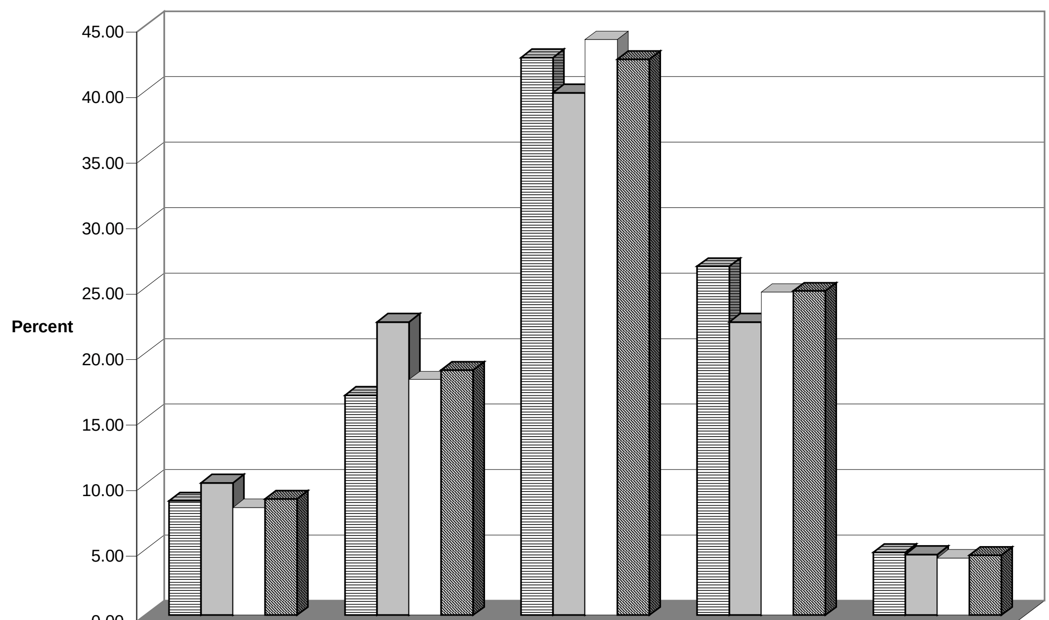
Figure 7-6 Is Mainline Preclearance An Invasion of Privacy?



	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	6.77	24.45	39.96	18.78	8.73
Pacific Northwest Carriers	7.65	29.51	41.26	14.48	6.83
Other Carriers	7.46	25.96	42.42	13.88	9.51
All Carriers	7.27	26.36	41.29	15.69	8.56

Figure 7-7 illustrates carriers agreement with the statement that mainline preclearance will improve the service carriers can provide to their customers. Again the responses were evenly distributed across strata. Nearly 25% of carriers on agreement with the statement while about 18% disagreed with the statement.

Figure 7-7 Will Mainline Preclearance Improve Services Provided By Carriers?



	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	8.73	16.81	42.58	26.64	4.80
Pacific Northwest Carriers	10.11	22.40	39.89	22.40	4.64
Other Carriers	8.23	17.99	43.96	24.68	4.37
All Carriers	8.88	18.72	42.45	24.76	4.59

8 SUMMARY – SECOND SURVEY

The survey described in this report was conducted from January to February 2000. It was the “after” or “Second Survey” designed as a way to monitor and assess motor carrier acceptance of new technology. The researchers sought to check user attitudes toward (1) electronic screening and its perceived impact on carriers, and (2) new services such as the RWIS and DSIS.

Questionnaires were mailed to a random sampling of 21,928 carriers registered to operate in Oregon, separating them into three strata so that they reached 1,200 Oregon-based carriers, 1,000 carriers based in Washington, California, Idaho, and Nevada (a "Pacific Northwest" carrier group), and 1,000 carriers based throughout other states and Canada.

Respondents to the second survey included more than 450 of the Oregon-based carriers, nearly 370 of the Pacific Northwest carriers, and nearly 400 of the other carriers. The respondents described themselves as follows:

80% said they had been working in the industry more than 10 years.

77% operate small fleets (1-10 trucks)

19% operate medium fleets (11-99 trucks)

4% operate large fleets (100 or more trucks)

The survey methodology included the mailing of (1) a "pre-letter" from ODOT announcing that a survey would be arriving soon, (2) a survey form and cover letter, (3) a postcard reminder, and (4) a second survey form and cover letter. Approximately 400 returned responses from each stratum was required to be within 10% of the truth, with a 95% confidence level. A higher degree of confidence in the results from Oregon carriers, was achieved by the moderate over sampling of Oregon carriers.

A summary of findings for the second survey is listed below:

- 32% of carriers agree that Mainline Pre-clearance will benefit their company (25% disagree and 42% have no opinion about the potential for benefit).
- 52% of carriers agree that a Road Weather Information System (RWIS) will benefit their company (15% disagree and 32% have no opinion).
- 38% of carriers agree that a Downhill Speed Information System (DSIS) will benefit their company (20% disagree and 41% have no opinion).
- 52% of carriers agree with the policy of screening trucks for possible inspection based on recent compliance with federal safety regulations (15% disagree and 31% have no opinion).
- 60% of carriers rate the overall performance of ODOT's Motor Carrier Services as "Good" and 6% rate it "Excellent" (26% rate it "Fair" and 4% rate it "Poor").

PART THREE

Transponder Penetration

Oregon State University
Transportation Research Institute
May 2000

9 INTRODUCTION – TRANSPONDER PENETRATION

9.1 Background

The Transponder Penetration Measure 3.1.2 is one of the evaluation measures that used to assess the acceptance of Green Light by the motor carrier industry. The Measure 3.1.2 tracked the issuance of transponders to the motor carrier population over the evaluation period, ending in March of 2000. In order to monitor motor carrier acceptance, a database file recorded the number of transponders in use over the evaluation period. The data requested was a monthly report of transponders being issued or returned by carriers. In addition, certain characteristics of the carrier's operations will be required to track differences that might occur due to fleet size and location of the fleet. Data elements included:

- Carrier name or more other identifier
- Location of motor carrier by state
- Fleet size
- Number of transponders in service

10 RESULTS – TRANSPONDER PENETRATION

This section presents the data for transponder issuance during the period of the evaluation. Figure 10-1 shows the distribution by month. The substantial increase in march 2000 reflects the decision by ODOT to distribute transponders at no cost to the carrier. Figure 10-2 shows the cumulative penetration of transponders and indicates that the total distributed was nearly 11,000 by March 2000.

Figure 10-1 Monthly Transponder Penetration

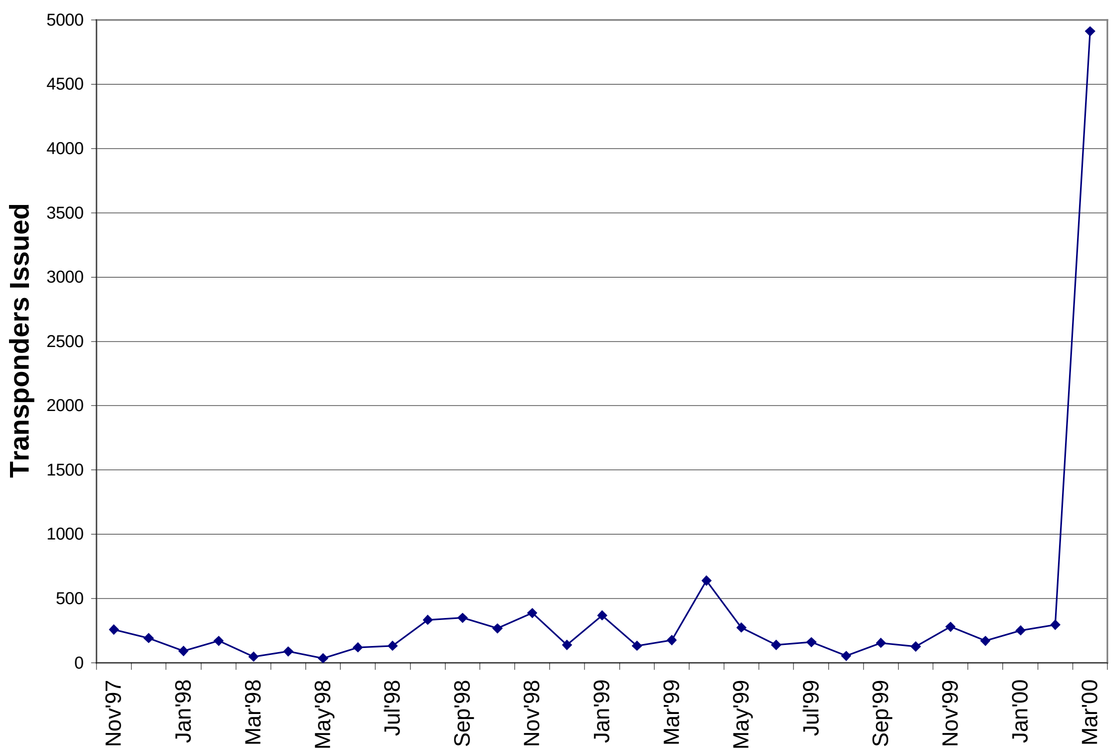
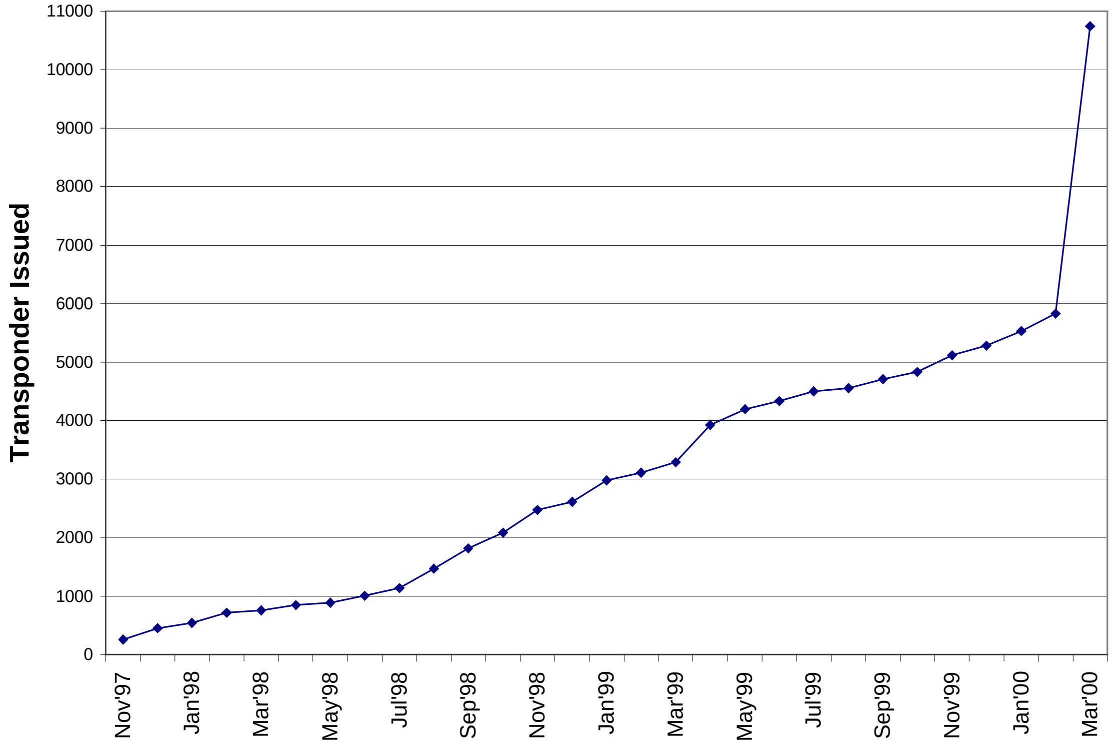


Figure 10-2 Accumulated Transponder Penetration



11 SUMMARY – TRANSPONDER PENETRATION

At the time this report was prepared specific data were not available for transponders issued in April through June 2000. However, ODOT issued approximately another 1500, and, would have issued many more if their stock had not run out. A new order for 12,500 more transponders was delayed; once delivered it is anticipated that they will be distributed quickly.

The following summarizes the findings:

- Nearly 12,500 transponders were in use by the motor carrier industry by June 2000.
- The number of transponders issued increased slowly until ODOT elected to distribute them free of charge.
- Transponder issuance increased dramatically (over 1,500 %) in March 2000 when the decision was made to distribute them at no cost to carriers.

APPENDICES

APPENDIX A

Sampling Methodology and Survey Design

The overall survey design was based, in part, on the design method outline in *Mail and Telephone Surveys-Total Design Method* by Don A. Dillman (Wiley and Sons, 1978). In his book, Don Dillman discusses that by using multiple mailings to the sample population, the response rates can increase nearly 50%. Mailings include an initial cover letter, the survey itself with accompanying a brief description of Green Light components, a follow-up postcard, and finally a second survey identical to the first, but with a slightly different cover letter.

Sampling

Over 60,000 motor carrier names and addresses are contained in ODOT's commercial motor vehicle database. A query of the database was conducted to collect carrier names and addresses from which to draw the sample. The population was limited to active carriers (those not currently suspended for one reason or another), diesel truck operators, and heavy trucks over 26,000 lbs. The initial query also eliminated certain operation classifications and body types (no taxis, bus services, small parcel carriers, passenger cars classified as commercial vehicles, etc.) The subset resulting from the query consisted of 21,928 commercial motor vehicle operators who were likely to be affected by the various Green Light components.

OSU used a stratified sampling approach as presented in *Sampling Techniques* by William Cochran (Wiley and Sons, 1953). The population of motor carriers was divided into three strata (subgroups), based on the locations of the carriers listed in the ODOT database. The systematic random samples were drawn from each of these sub-strata.

The population of 21,928 addresses was broken down into three homogenous subgroups of Oregon carriers, Pacific Northwest carriers (carriers from states, such as Washington, California, Nevada, and Idaho, that have a common border with Oregon), and all other carriers that include all of the Canadian provinces.

Approximately 400 returned responses from each stratum are required to be within 10% of the truth, with a 95% confidence level. There will exist a higher degree of confidence in the results from Oregon carriers than from the entire population if a stratified sampling approach is used with a moderate oversample of the Oregon carriers.

To acquire 400 returned surveys, approximate 1000 – 1200 surveys have to mail out to carriers of each stratum. Choosing participants involves rolling a 10 sided dice to obtain the first element in sample and then selecting every population to sample proportion length, for instant every 7th carrier in Oregon carriers stratum. After getting the proportion length from the three strata, a systematic random sampling list of subjects was formed.

In all, 3200 questionnaires were mailed as shown in Table A-1 below:

Figure 0-1 Sample Sizes

STRATA	CARRIER POPULATION		SAMPLE
	SURVEY ONE	SURVEY TWO	
OREGON	7602	7394	1200
WASHINGTON	2247	2628	
CALIFORNIA	1626	2026	
NEVADA	116	153	
IDAHO	857	1009	
ALL PACIFIC NORTHWEST	4846	5816	1000
ALL OTHERS	7238	8718	1000

Survey Mailing Process

The process for mailing was the same for both surveys. The steps were as follows:

1. **Send out a "pre-letter" announcing that a survey will be arriving** – this will originate from ODOT in order to give the survey credence, a week before the first survey mailing.
2. **Send out the first survey and cover letter** – the survey will contain a brief description of Green Light components, and a return envelope.
3. **Send out a postcard as a reminder** - mailed out to each carrier one week after the first survey is mailed.
4. **Send out second survey and cover letter**- mailed out two weeks after the initial mailing.

APPENDIX B

Figures and Tables of Results
First and Second Surveys

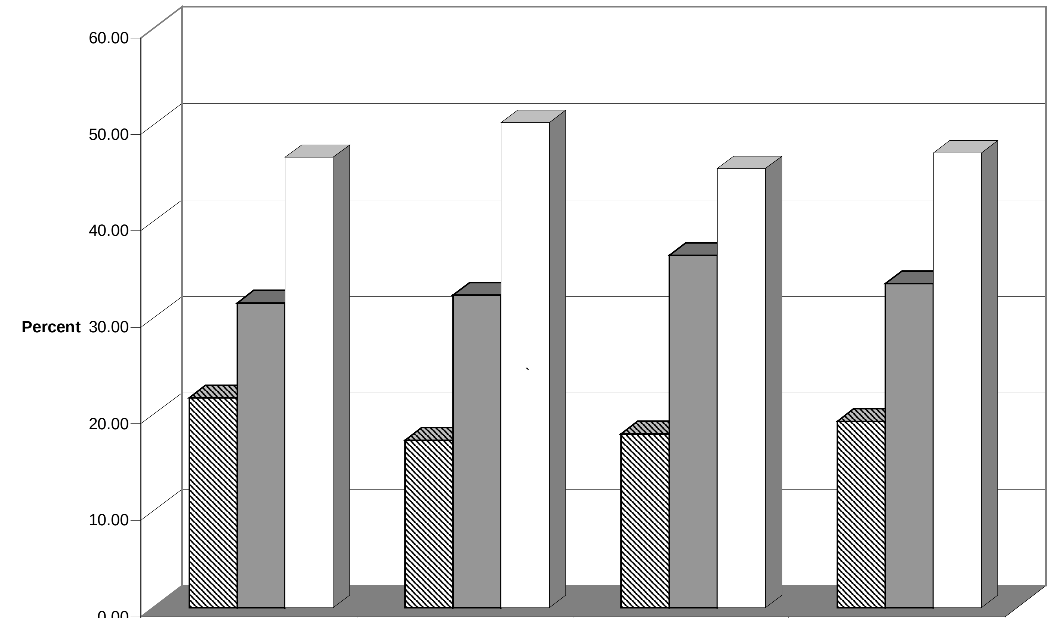
The following figures and tables show the percentages of the population who answered the particular question with the answer shown. The frequencies are representative of the population of carriers who conduct business in Oregon within a certain degree of error. Complete data sets in the form of tables, including standard errors are contained in Appendix C.

Example:

In question #1 on the following page, 21.76% of the carriers in Oregon have worked less than ten years in the industry. Standard errors (Appendix C, page 1) show the error as 1.48%. That is 21.76% of the carriers in Oregon have worked less than ten years in the industry ,+/- 1.48%.

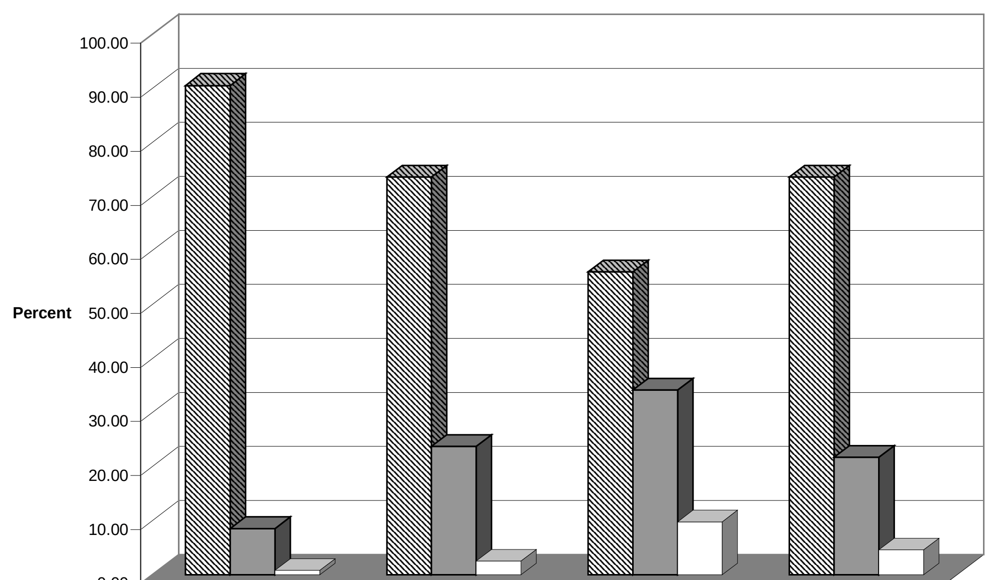
The results of the second survey begin on page B-20.

Q.1) How many years have you personally been working in the industry?



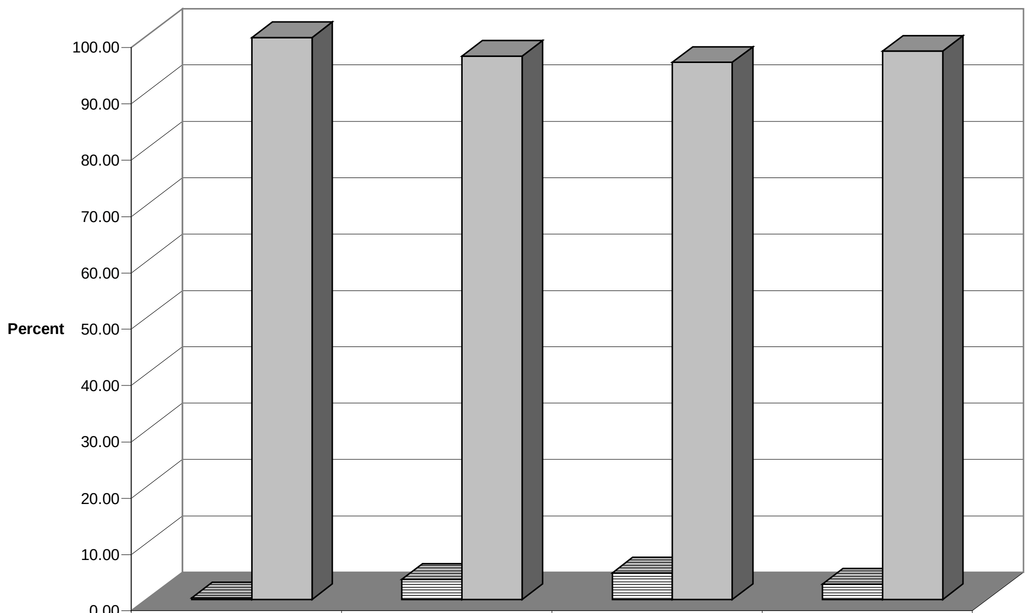
	Oregon Carriers	Pacific Northwest Carriers	Other Carriers	All Carriers
Less than ten years	21.76	17.35	18.02	19.30
11 to 20 years	31.58	32.40	36.49	33.58
More than 20 years	46.66	50.26	45.50	47.12

Q. 2) How large is your company in terms of fleet size?



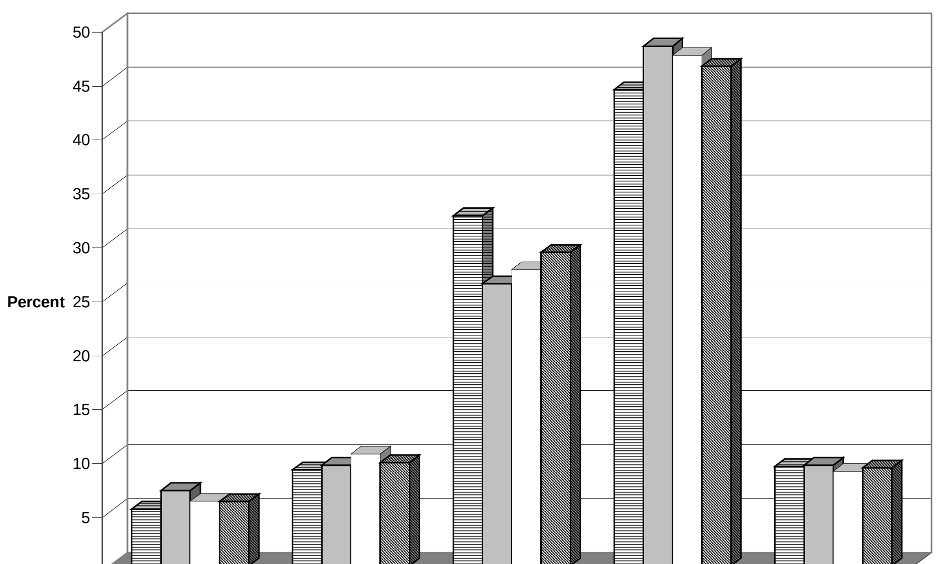
	Oregon Carriers	Pacific Northwest Carriers	Other Carriers	All Carriers
Small (1-10 Tractors)	90.58	73.66	56.03	73.66
Medium (11-99 Tractors)	8.56	23.79	34.15	21.75
Large (100 or more Tractors)	0.86	2.56	9.82	4.59

Q. 5) Have you ever participated in any other transponder-based mainstreaming project such as HELP or Advantage I-75?



	Oregon Carriers	Pacific Northwest Carriers	Other Carriers	All Carriers
Yes	0.28	3.55	4.70	2.71
No	99.72	96.45	95.30	97.29

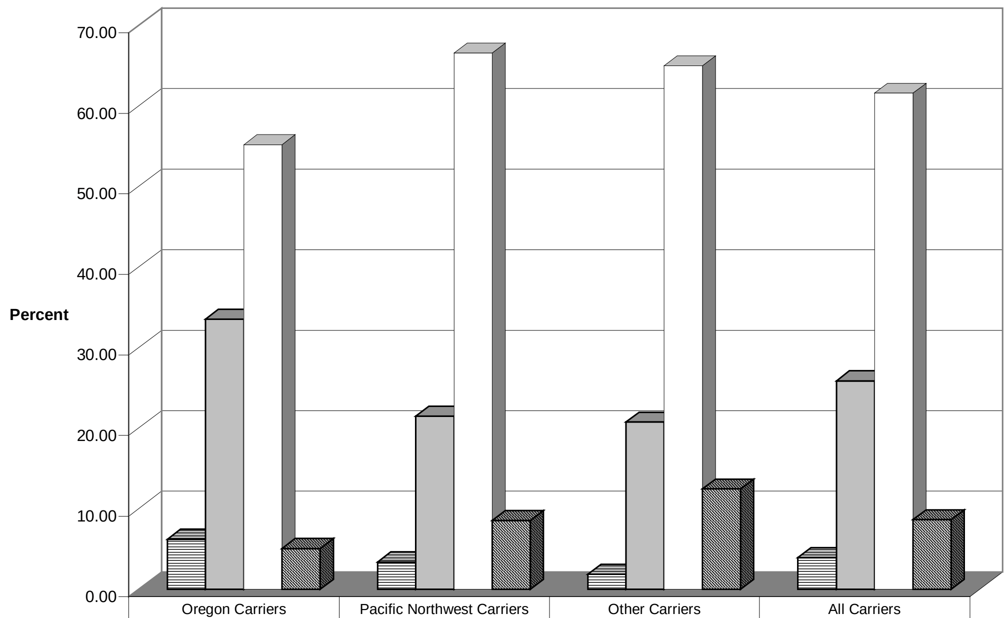
Q. 6) How strongly do you agree with the policy of screening vehicles for possible inspection based on recent compliance with the Federal Motor Vehicle Safety



	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	5.26	8.92	32.46	44.15	9.21
Pacific Northwest Carriers	6.99	9.33	26.17	48.19	9.33
Other Carriers	6	10.39	27.48	47.34	8.78
All Carriers	5.96	9.56	29.07	46.32	9.08

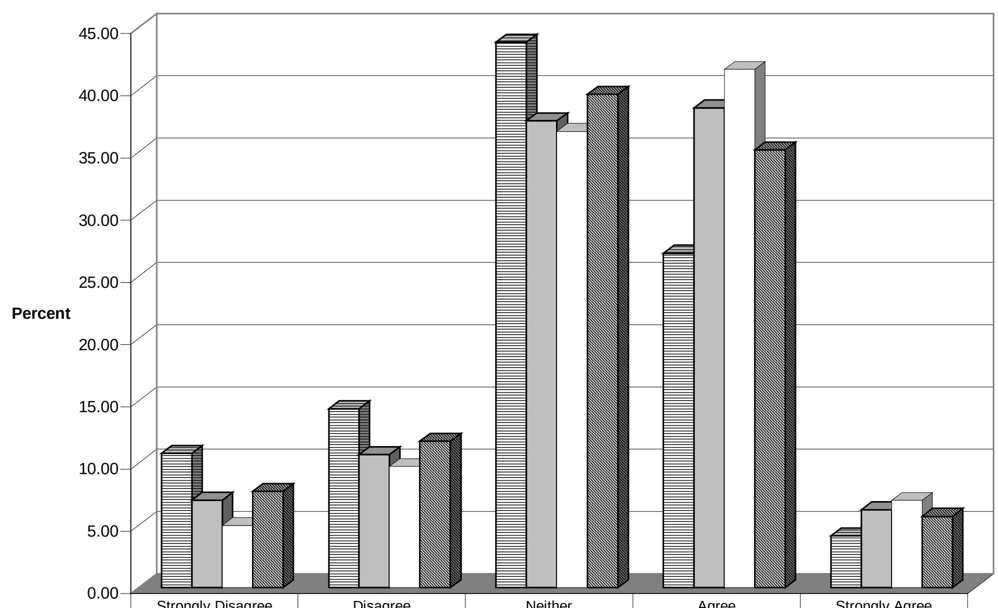
Regulations?

Q. 7) Would you rate the overall performance of ODOT's current Motor Carrier Services as poor, fair, good, or excellent?



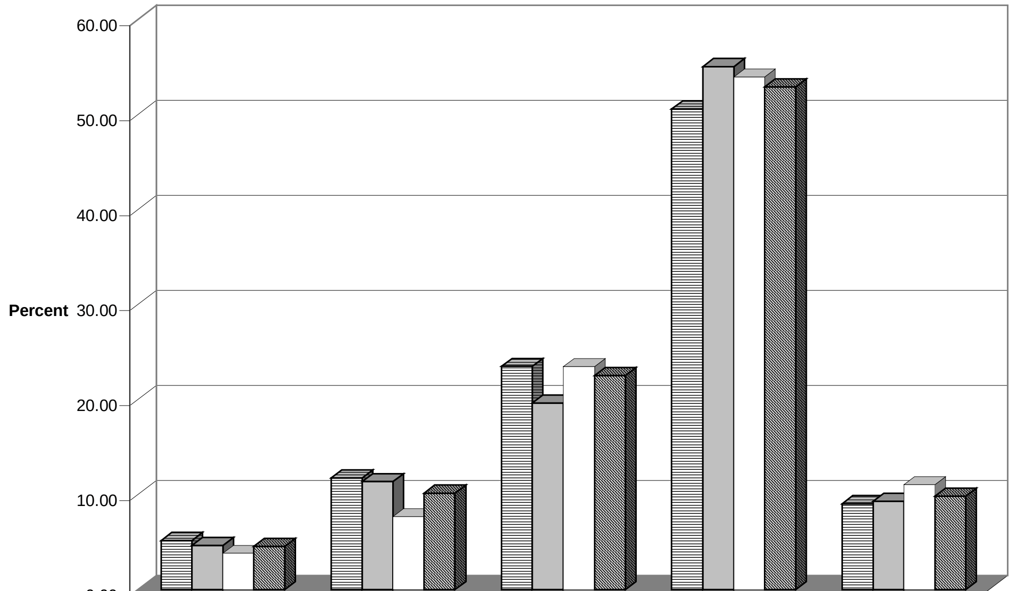
	Oregon Carriers	Pacific Northwest Carriers	Other Carriers	All Carriers
Poor	6.21	3.37	1.84	3.92
Fair	33.53	21.50	20.74	25.89
Good	55.20	66.58	64.98	61.58
Excellent	5.06	8.55	12.44	8.62

Q. 8a) Mainline Preclearance will benefit my company.



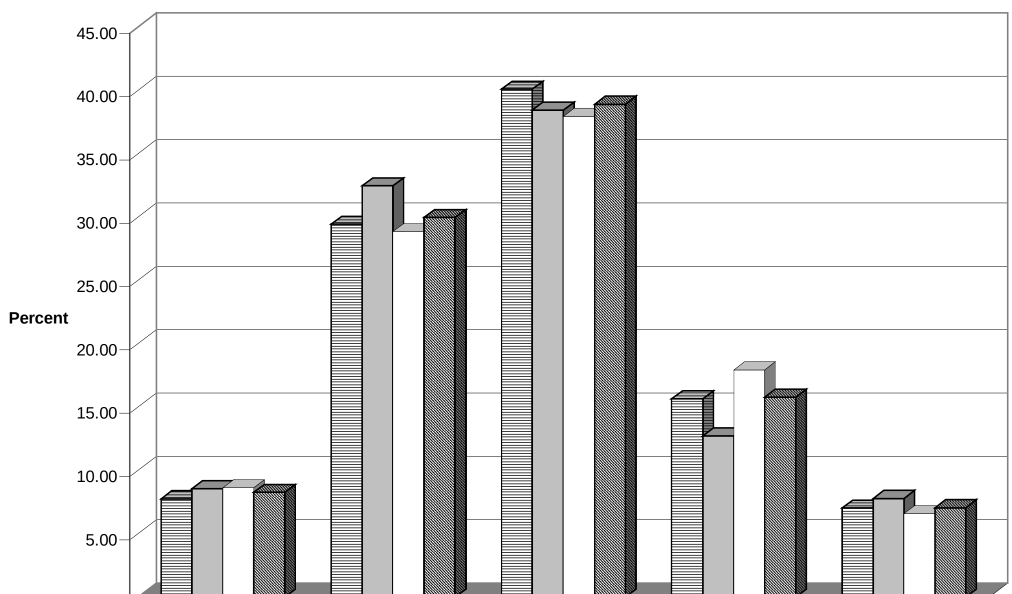
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	10.78	14.37	43.82	26.87	4.17
Pacific Northwest Carriers	7.03	10.68	37.50	38.54	6.25
Other Carriers	4.98	9.73	36.65	41.63	7.01
All Carriers	7.72	11.76	39.63	35.16	5.73

Q. 8b) Mainline preclearance will improve safety on the road.



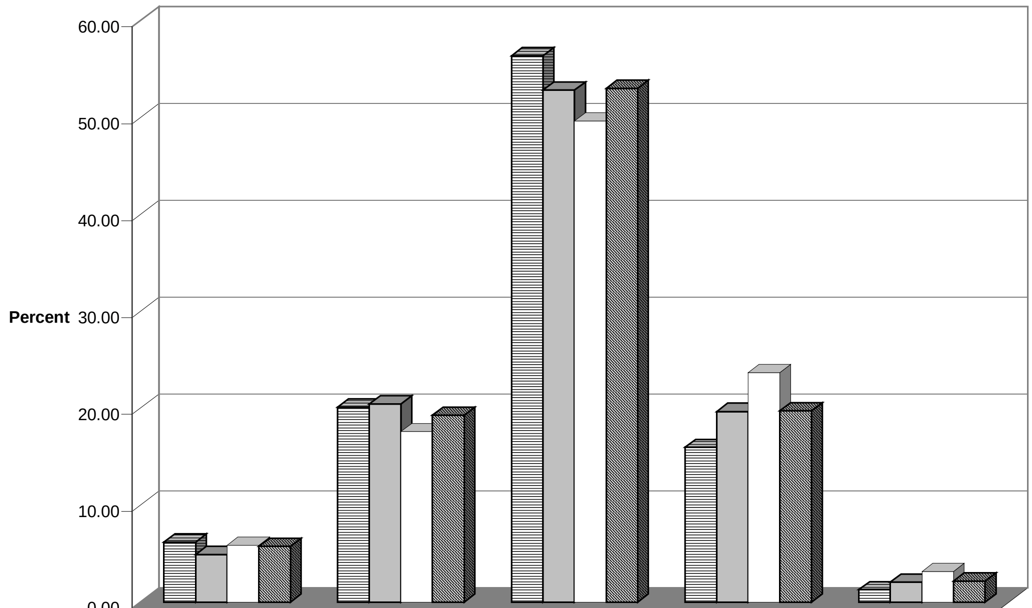
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	5.16	11.75	23.50	50.57	9.03
Pacific Northwest Carriers	4.65	11.37	19.64	55.04	9.30
Other Carriers	3.84	7.67	23.48	53.95	11.06
All Carriers	4.55	10.15	22.54	52.91	9.84

Q. 8c) Mainline preclearance will be an invasion of my driver's privacy.



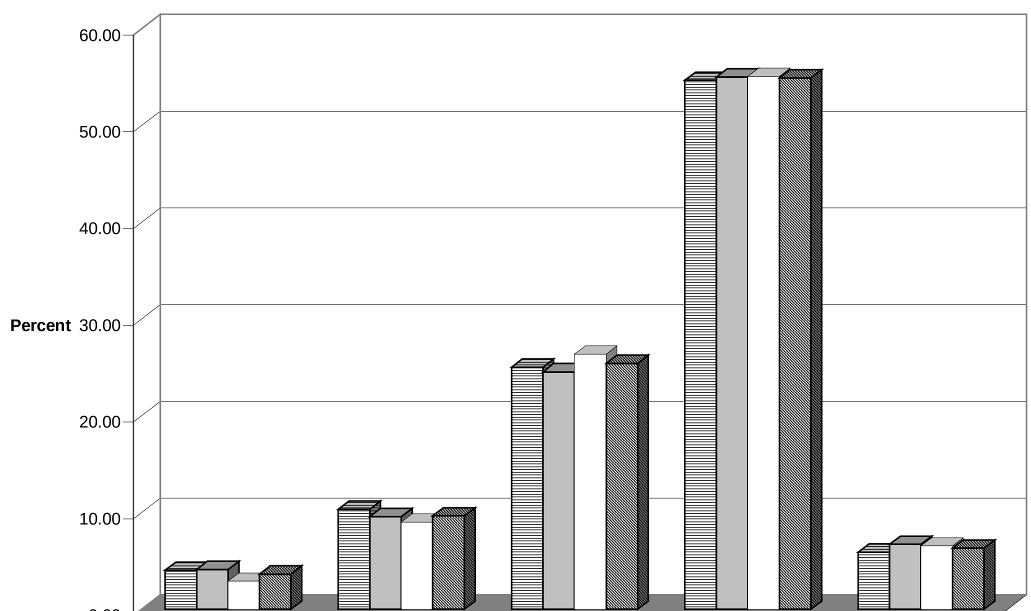
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	7.76	29.45	40.09	15.66	7.04
Pacific Northwest Carriers	8.57	32.47	38.44	12.73	7.79
Other Carriers	8.64	28.86	37.95	17.95	6.59
All Carriers	8.28	29.97	38.90	15.79	7.06

Q. 8d) Mainline preclearance will make my company and its drivers more independent.



	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	6.19	20.14	56.40	15.97	1.29
Pacific Northwest Carriers	4.92	20.47	52.85	19.69	2.07
Other Carriers	5.87	17.61	49.66	23.70	3.16
All Carriers	5.76	19.29	53.04	19.74	2.17

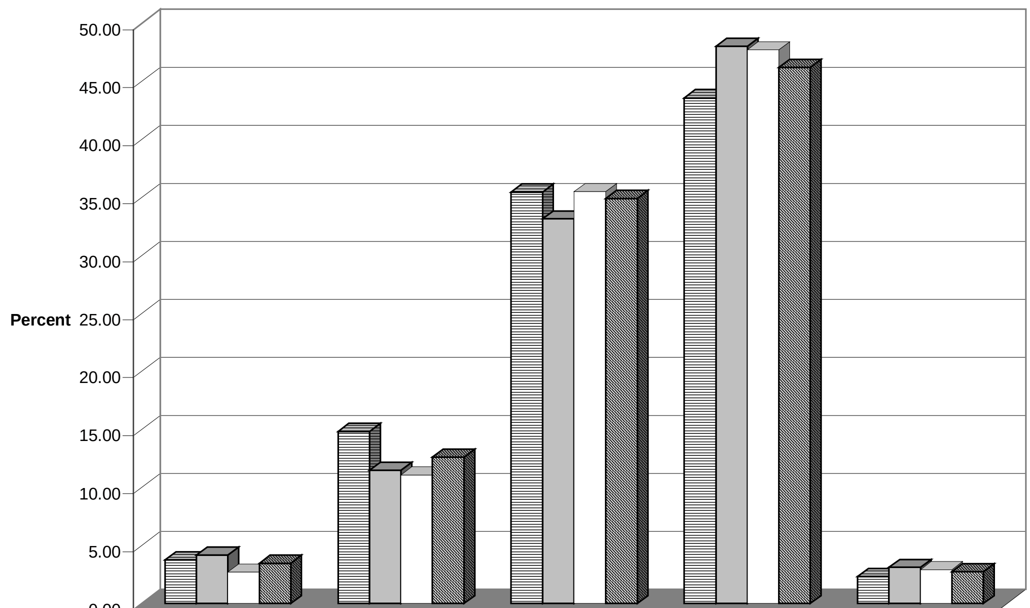
Q. 8e) Mainline preclearance will create more incentives for carriers to comply with



	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	4.03	10.36	25.04	54.68	5.90
Pacific Northwest Carriers	4.13	9.56	24.55	55.04	6.72
Other Carriers	2.93	9.03	26.41	55.08	6.55
All Carriers	3.65	9.67	25.42	54.91	6.34

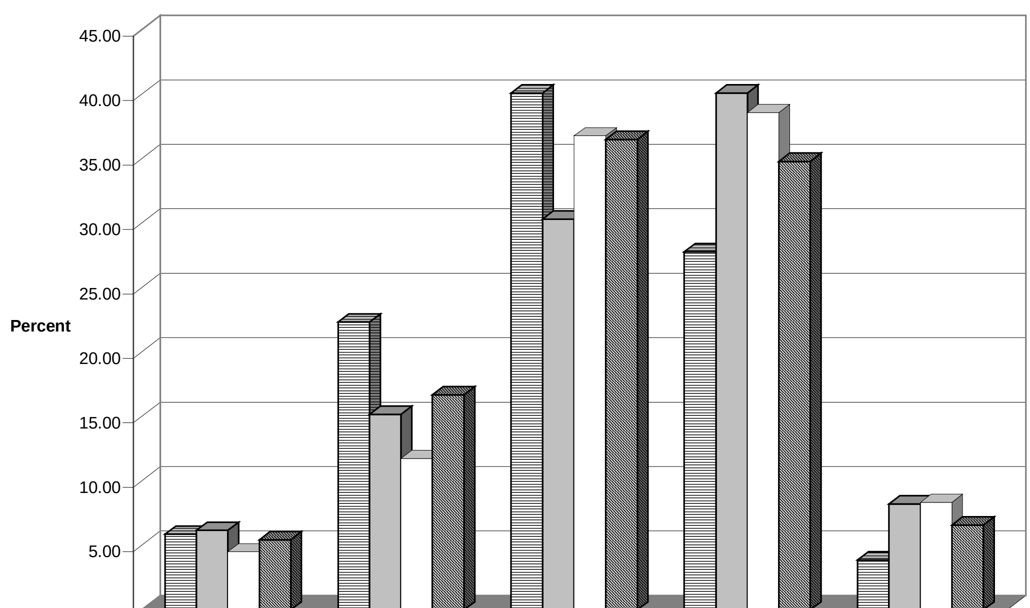
regulations.

Q. 8f) Mainline preclearance will accurately pre-screen vehicles.



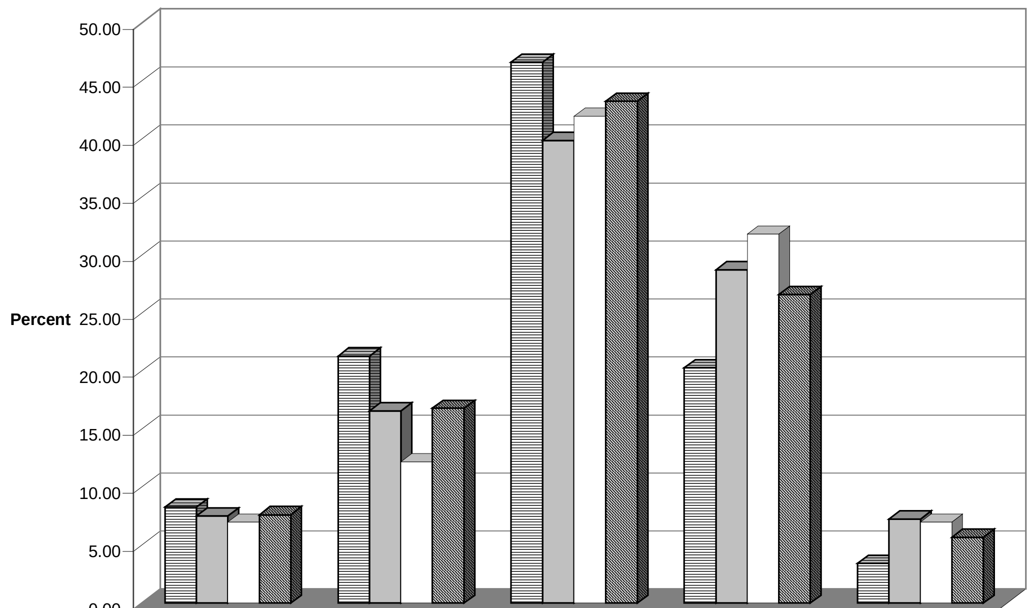
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	3.78	14.83	35.47	43.60	2.33
Pacific Northwest Carriers	4.18	11.49	33.16	48.04	3.13
Other Carriers	2.71	11.09	35.52	47.74	2.94
All Carriers	3.48	12.62	34.92	46.22	2.75

Q. 8g) Mainline preclearance will reduce the amount of wear and tear on my vehicle.



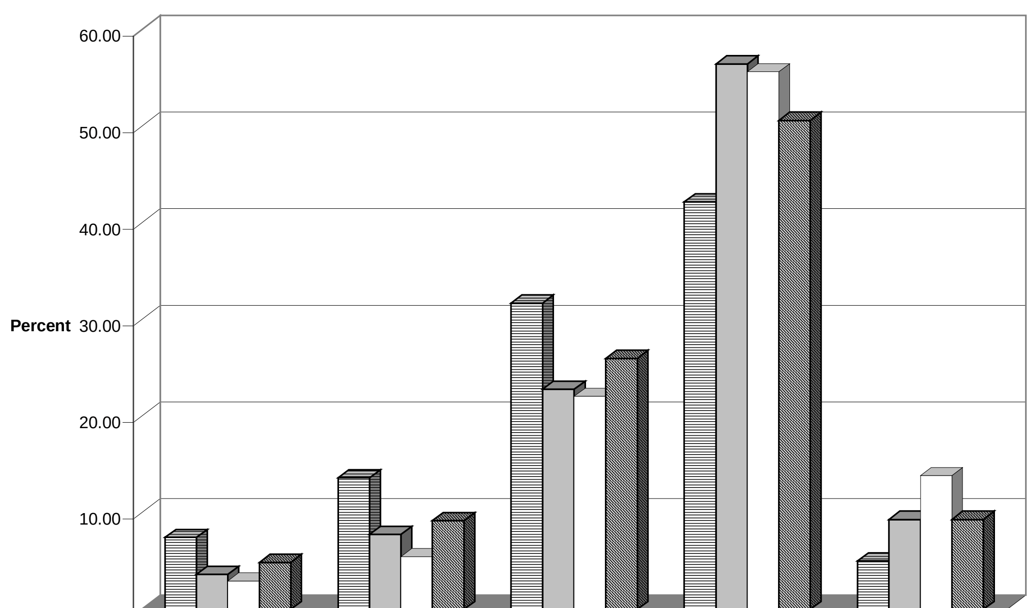
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	5.87	22.35	40.11	27.79	3.87
Pacific Northwest Carriers	6.17	15.17	30.33	40.10	8.23
Other Carriers	4.51	11.74	36.79	38.60	8.35
All Carriers	5.45	16.68	36.49	34.80	6.59

Q. 8h) Mainline preclearance will improve the service I provides to my customers.



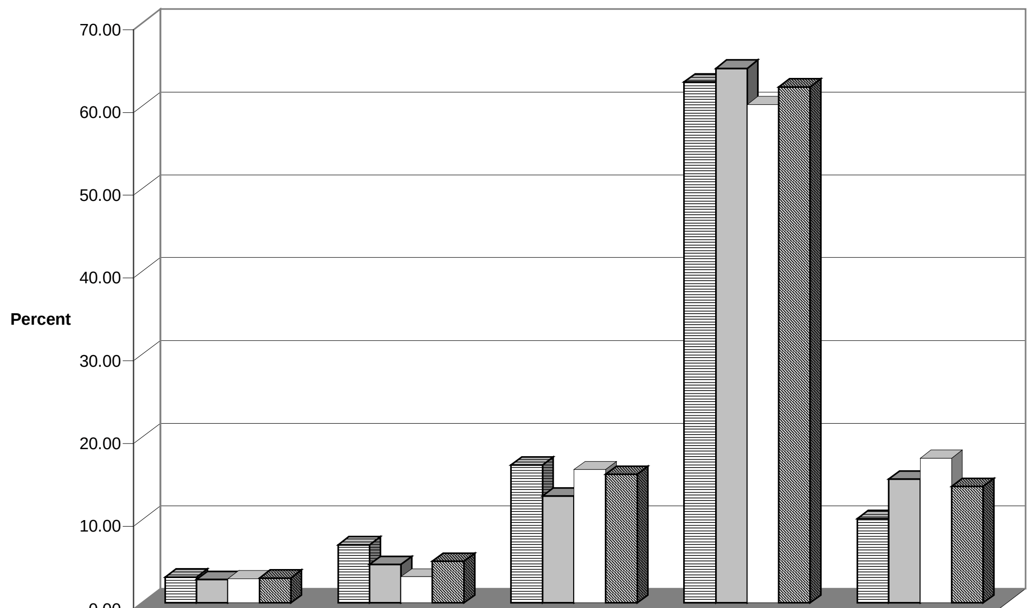
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	8.30	21.32	46.64	20.31	3.43
Pacific Northwest Carriers	7.51	16.58	39.90	28.76	7.25
Other Carriers	7.00	12.19	41.99	31.83	7.00
All Carriers	7.63	16.80	43.28	26.62	5.68

Q. 9a) RWIS will benefit my company



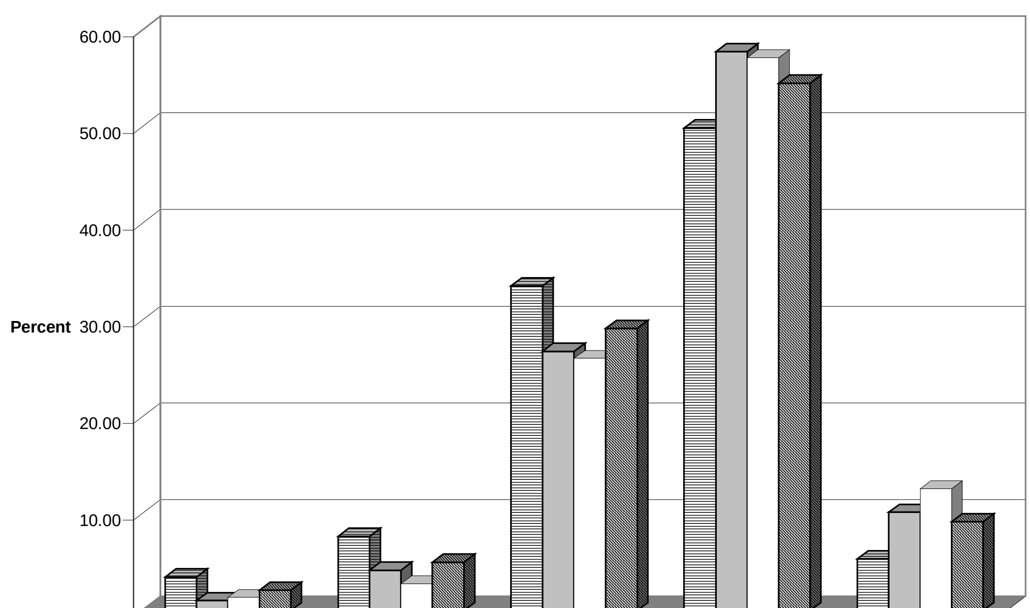
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	7.46	13.63	31.71	42.18	5.02
Pacific Northwest Carriers	3.63	7.77	22.80	56.48	9.33
Other Carriers	2.95	5.45	22.05	55.68	13.86
All Carriers	4.87	9.19	25.98	50.64	9.32

Q. 9b) RWIS will improve safety on the road.



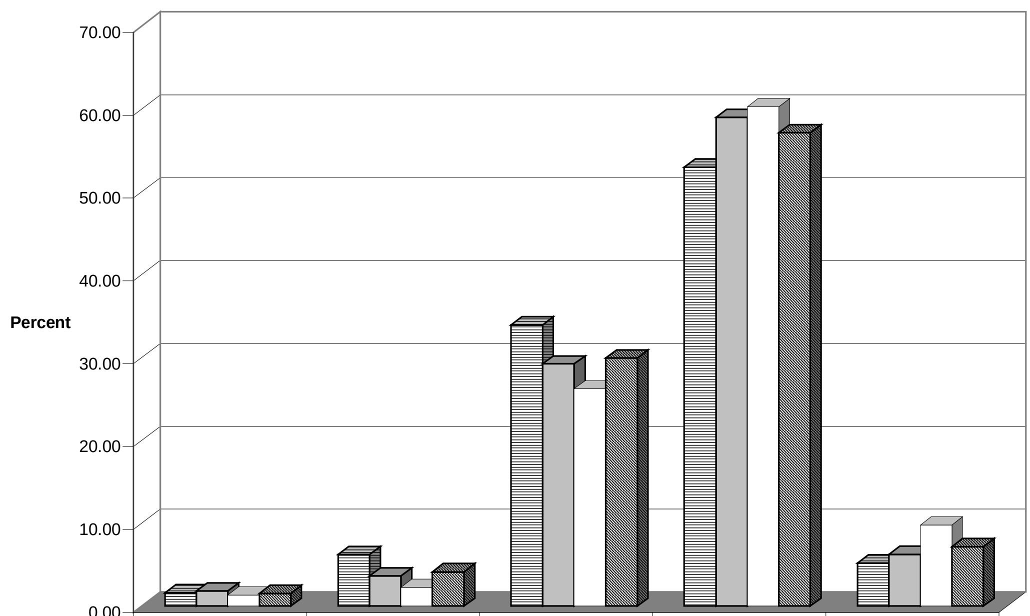
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	3.16	7.04	16.67	62.93	10.20
Pacific Northwest Carriers	2.84	4.65	12.92	64.60	14.99
Other Carriers	2.95	3.18	16.14	60.23	17.50
All Carriers	3.01	5.04	15.55	62.35	14.06

Q. 9c) RWIS will provide accurate weather information to my company and its drivers.



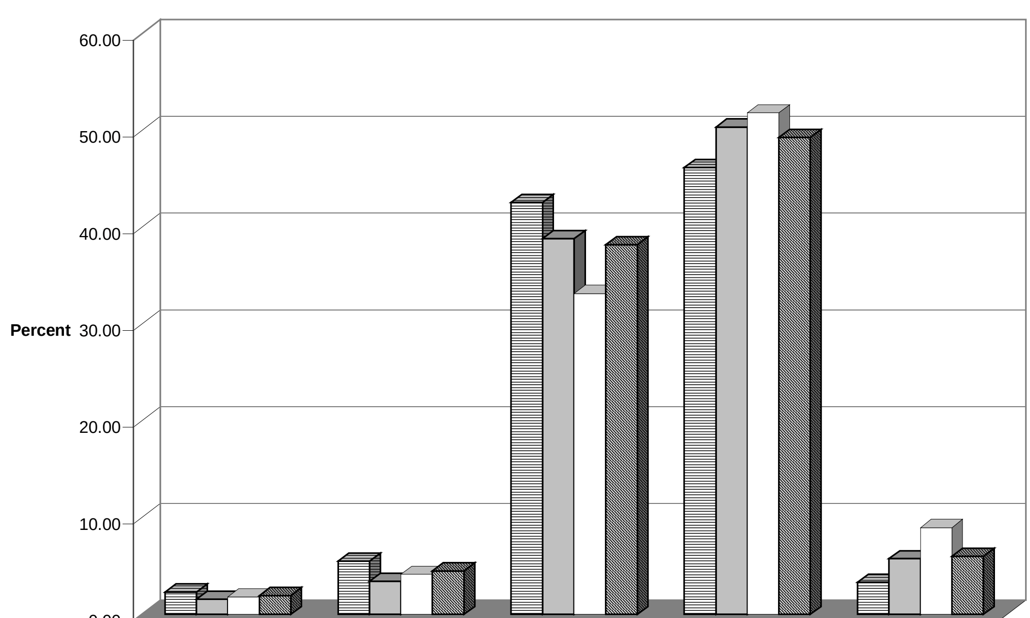
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	3.47	7.67	33.57	49.93	5.35
Pacific Northwest Carriers	1.04	4.17	26.82	57.81	10.16
Other Carriers	1.37	2.75	26.09	57.21	12.59
All Carriers	2.10	5.00	29.17	54.54	9.19

Q. 9d) RWIS will provide information in a timely fashion.



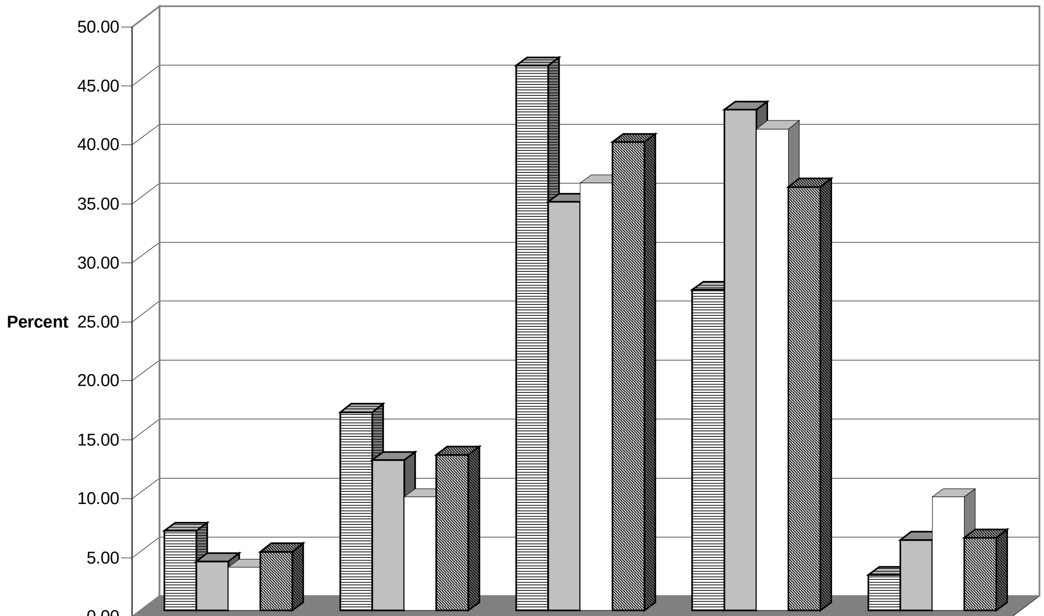
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	1.60	6.24	33.96	52.98	5.22
Pacific Northwest Carriers	1.83	3.66	29.24	59.01	6.27
Other Carriers	1.37	2.28	26.26	60.27	9.82
All Carriers	1.57	4.15	29.96	57.14	7.17

Q. 9e) RWIS information will be easy to use and understand



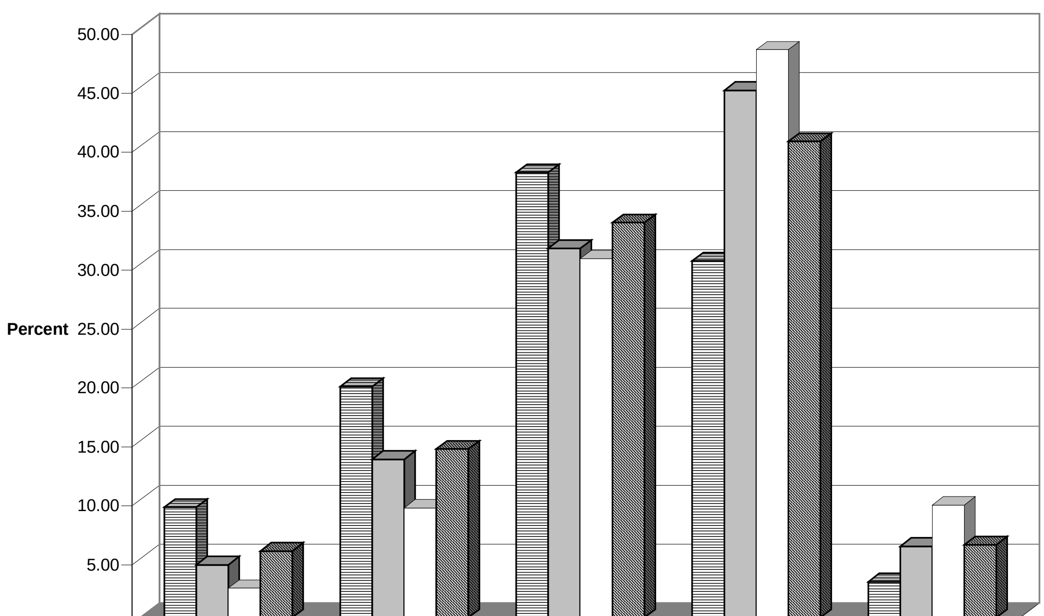
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	2.33	5.52	42.59	46.22	3.34
Pacific Northwest Carriers	1.57	3.41	38.85	50.39	5.77
Other Carriers	1.84	4.15	33.18	51.84	8.99
All Carriers	1.96	4.50	38.22	49.31	6.01

Q. 9f) RWIS will improve the service I provide to my customers



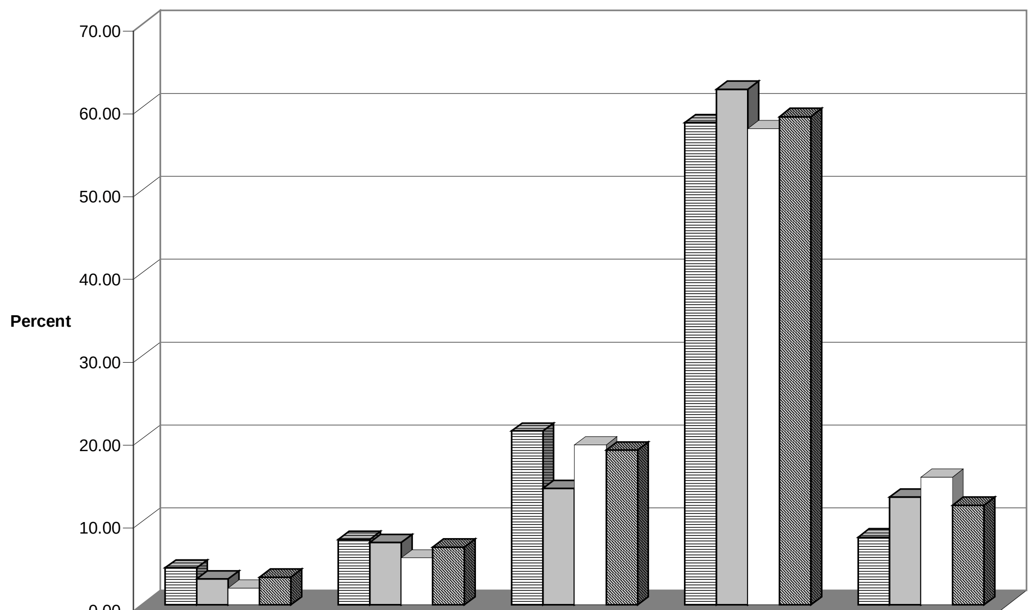
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	6.76	16.83	46.19	27.19	3.02
Pacific Northwest Carriers	4.17	12.76	34.64	42.45	5.99
Other Carriers	3.67	9.63	36.24	40.83	9.63
All Carriers	4.99	13.20	39.71	35.92	6.17

Q. 10 a) The Downhill Information System (DSIS) will benefit my company



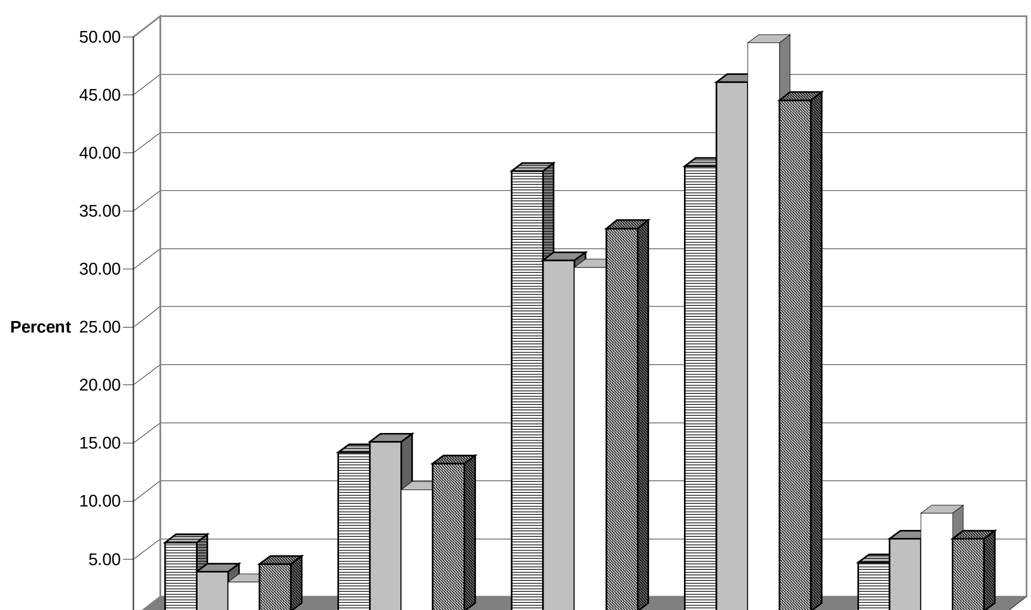
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	9.37	19.60	37.75	30.26	3.03
Pacific Northwest Carriers	4.47	13.42	31.32	44.74	6.05
Other Carriers	2.50	9.32	30.45	48.18	9.55
All Carriers	5.64	14.30	33.50	40.39	6.17

Q. 10b) DSIS will improve safety on the road



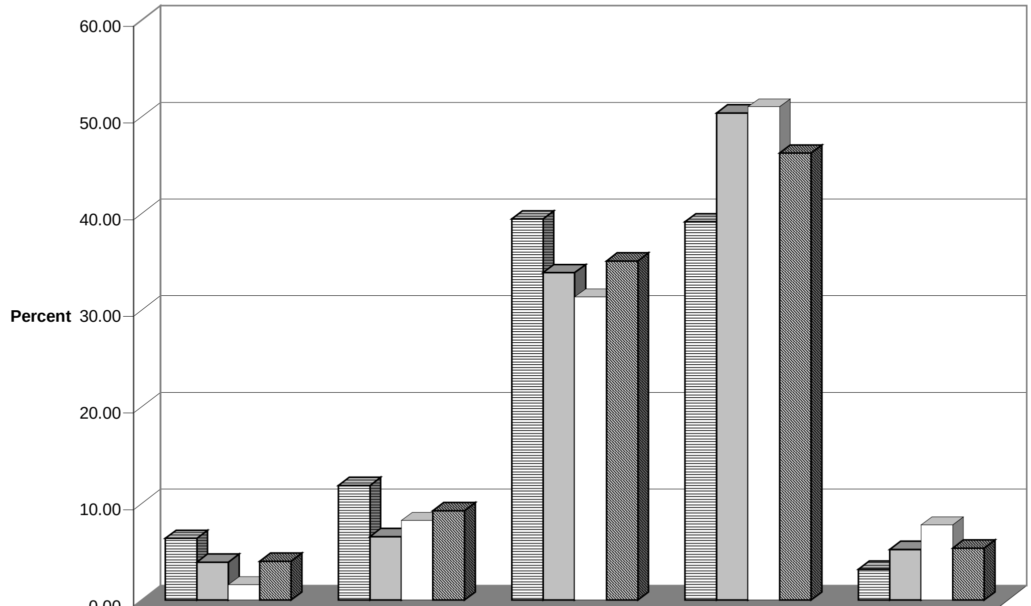
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	4.47	7.90	20.98	58.19	8.19
Pacific Northwest Carriers	3.12	7.55	14.06	62.24	13.02
Other Carriers	2.05	5.68	19.32	57.50	15.45
All Carriers	3.35	7.00	18.68	58.93	12.04

Q. 10c) DSIS will make it easier to comply with existing speed limits



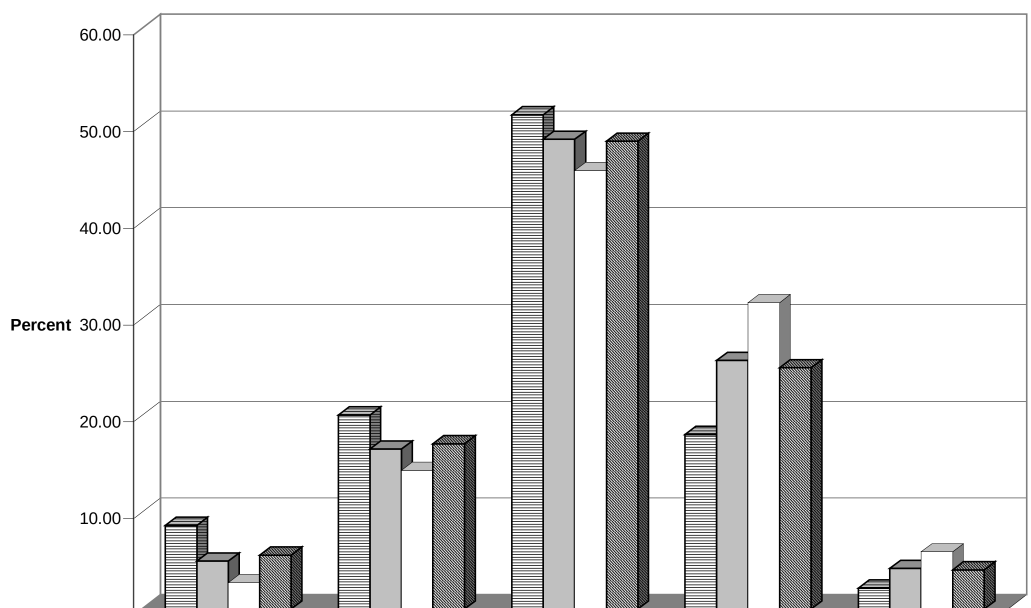
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	5.91	13.69	37.90	38.33	4.18
Pacific Northwest Carriers	3.39	14.58	30.21	45.57	6.25
Other Carriers	2.51	10.48	29.61	48.97	8.43
All Carriers	4.04	12.73	32.97	44.02	6.25

Q. 10d) DSIS will provide reliable and accurate information



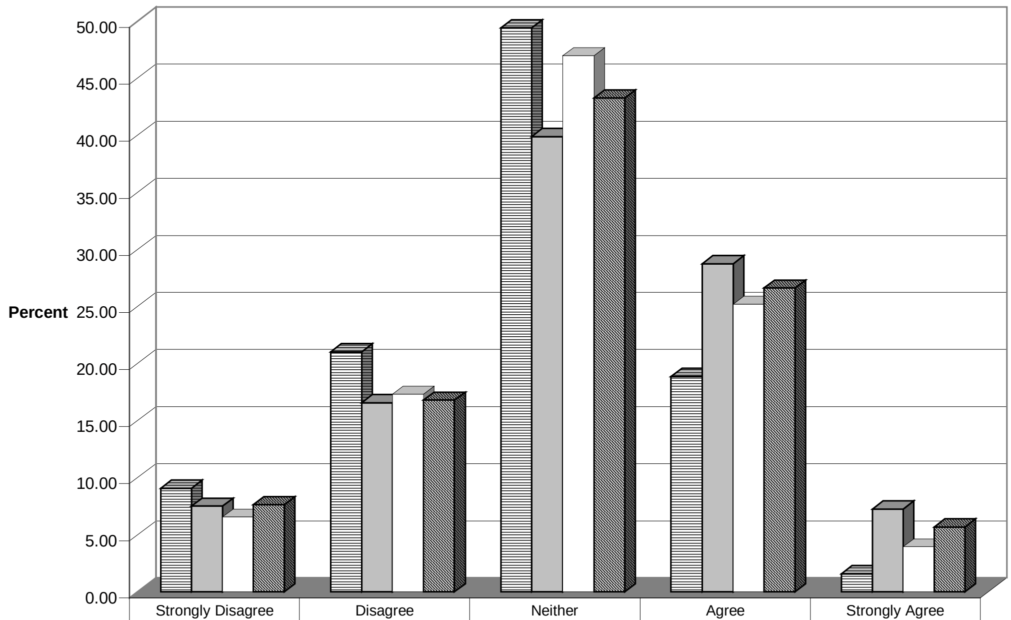
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	6.38	11.88	39.42	39.13	3.19
Pacific Northwest Carriers	3.94	6.56	33.86	50.39	5.25
Other Carriers	1.60	8.24	31.35	51.03	7.78
All Carriers	4.02	9.24	35.09	46.26	5.38

Q. 10 e) DSIS will improve the services I provide to my customers



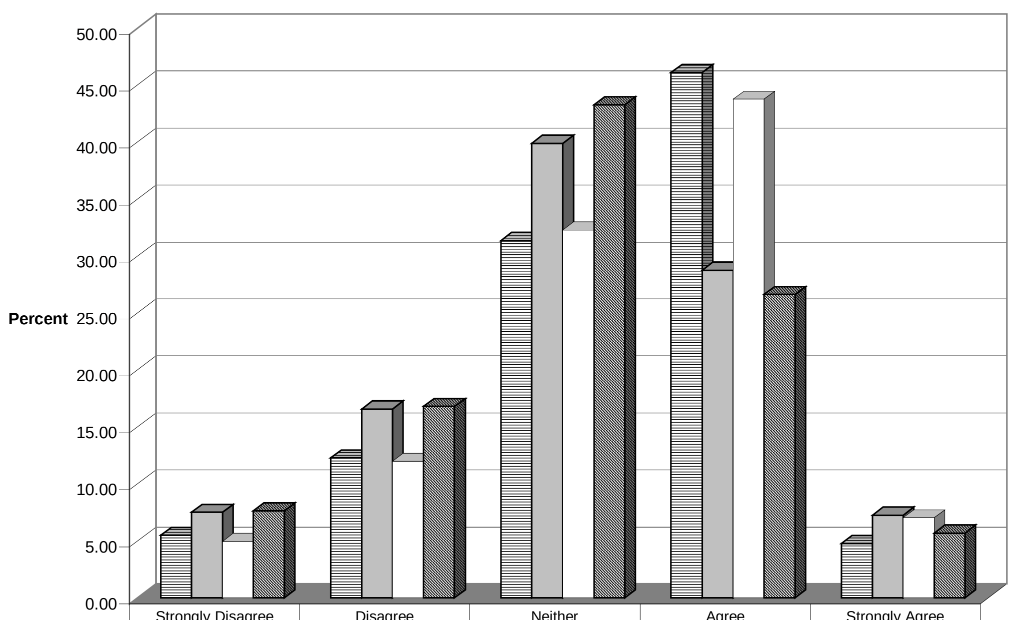
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	8.66	20.06	51.08	18.04	2.16
Pacific Northwest Carriers	4.99	16.54	48.56	25.72	4.20
Other Carriers	2.73	14.35	45.33	31.66	5.92
All Carriers	5.58	17.10	48.35	24.93	4.05

Q. 11a) The Integrated Tactical Enforcement Network (ITEN) will benefit my company



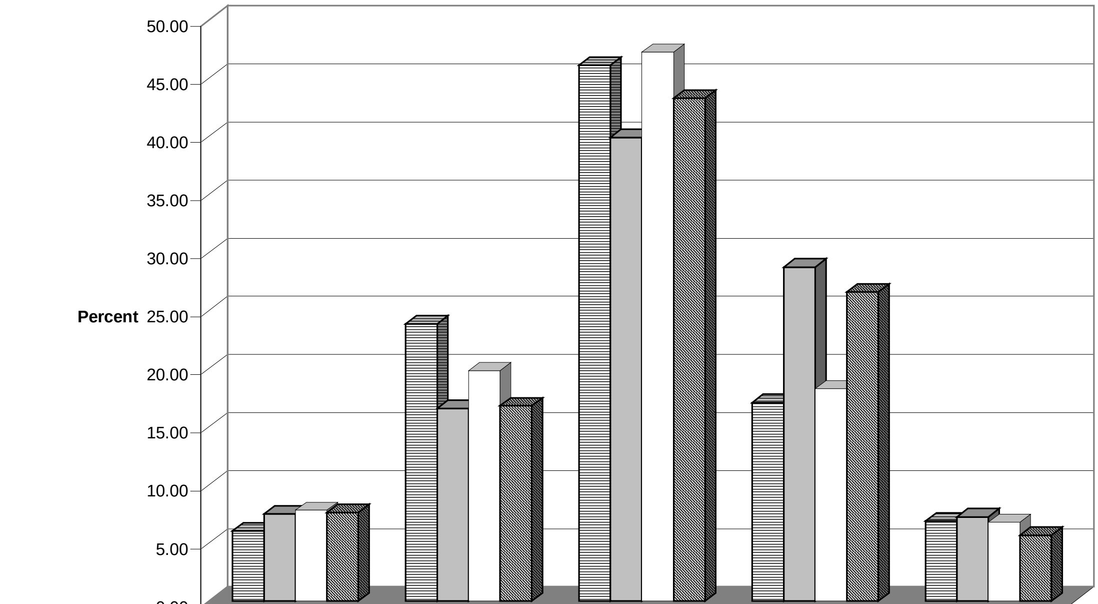
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	9.08	21.04	49.42	18.88	1.59
Pacific Northwest Carriers	7.51	16.58	39.90	28.76	7.25
Other Carriers	6.56	17.32	46.98	25.20	3.94
All Carriers	7.63	16.80	43.28	26.62	5.68

Q. 11b) ITEN will improve safety on the road



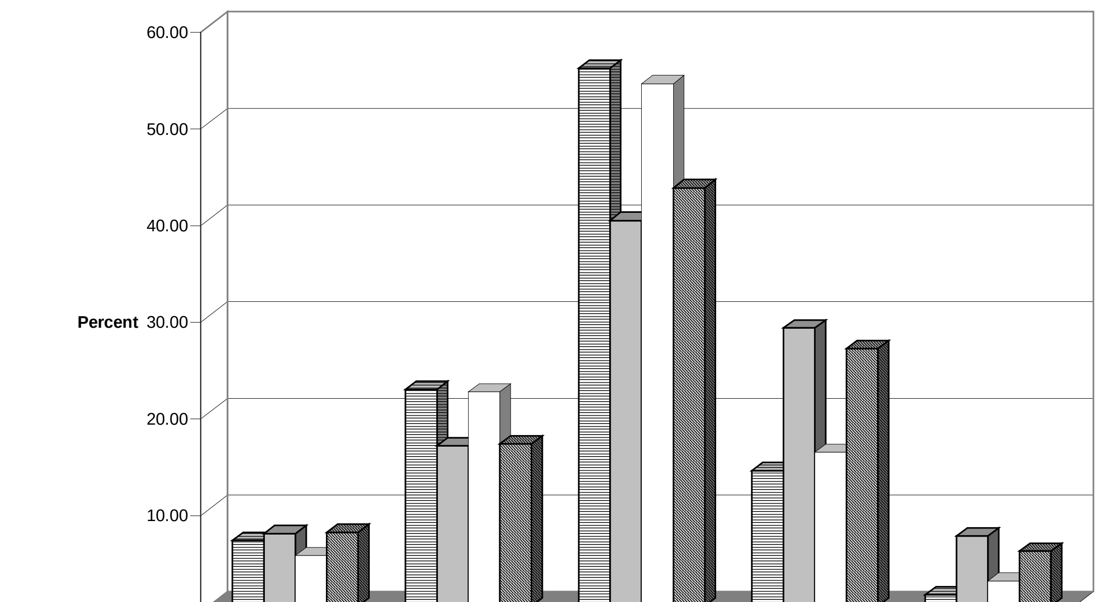
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	5.49	12.28	31.36	46.10	4.77
Pacific Northwest Carriers	7.51	16.58	39.90	28.76	7.25
Other Carriers	4.95	11.98	32.29	43.75	7.03
All Carriers	7.63	16.80	43.28	26.62	5.68

Q. 11c) ITEN will be an invasion of my drivers policy



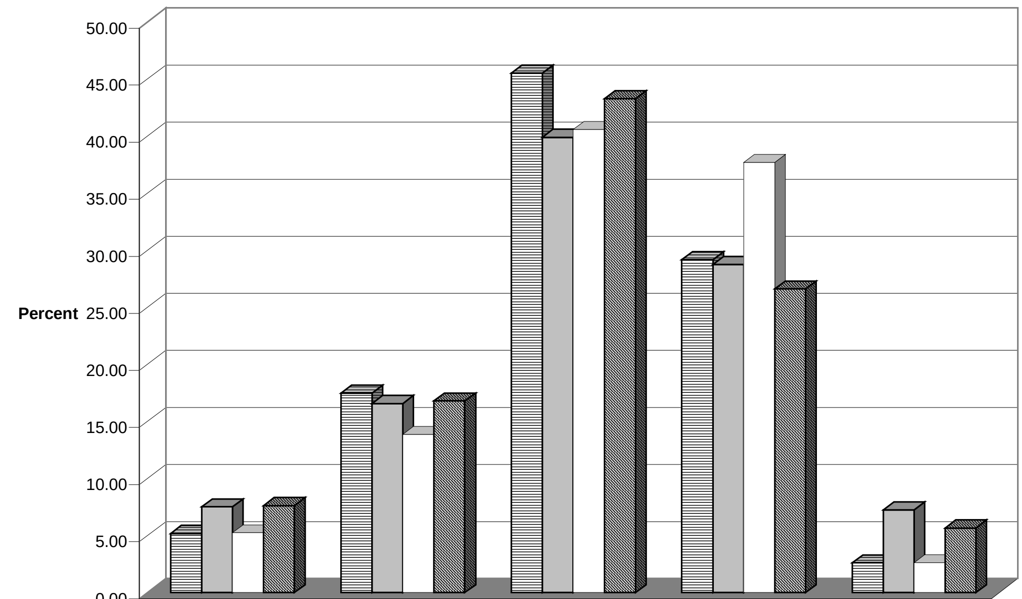
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	6.03	23.85	46.12	17.10	6.90
Pacific Northwest Carriers	7.51	16.58	39.90	28.76	7.25
Other Carriers	7.83	19.84	47.26	18.28	6.79
All Carriers	7.63	16.80	43.28	26.62	5.68

Q. 11d) ITEN will make my company and its drivers more dependent



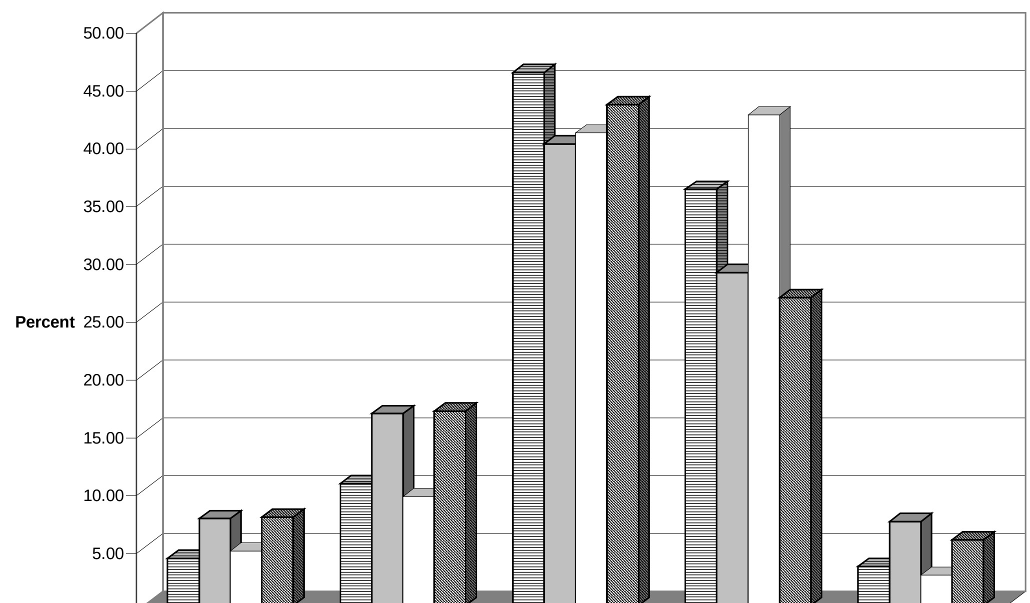
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	6.79	22.40	55.64	14.02	1.16
Pacific Northwest Carriers	7.51	16.58	39.90	28.76	7.25
Other Carriers	5.22	22.19	54.05	15.93	2.61
All Carriers	7.63	16.80	43.28	26.62	5.68

Q 11e) ITEN will make it easier to comply with existing regulations



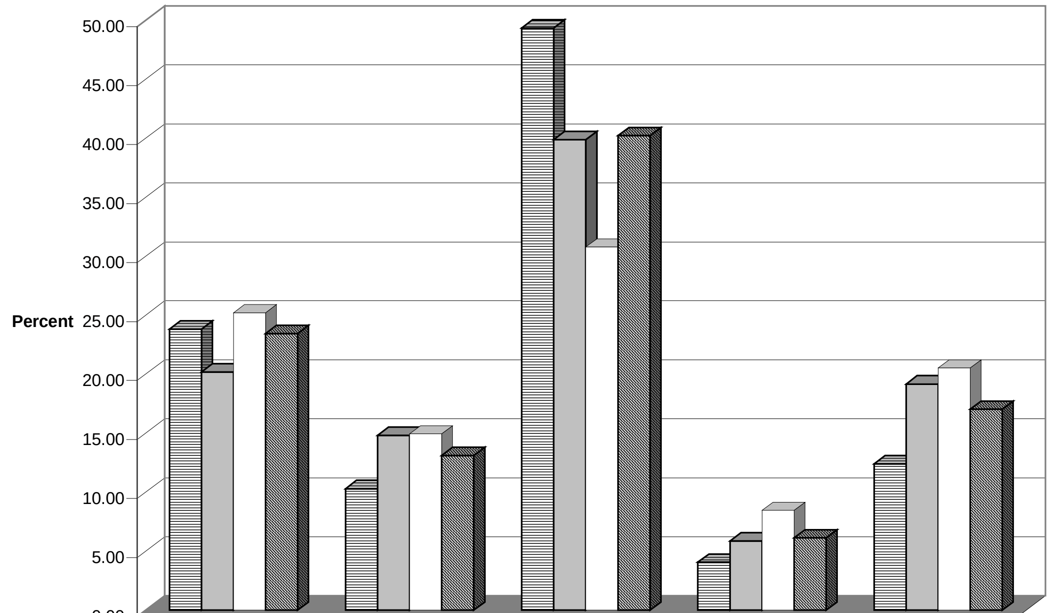
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	5.20	17.49	45.52	29.19	2.60
Pacific Northwest Carriers	7.51	16.58	39.90	28.76	7.25
Other Carriers	5.24	13.87	40.58	37.70	2.62
All Carriers	7.63	16.80	43.28	26.62	5.68

Q. 11f) ITEN will provide reliable and accurate data



	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Series1	4.09	10.53	46.05	35.96	3.36
Series2	7.51	16.58	39.90	28.76	7.25
Series3	4.71	9.42	40.84	42.41	2.62
Series4	7.63	16.80	43.28	26.62	5.68

Q 13) Please indicate your position within your company



	President	Fleet Manager	Owner	Dispatcher	Other
Oregon Carriers	23.84	10.30	49.37	4.09	12.41
Pacific Northwest Carriers	20.20	14.83	39.90	5.88	19.18
Other Carriers	25.22	14.96	30.80	8.48	20.54
All Carriers	23.46	13.12	40.22	6.14	17.05

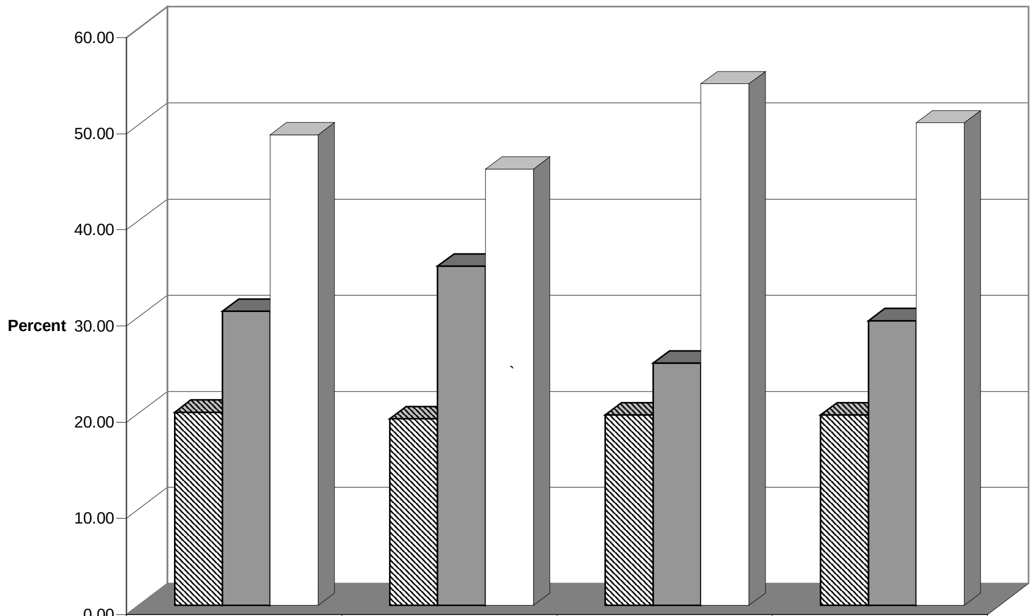
Figures and Tables of Results
Second Survey

The following figures and tables show the percentages of the population who answered the particular question with the answer shown. The frequencies are representative of the population of carriers who conduct business in Oregon within a certain degree of error. Complete data sets in the form of tables, including standard errors are contained in Appendix C.

Example:

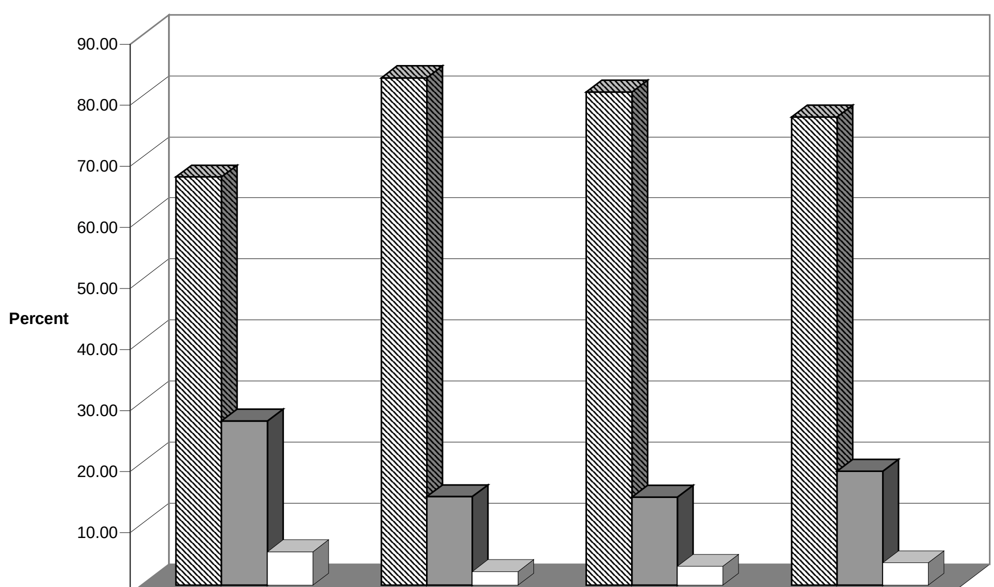
In question #1 on the following page, 20.09% of the carriers in Oregon have worked less than ten years in the industry. Standard errors (Appendix C, page 1) show the error as 2.09%. That is 20.09% of the carriers in Oregon have worked less than ten years in the industry, +/- 2.09%.

Q.1) How many years have you personally been working in the industry?



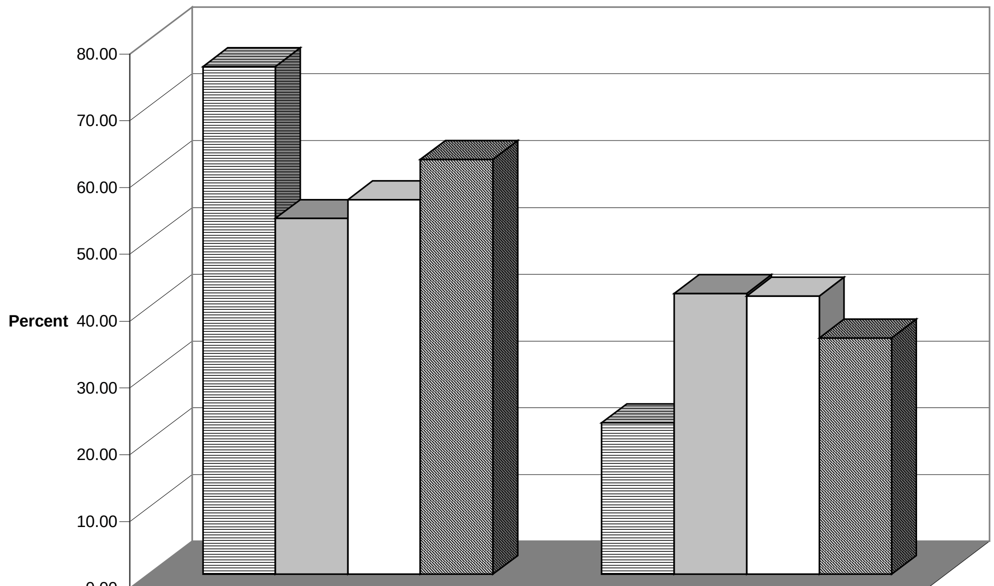
	Oregon Carriers	Pacific Northwest Carriers	Other Carriers	All Carriers
Less than ten years	20.09	19.40	19.79	19.79
11 to 20 years	30.57	35.25	25.19	29.58
More than 20 years	48.91	45.36	54.24	50.17

Q. 2) How large is your company in terms of fleet size?



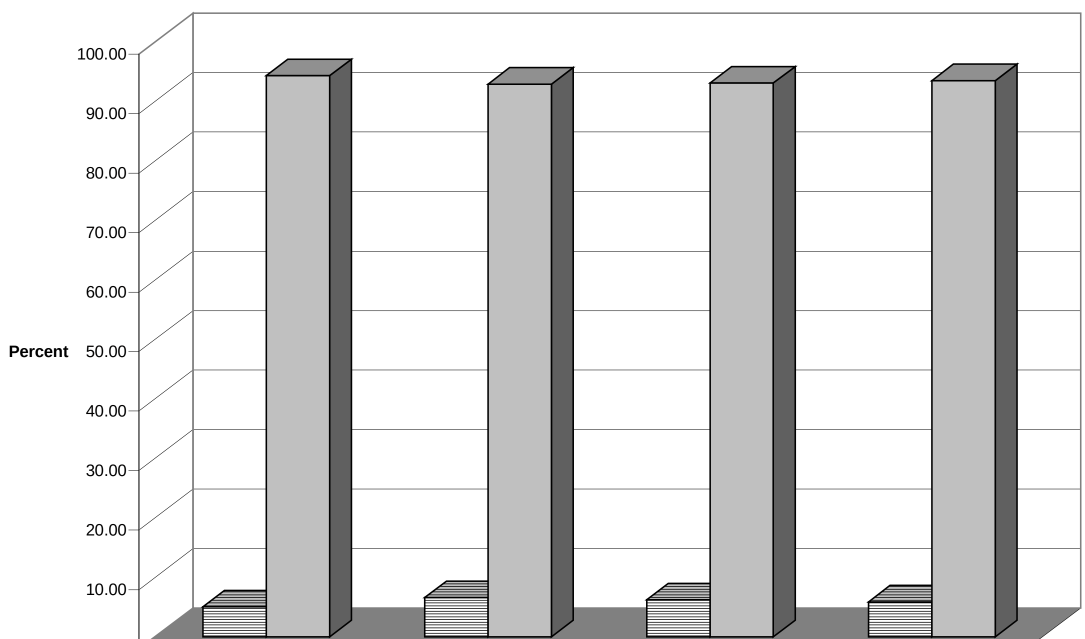
	Oregon Carriers	Pacific Northwest Carriers	Other Carriers	All Carriers
Small (1-10 Tractors)	66.81	83.06	80.72	76.61
Medium (11-99 Tractors)	26.86	14.48	14.40	18.63
Large (100 or more Tractors)	5.46	2.19	3.08	3.66

Q. 4) Are your operations predominantly INTERSTATE or INTRASTATE?



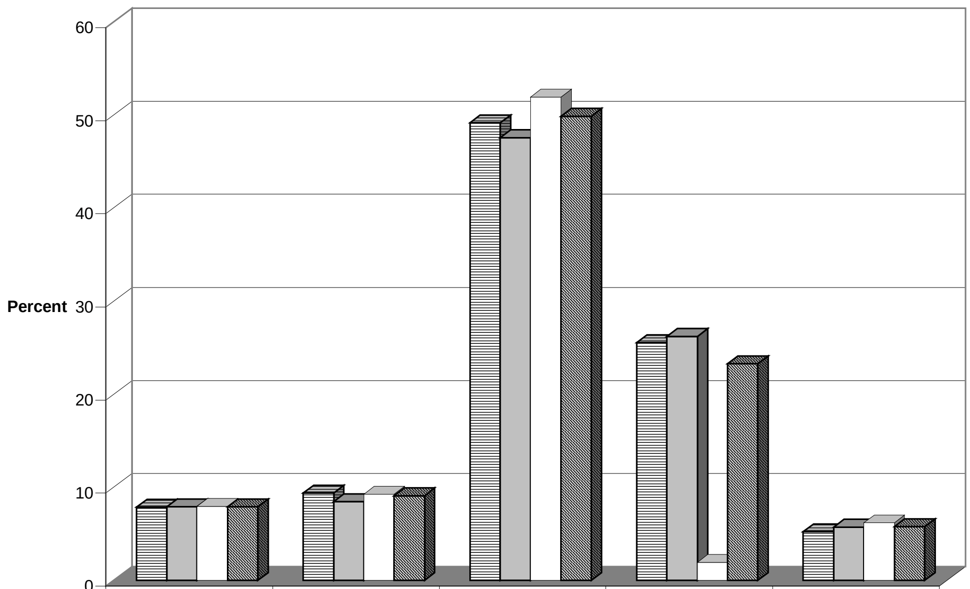
	Interstate	Intrastate
Oregon Carriers	75.98	22.71
Pacific Northwest Carriers	53.28	42.08
Other Carriers	56.04	41.65
All Carriers	62.08	35.35

Q. 6) Are you currently participating in Oregon's Green Light program?



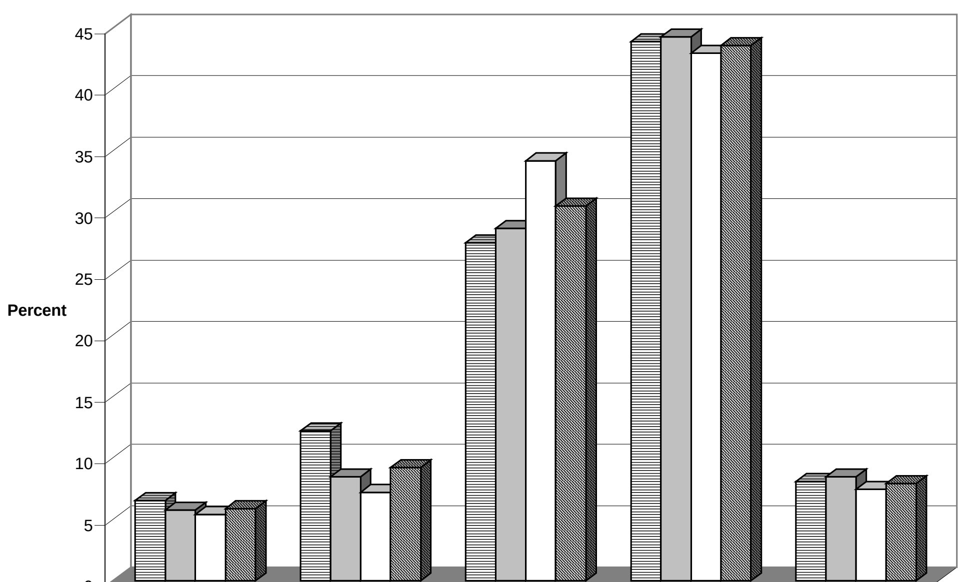
	Oregon Carriers	Pacific Northwest Carriers	Other Carriers	All Carriers
Yes	5.02	6.56	6.17	5.88
No	94.32	92.90	93.06	93.46

Q. 7) How strongly do you agree with the interoperability of the transponder-based mainline preclearances systems?



	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	7.86	9.39	49.13	25.55	5.24
Pacific Northwest Carriers	7.92	8.47	47.54	26.23	5.74
Other Carriers	7.97	9.25	51.93	1.95	6.17
All Carriers	7.92	9.10	49.86	23.28	5.75

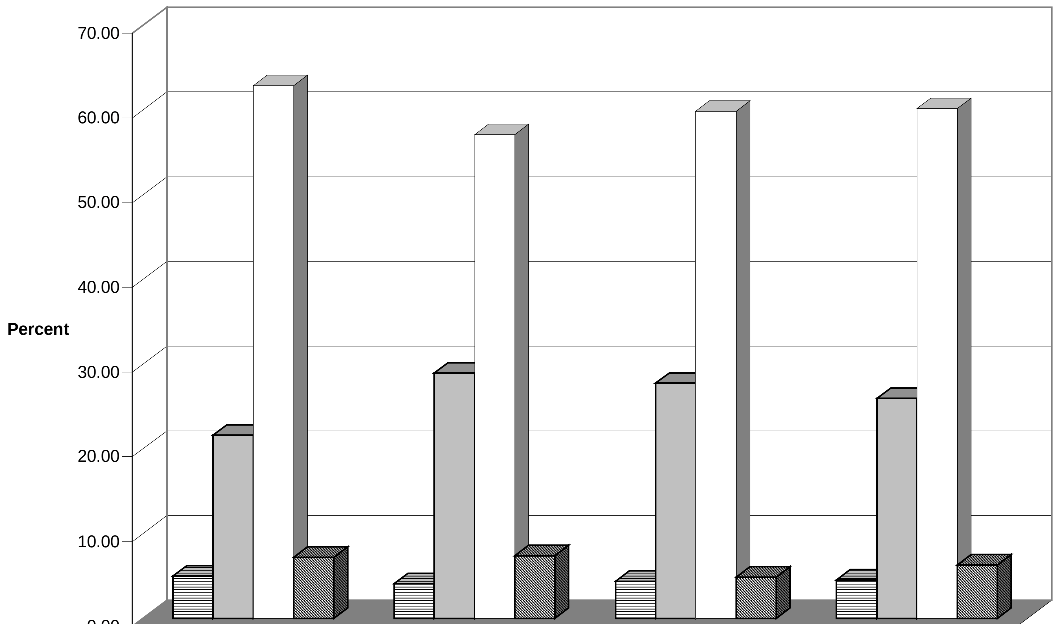
Q. 8) How strongly do you agree with the policy of screening vehicles for possible inspection based on recent compliance with the Federal Motor Vehicle Safety



	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	6.55	12.23	27.51	43.89	8.08
Pacific Northwest Carriers	5.74	8.47	28.69	44.26	8.47
Other Carriers	5.4	7.2	34.19	42.93	7.46
All Carriers	5.87	9.22	30.53	43.59	7.93

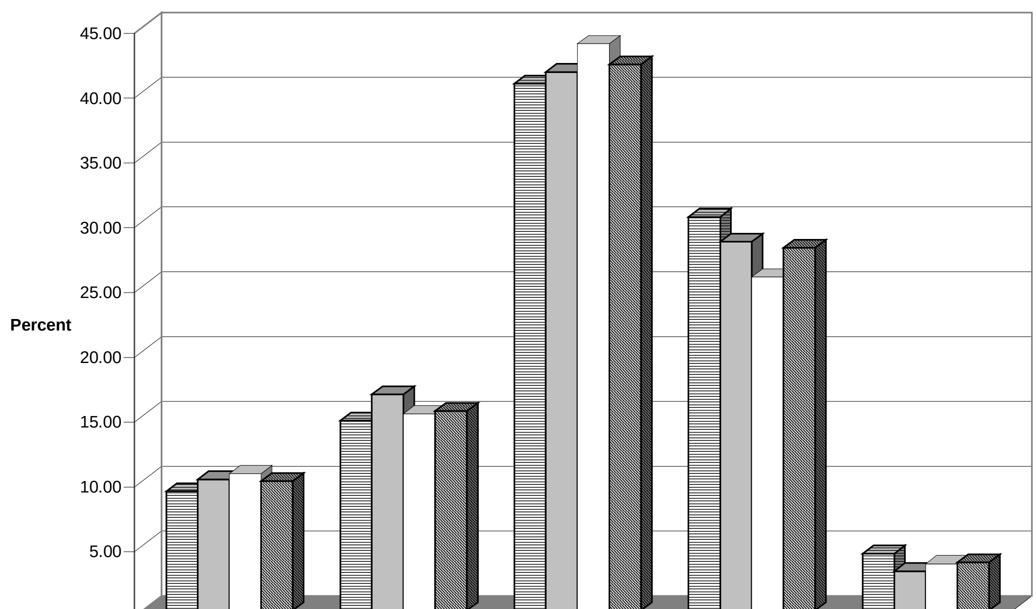
Regulations?

Q. 9) Would you rate the overall performance of ODOT's current Motor Carrier Services as poor, fair, good or excellent?



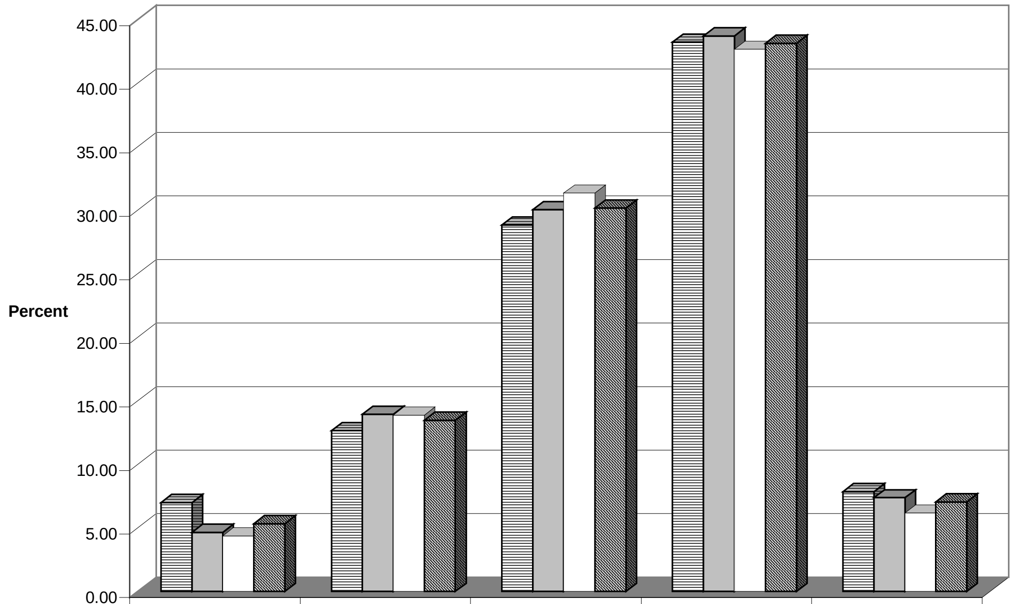
	Oregon Carriers	Pacific Northwest Carriers	Other Carriers	All Carriers
Poor	5.02	4.10	4.37	4.52
Fair	21.62	28.96	27.76	25.99
Good	62.88	57.10	59.90	60.19
Excellent	7.21	7.38	4.88	6.31

Q. 10a) Mainline preclearance will benefit my company.



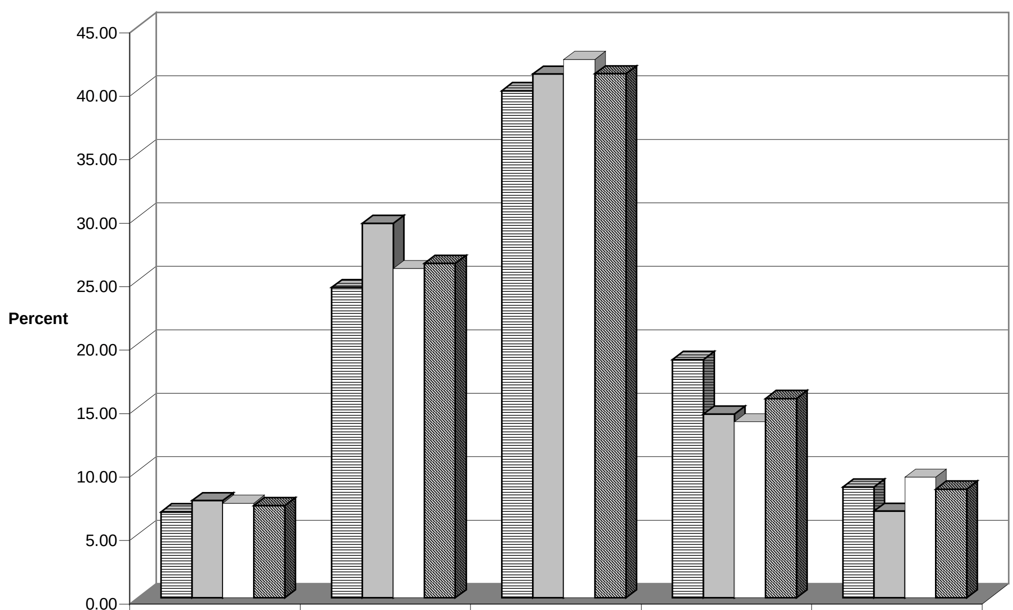
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	9.17	14.63	40.61	30.35	4.37
Pacific Northwest Carriers	10.11	16.67	41.53	28.42	3.01
Other Carriers	10.54	15.17	43.70	25.71	3.60
All Carriers	9.97	15.37	42.10	27.97	3.71

Q. 10b) Mainline preclearance will improve safety on the road.



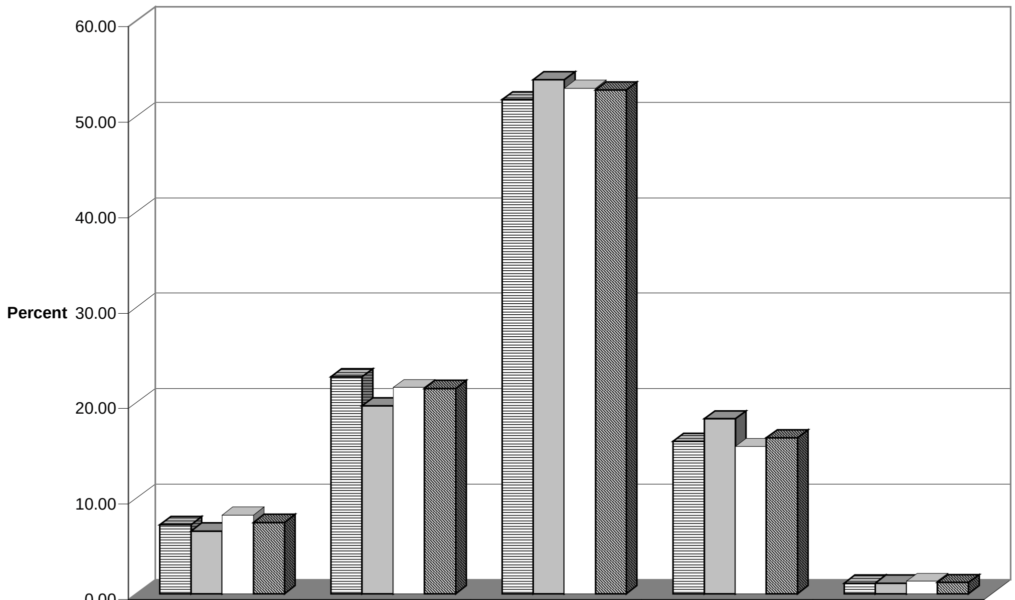
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	6.99	12.66	28.82	43.23	7.86
Pacific Northwest Carriers	4.64	13.93	30.05	43.72	7.38
Other Carriers	4.37	13.88	31.36	42.67	6.17
All Carriers	5.33	13.48	30.17	43.13	7.05

Q. 10c) Mainline preclearance will be an invasion of my driver's privacy.



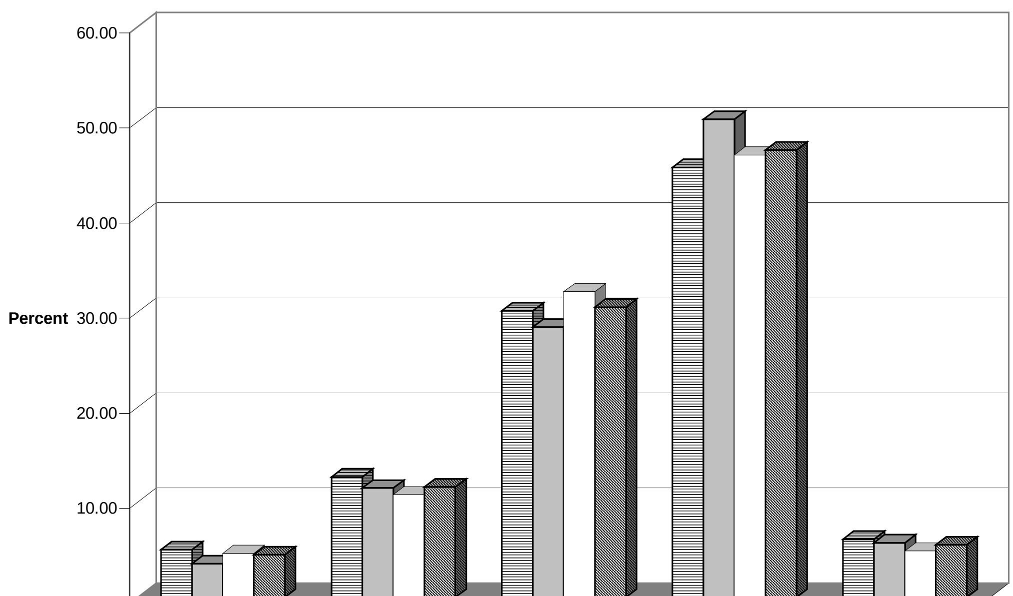
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	6.77	24.45	39.96	18.78	8.73
Pacific Northwest Carriers	7.65	29.51	41.26	14.48	6.83
Other Carriers	7.46	25.96	42.42	13.88	9.51
All Carriers	7.27	26.36	41.29	15.69	8.56

Q. 10d) Mainline preclearance will make my company and its drivers more independent.



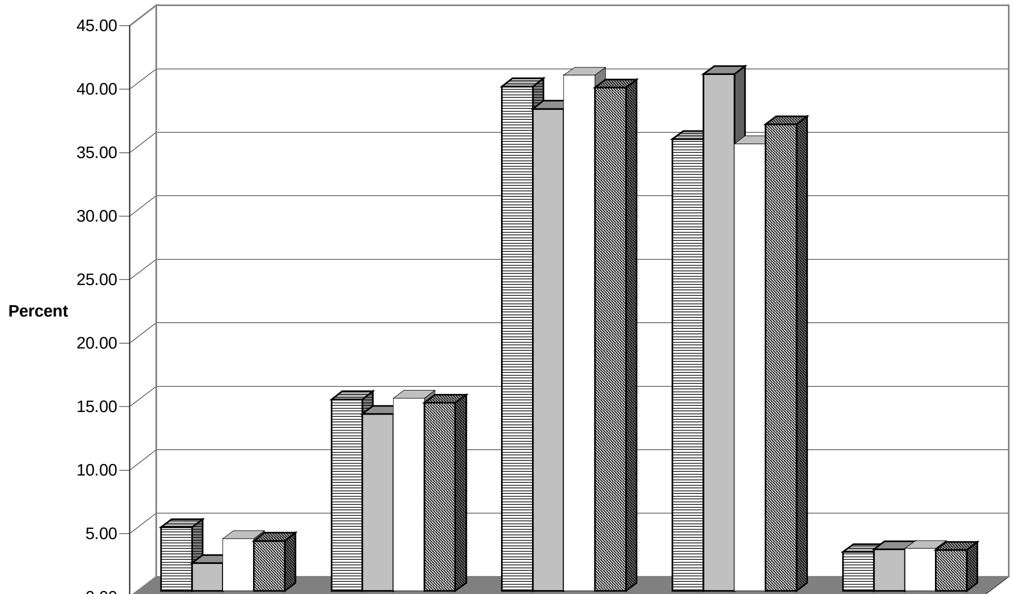
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	7.21	22.71	51.75	15.94	1.09
Pacific Northwest Carriers	6.56	19.67	53.83	18.31	1.09
Other Carriers	8.23	21.59	52.96	15.42	1.29
All Carriers	7.46	21.48	52.77	16.33	1.17

Q. 10e) Mainline preclearance will create more incentives for carriers to comply with regulations.



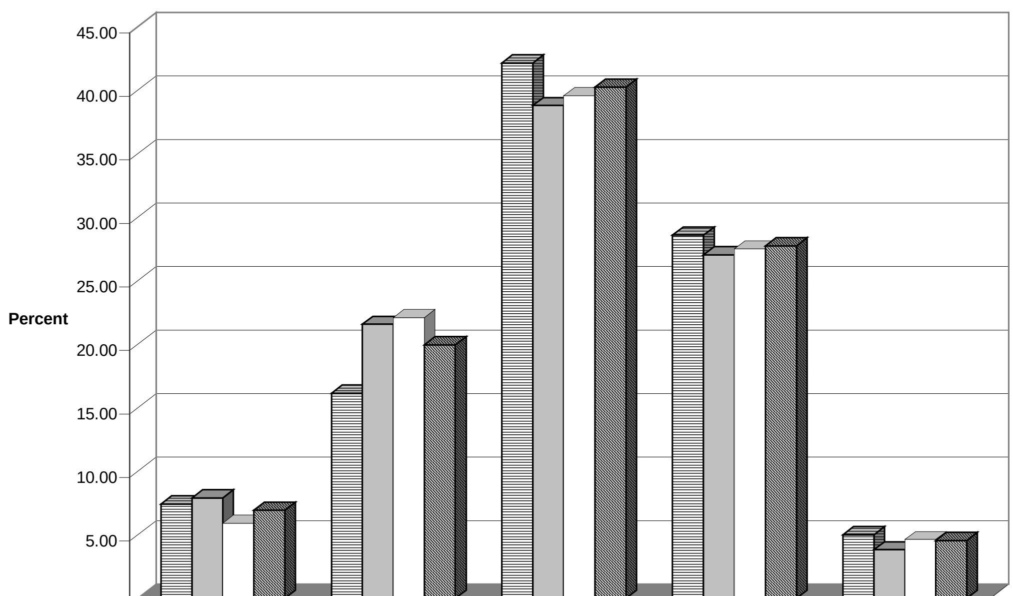
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	5.02	12.66	30.13	45.20	6.11
Pacific Northwest Carriers	3.55	11.48	28.42	50.27	5.74
Other Carriers	4.63	10.80	32.13	46.53	4.88
All Carriers	4.49	11.60	30.51	47.03	5.52

Q. 10f) Mainline preclearance will accurately pre-screen vehicles.



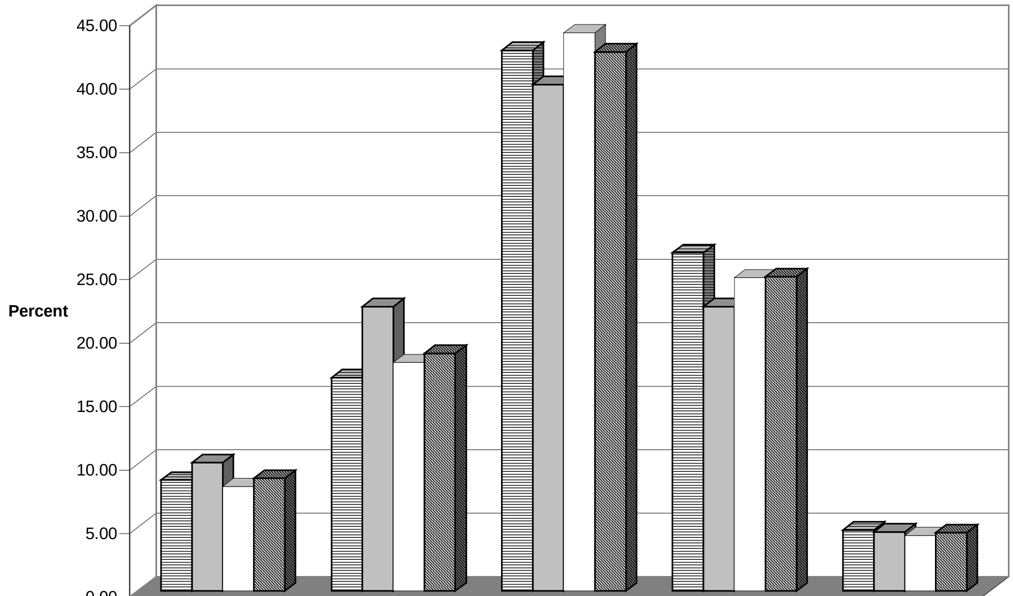
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	5.02	15.07	39.74	35.59	3.06
Pacific Northwest Carriers	2.19	13.93	37.98	40.71	3.28
Other Carriers	4.11	15.17	40.62	35.22	3.34
All Carriers	3.93	14.82	39.65	36.75	3.23

Q. 10g) Mainline preclearance will reduce the amount of wear and tear on my vehicle.



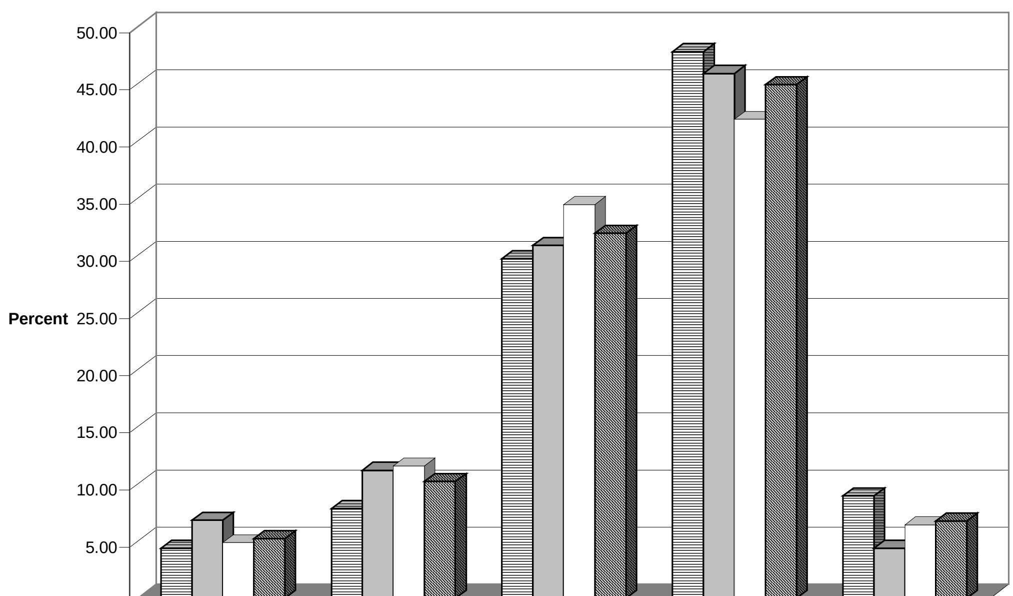
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	7.42	16.16	42.14	28.60	5.02
Pacific Northwest Carriers	7.92	21.58	38.80	27.05	3.83
Other Carriers	5.91	22.11	39.59	27.51	4.63
All Carriers	6.94	19.96	40.25	27.76	4.56

Q. 10h) Mainline preclearance will improve the service I provide to my customers.



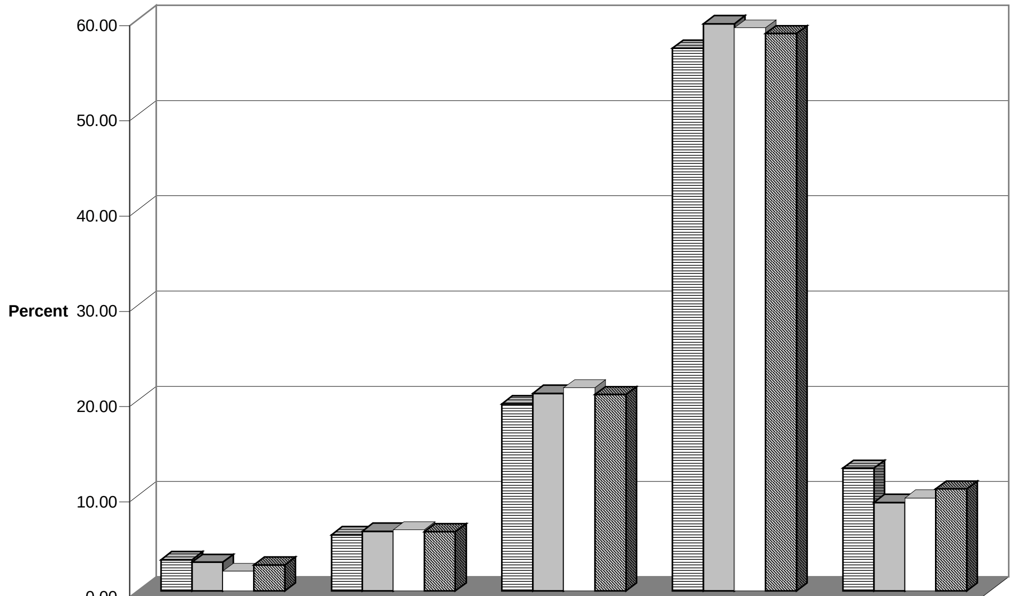
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	8.73	16.81	42.58	26.64	4.80
Pacific Northwest Carriers	10.11	22.40	39.89	22.40	4.64
Other Carriers	8.23	17.99	43.96	24.68	4.37
All Carriers	8.88	18.72	42.45	24.76	4.59

Q. 11a) The Road Weather Information System (RWIS) will benefit my company.



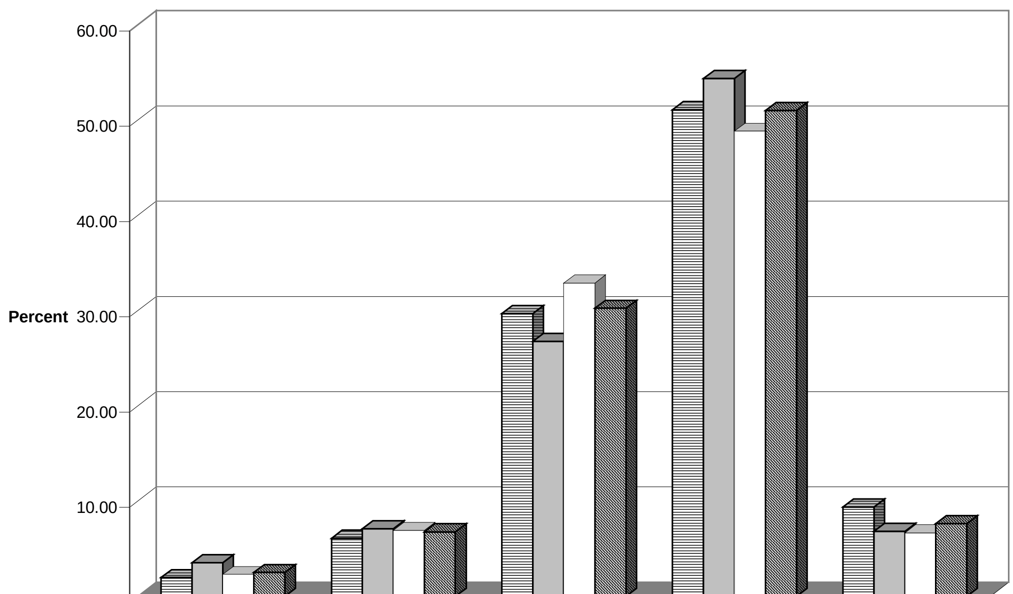
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	4.37	7.86	29.69	47.82	8.95
Pacific Northwest Carriers	6.83	11.20	30.87	45.90	4.37
Other Carriers	4.88	11.57	34.45	41.90	6.43
All Carriers	5.21	10.22	31.93	44.92	6.76

Q. 11b) RWIS will provide safety on the road.



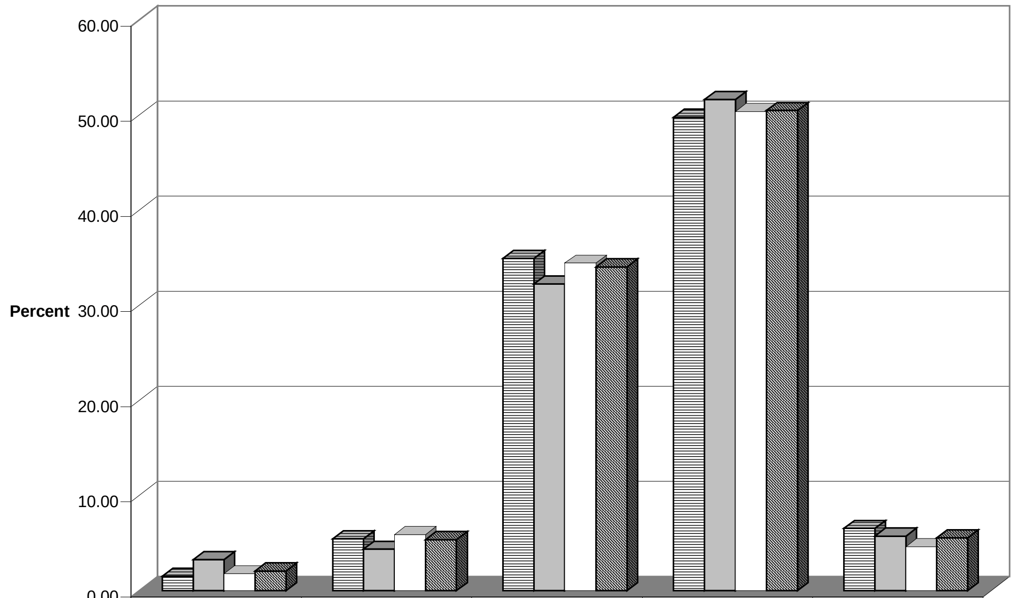
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	3.28	5.90	19.65	56.99	12.88
Pacific Northwest Carriers	3.01	6.28	20.77	59.56	9.29
Other Carriers	2.06	6.43	21.34	59.13	9.77
All Carriers	2.71	6.21	20.62	58.51	10.70

Q. 11c) RWIS will make provide accurate weather information to my company an d its drivers.



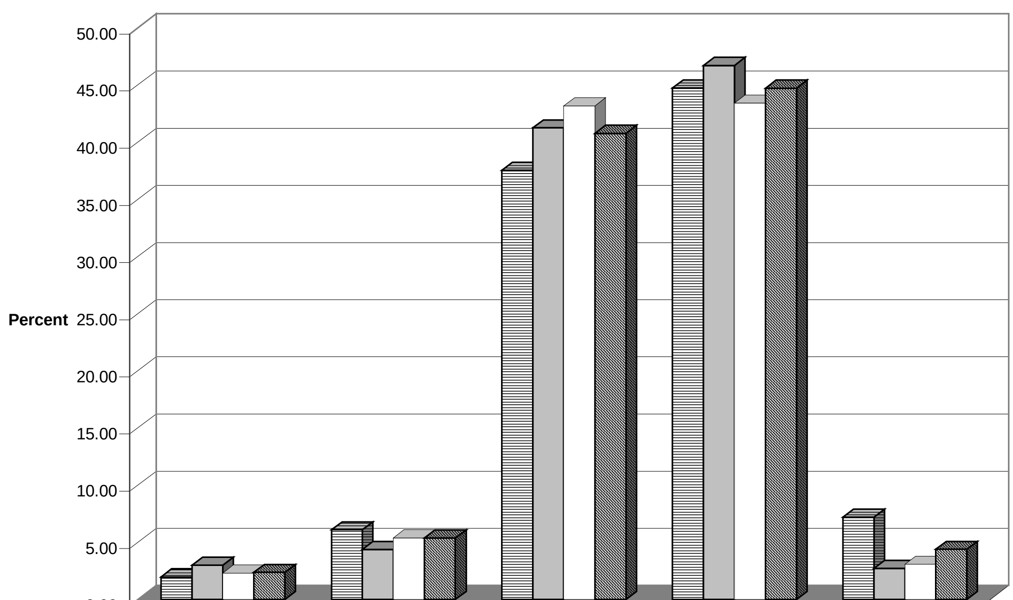
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	1.97	6.11	29.69	51.09	9.39
Pacific Northwest Carriers	3.55	7.10	26.78	54.37	6.83
Other Carriers	2.31	6.94	32.90	48.84	6.68
All Carriers	2.51	6.77	30.25	51.01	7.64

Q. 11d) RWIS will provide information in a timely fashion.



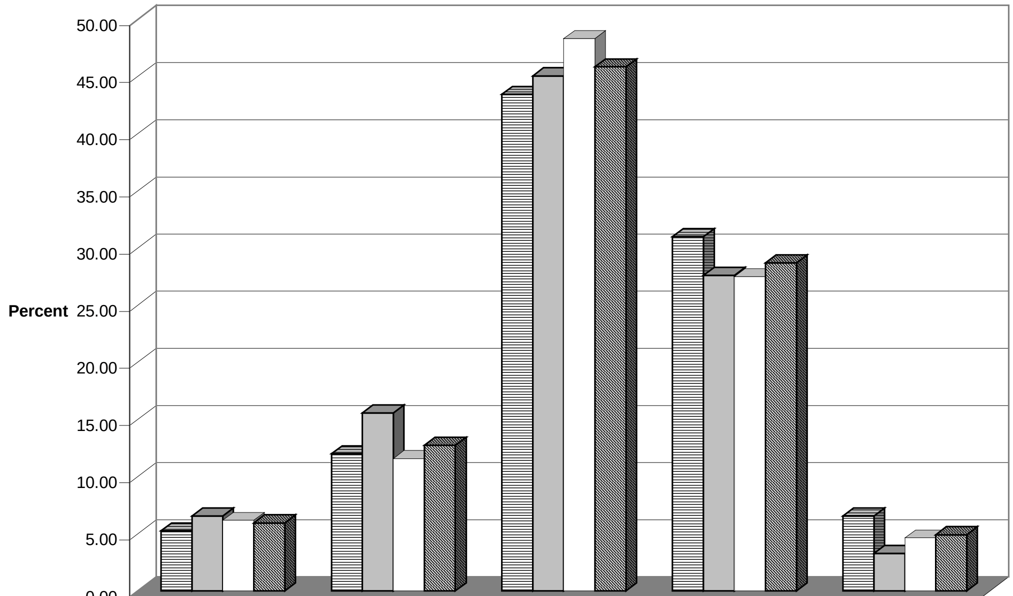
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	1.53	5.46	34.93	49.78	6.55
Pacific Northwest Carriers	3.28	4.37	32.24	51.64	5.74
Other Carriers	1.80	5.91	34.45	50.39	4.63
All Carriers	2.09	5.37	34.05	50.50	5.56

Q. 11e) RWIS information will be easy to use and understand.



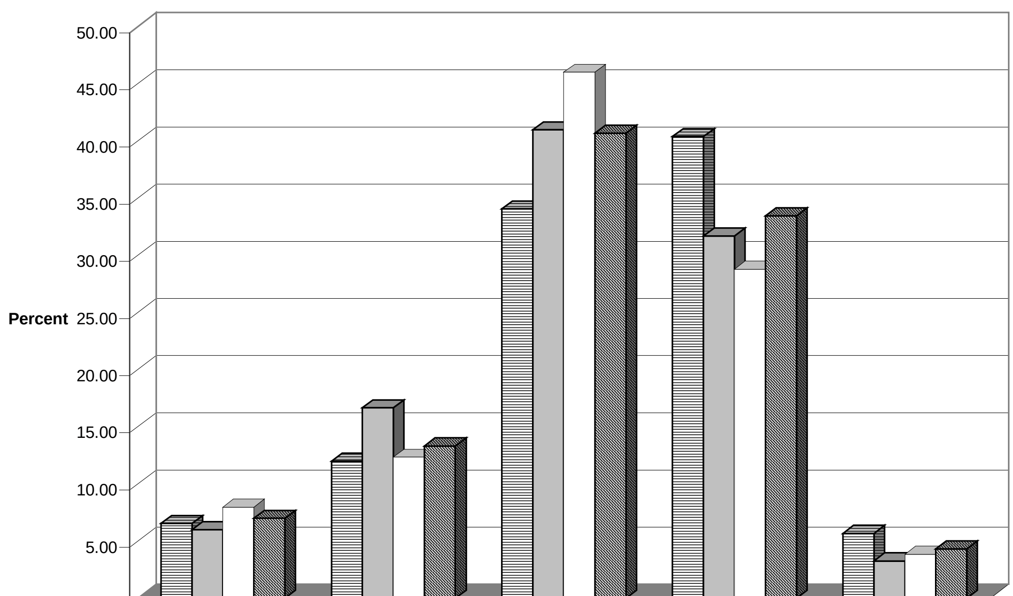
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	1.97	6.11	37.55	44.76	7.21
Pacific Northwest Carriers	3.01	4.37	41.26	46.72	2.73
Other Carriers	2.31	5.40	43.19	43.44	3.08
All Carriers	2.37	5.38	40.79	44.73	4.39

Q. 11f) RWIS will improve the service I provide to my customers.



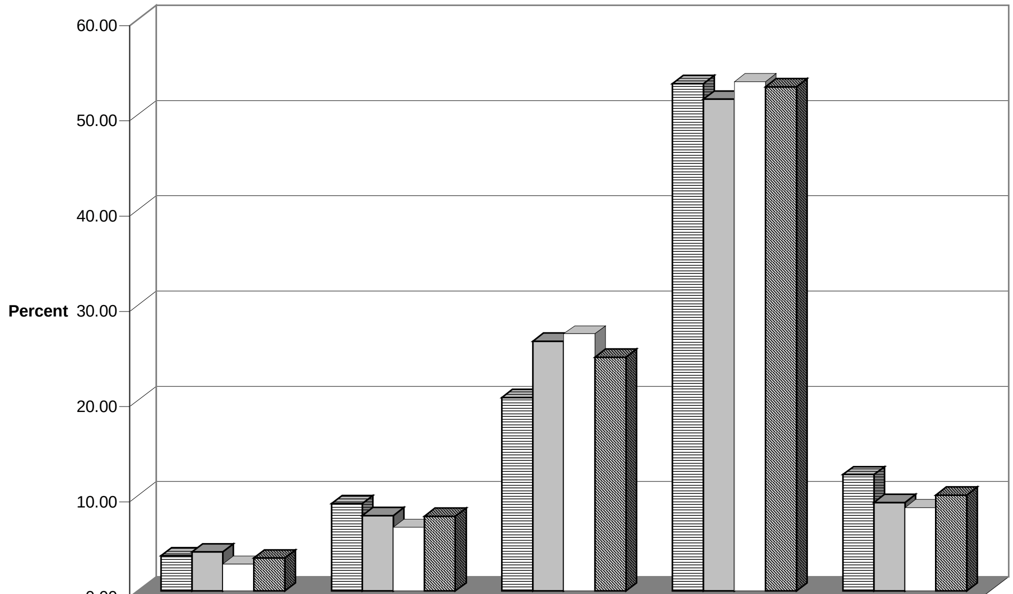
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	5.24	12.01	43.45	31.00	6.55
Pacific Northwest Carriers	6.56	15.57	45.08	27.60	3.28
Other Carriers	6.17	11.57	48.33	27.51	4.63
All Carriers	5.95	12.74	45.85	28.71	4.93

Q. 12a) The Downhill Speed Information System (DSIS) will benefit my company.



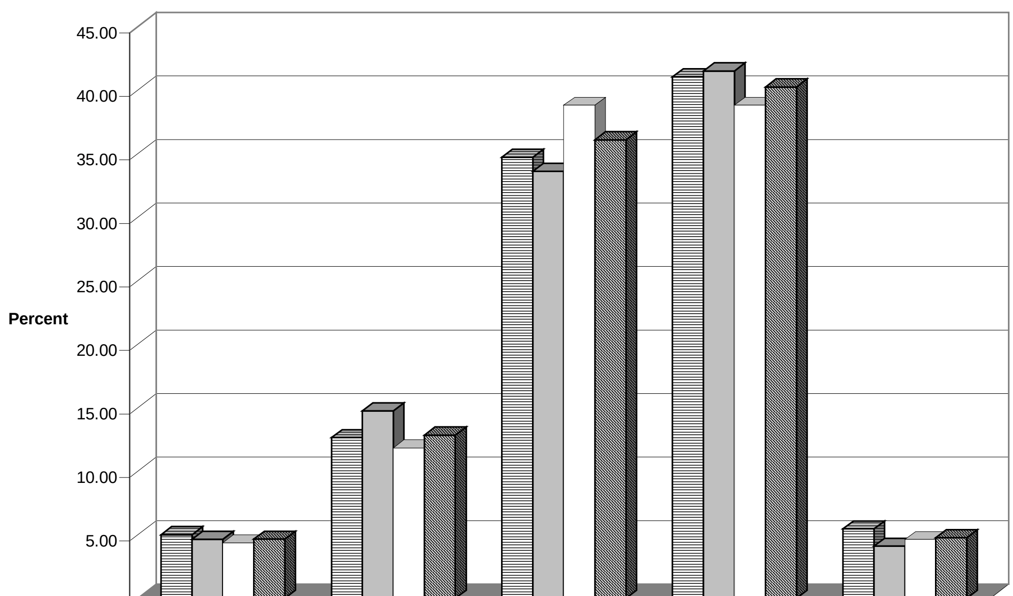
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	6.55	12.01	34.06	40.39	5.68
Pacific Northwest Carriers	6.01	16.67	40.98	31.69	3.28
Other Carriers	7.97	12.34	46.02	28.79	3.86
All Carriers	6.99	13.33	40.69	33.46	4.32

Q. 12b) DSIS will improve safety on the road.



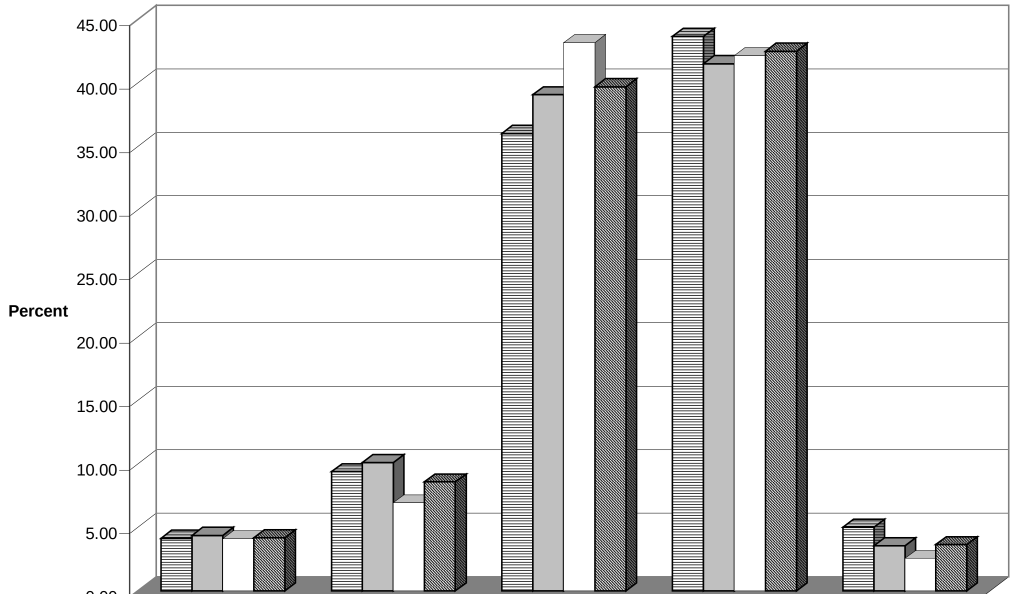
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	3.71	9.17	20.31	53.28	12.23
Pacific Northwest Carriers	4.10	7.92	26.23	51.64	9.29
Other Carriers	2.83	6.68	26.99	53.47	8.74
All Carriers	3.45	7.84	24.54	52.94	10.06

Q. 12c) DSIS will make it easier to comply with existing speed limits.



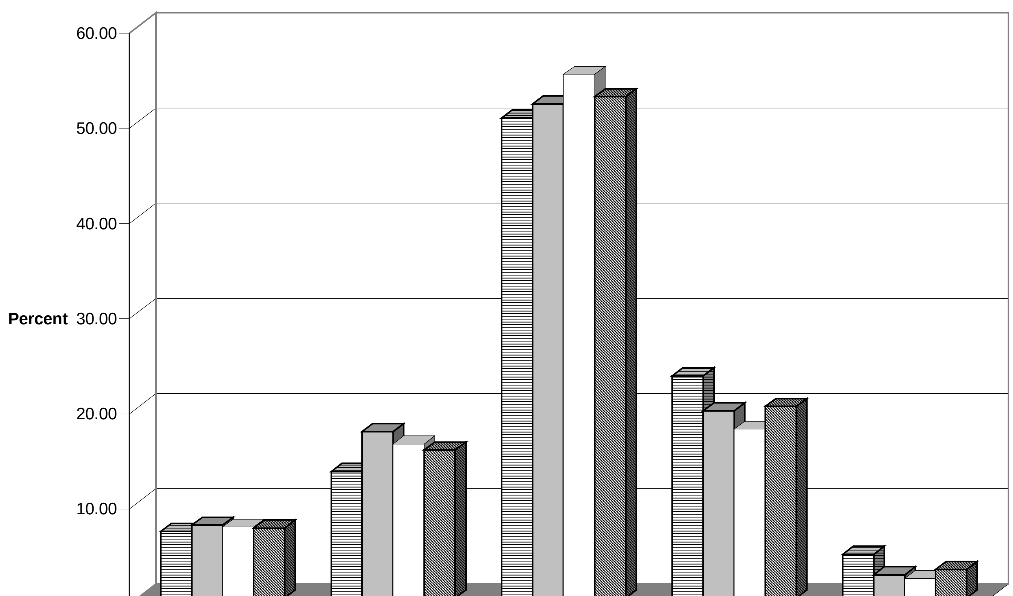
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	5.02	12.66	34.72	41.05	5.46
Pacific Northwest Carriers	4.64	14.75	33.61	41.53	4.10
Other Carriers	4.37	11.83	38.82	38.82	4.63
All Carriers	4.66	12.86	36.10	40.26	4.77

Q. 12d) DSIS will provide reliable and accurate data to my company and its drivers.



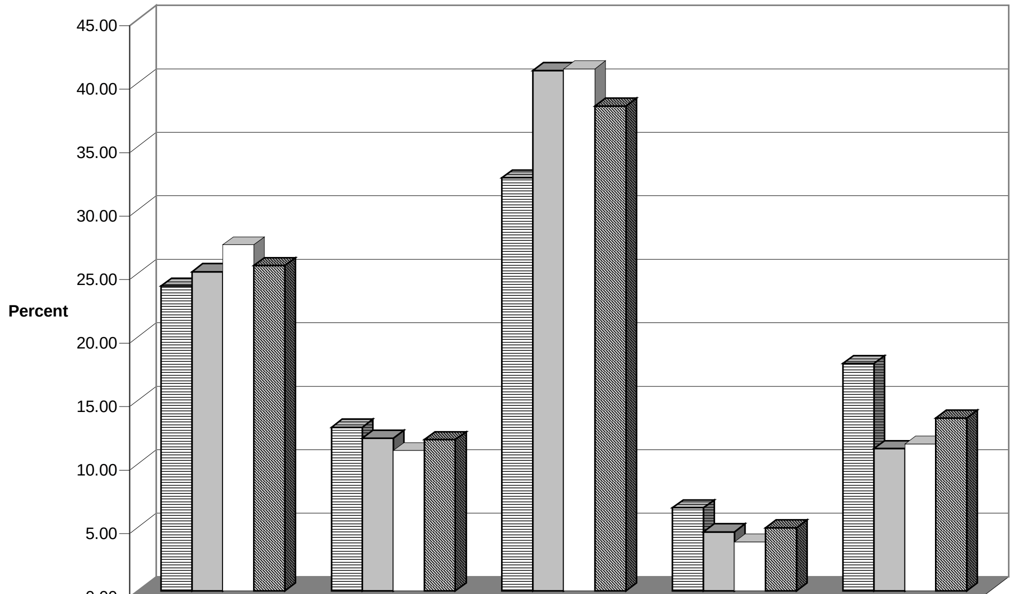
	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	4.15	9.39	36.03	43.67	5.02
Pacific Northwest Carriers	4.37	10.11	39.07	41.53	3.55
Other Carriers	4.11	6.94	43.19	42.16	2.57
All Carriers	4.19	8.58	39.71	42.51	3.65

Q. 12e) DSIS will improve the service I provide to my customers.



	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
Oregon Carriers	6.99	13.32	50.44	23.36	4.59
Pacific Northwest Carriers	7.65	17.49	51.91	19.67	2.46
Other Carriers	7.46	16.20	55.01	17.74	2.06
All Carriers	7.35	15.55	52.67	20.13	3.01

Q. 14) Please indicate your position within your company.



	President	Fleet Manager	Owner	Dispatcher	Other
Oregon Carriers	24.02	12.88	32.53	6.55	17.90
Pacific Northwest Carriers	25.14	12.02	40.98	4.64	11.20
Other Carriers	27.25	11.05	41.13	3.86	11.57
All Carriers	25.62	11.92	38.18	4.97	13.62

APPENDIX C - 1

Oregon Strata Sudaan Frequency Analysis and Standard Errors – FIRST SURVEY

APPENDIX C - 2

Oregon Strata Sudaan Frequency Analysis and Standard Errors – SECOND SURVEY

APPENDIX D-1

Pacific Northwest Strata Sudaan Frequency Analysis and Standard Errors – SURVEY ONE

APPENDIX D-2

Pacific Northwest Strata Sudaan Frequency Analysis and Standard Errors – SURVEY TWO

APPENDIX E-1

All Others Sudaan Frequency Analysis and Standard Errors - SURVEY ONE

APPENDIX E-2
All Others Sudaan Frequency Analysis and Standard Errors - SURVEY TWO

APPENDIX F-1

Cumulative (All) Strata Sudaan Frequency Analysis and Standard Errors – SURVEY ONE

APPENDIX F-2

Cumulative (All) Strata Sudaan Frequency Analysis and Standard Errors – SURVEY TWO

APPENDIX G-1

SURVEY and COVER LETTER
FIRST SURVEY

APPENDIX G-2

SURVEY and COVER LETTER
SECOND SURVEY

Oregon Green Light CVO Evaluation

FINAL REPORT

DETAILED TEST PLAN 12

Agency Acceptance of Green Light Technology

Paul E. Montagne

Chris A. Bell

Transportation Research Report No. 00-19

Transportation Research Institute

Oregon State University

Corvallis, OR 97331

June 2000

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This project was funded by the Oregon Department of Transportation (ODOT) as a requirement for an Independent Evaluation through their ITS Partnership Agreement with the Federal Highway Administration to deploy a mainline preclearance system in the state of Oregon. The project was of five years duration, and, was administered by ODOT's Motor Carrier Transportation Division. Oregon State University (OSU) Transportation Research Institute was the prime contractor for the independent evaluation, with Chris Bell as the principal investigator. The Center for Transportation Research and Education (CTRE) at Iowa State University was a sub-contractor to OSU, with Bill McCall as the principal investigator. Michael C. Walton of WHM Transportation Engineering served as a consultant for several aspects of the evaluation.

The authors are indebted to the personnel of ODOT's Motor Carrier Transportation Division, who have provided information and data to the evaluation team throughout the project. We are particularly indebted to Ken Evert, Gregg Dal Ponte, Randal Thomas and David Fifer. Ken's untimely death in 1998 meant that he did not see his vision completed. The evaluation team is forever indebted to him for his support and for the opportunity to participate in the deployment.

DISCLAIMER

TABLE OF CONTENTS

1 INTRODUCTION

1.1 BACKGROUND

This Detailed Test Report is the tenth of 12 reports submitted as part of the independent technical evaluation of the Oregon Green Light CVO project. The Oregon Department of Transportation (ODOT) is near completion of the implementation of their Intelligent Vehicle Highway System Strategic Plan for Commercial Vehicle Operations (now referred to as ITS/CVO). Through Green Light, Oregon is installing twenty-one mainline preclearance systems featuring weigh-in-motion (WIM) devices and automatic vehicle identification (AVI) at the major weigh stations and ports-of-entry throughout the state. In addition, certain sites have been equipped with safety enhancements that regulate road conditions and speed. Examples are the Downhill Speed Information System at Emigrant Hill, and the installation of weather stations at three location across the state.

This report presents the results of Detailed Test Plan (DTP) #12. There will be similar reports for all other Detailed Test Plans developed for the Green Light Evaluation. The Detailed Test Plans were published in 1997, Oregon “Green Light” CVO Evaluation-Detailed Test Plans [1]. Earlier documents providing essential background to the Evaluation are the Evaluation Plan [2], and , Individual Test Plans (ITP) [3].

Each of the tests conducted by the research team for the evaluation of Green Light addressed one of five goals of the evaluation as documented in the Evaluation Plan. These are:

Assessment of Safety

Assessment of Productivity

Assessment of User Acceptance

Assessment of Mainstreaming Issues

Assessment of Non-Technical Interoperability Issues

The objectives associated with each goal are given in detail in the Individual Test Plans [3]. In addition, condensed one-page tables are contained in the appendices of the ITP, outlining the measures to be conducted for each of the stated objectives. The detailed test plan documents expand on the information provided in the ITP and provide in detail the activities planned for each *evaluation measure* during the course of the evaluation in regards to the stated objectives.

1.2 PURPOSE AND SCOPE

This report presents the results of the test measures used to obtain the objective of assessing agency acceptance of Green Light, one of two objectives in support of the goal of assessing user acceptance.

The evaluation measures used to determine change in safety compliance for the Oregon Green Light are stated below:

> **Measure 3.2.1 Determine attitude of agency personnel towards electronic screening, including perceived impacts**
>
> **Measure 3.2.2 Determine attitude of agency personnel towards new services**

The purpose of Detailed Test Plan #12 is to gain insight about how Green Light met its initial objectives in the eyes of the staff that work with the system as well as those that developed and deployed it. The interviews will provide an opportunity to document the lessons learned during Green Light's deployment. The interview process will be tailored to focus on both Green Light's benefits, and the obstacles that may have hindered the development of the system's integration into the MCTD's business and operations.

It is hoped that the successes and failures of Green Light, as documented through interviews with selected ODOT staff, will serve to provide a valuable resource to similar federally-funded mainstreaming projects as they are deployed.

2 TEST METHODOLOGY

2.1 PHYSICAL DESCRIPTION

Questions will be developed to gain insight on the following:

- How well Green Light has met its initial objectives according to those who use the system. Some of Green Light initial objectives are stated below:
    - decreasing traffic at GL weigh sites
    - altering the profile of the vehicle stream to one that is likely to have compliance issues
    - enhancing the ability of inspectors to target problem carriers
- How Green Light has enhanced the operations of the MCTD in terms of day to day operations.
    - Weighing
    - Credentialing
    - Safety Inspections
    - Data Collection
- What are the success stories that can be taken from the Green Light project?
    - Trusted Carrier Partner Program
    - Enhanced Data Collection
    - Decreased Traffic at Woodburn
    - NORPASS
    - DSIS and RWIS
- What are the carriers that have deterred Green Light from reaching its objectives (if any)?
    - System Integration

- Marketing Efforts
- HELP/PrePass interoperability
- DSIS and RWIS

Questions will be tailored to each interviewee. Obviously, management will have more insight into the problems and successes in the deployment, and interoperability issues. Roadside issues will be the main focus for those interviews conducted with the folks who use the system in the field.

2.2 TEST ACTIVITIES

Questions will be asked in phone interviews and recorded into a handheld recorder and transcribed. Transcriptions will be in the form of appendices in the final document .

3 RESULTS

The interviews consisted of questions regarding the success of the Green Light program in meeting its original objectives and regarding the actual operation of the system. Only those interviewees that had first-hand knowledge were asked the questions regarding operations.

Each of the following sections describes a question asked in the interviews and summarizes the responses to it. The full text of the interviews is included in Appendices A - E.

3.1 Question One: Weigh-Station Traffic Decrease

"One of the objectives of Green Light was to decrease traffic at sites. Do you believe this objective is being met? To what extent?"

All the interviewees agreed that the Green Light program was successful in reducing the traffic entering and exiting the weigh-stations. One stipulated that this effect was dependent on the length of time that a system had been up and running. Some locations have only just been installed, and those locations have not seen as much of a decrease in traffic. This is because the carriers that typically pass those points often haven't had had as much exposure to the program and so haven't yet signed up in the numbers necessary to significantly reduce traffic. New installation points generally see steady growth in participation and should soon be more effective.

3.2 Question Two: Altered Profile of Vehicle Stream

"Another of the objectives of Green Light was to alter the profile of the vehicle steam entering the weigh station to one more likely to have compliance issues. Do you believe this objective is being met? To what extent?"

Four of the five interviewees thought that Green Light was meeting the objective of changing the profile of the vehicle steam. The exception stated that the answer to that question would be best answered by comparing the number and proportions of inspections, violations, warnings, and citations. The interviewee believed that those numbers would not reflect a change in the traffic profile. That comment was amended with the statement that the conditions are far from scientific, in that over the course of the Green Light installation, other factors have changed that may cloud its effects. "We don't have a laboratory to work in; we've got the real world."

3.3 Question Three: Enhanced Inspection Targeting

"In terms of the final objective of Green Light, enhancing the ability of inspectors to target problem carriers, do you believe this objective is being met? To what extent?"

Again, four of the five interviewees agreed that the Green Light system helps inspectors target those trucks more likely to have safety problems. The exception stated that there have been changes since the inception of Green Light, specifically the use of the federally provided Inspection Selection System (ISS) and the Previous Inspection Query (PIQ) system. The Green Light plan assumed that inspections would be done randomly among the vehicles that pulled into the weigh station, and that the change in vehicle steam profile would increase the number of "hits" on problem carriers. The new systems provide non-random recommendations for inspectors, based on past behaviors, accident, citations, and the date and location of previous inspections. In short, it was stated that the Green Light system is sound in theory, but has been overshadowed in inspection-selection by these other systems. The other systems are designed to focus inspections on those carriers that are more likely to have problems, so the Green Light system doesn't have much of an independent effect.

3.4 Question Four: Enhanced Scale Operations

"In terms of weighing at the scales, how has Green Light enhanced the operations of the MCTD?"

Only three of the five interviewees were asked this question because of its dependence on direct knowledge or experience of field operations. Two responded that operations have been enhanced mostly because of the decrease in traffic: in the past, there had been occasions were weigh stations had to essentially close and let many trucks pass un-weighed and un-inspected until the station cleared out, because traffic had backed up and was blocking the freeway. Weighing operations were enhanced simply because of less congestion. The third explained that some facilities were helped and others harmed by the system. It was stated that the system takes a certain amount of training, skill, and experience. While those sites that had training provided felt empowered by the new technology , those that did not were frustrated and less effective. This is a function of how long the Green Light system has been installed and operational at a given facility, so training should improve effectiveness at those sites that are currently not rolled out completely.

3.5 Question Five: Enhanced Credentialing

"In terms of credentialing, how has Green Light enhanced the operations of the MCTD?"

Only two of the interviewee's were asked this question. They both said that the Green Light system wasn't especially effective in enhancing operations in terms of credentialing. Trucks without proper credentials are ineligible for the Green Light program, so would pull into the station anyway. No real change in credentialing happens because of Green Light.

3.6 Question Six: Impact on Safety Inspections

"In terms of safety inspections, what impact has Green Light had on the day-to-day operations of the MCTD?"

The two people that were asked this question responded similarly. They commented that the Green Light system increased the efficiency of the inspection process. This occurs mostly by altering the stream of traffic into the weigh station. Those carriers that have consistently earned high safety ratings typically receive green lights and stay out of the weigh stations. The remaining trucks that pull in are more likely to have safety problems an as a result, are more likely to be inspected. Also, one interviewee commented that the system helps inspectors anticipate what details to focus on during an inspection. For example, a truck may pull in and the inspectors will already know from the weigh-In-motion scale that the truck has weight problems, so that can be focused on quickly instead of starting from scratch every time.

3.7 Question Seven: Enhanced Collection of Weight and Configuration Data

"In terms of data collection, in what ways has Green Light enhanced MCTD's ability to collect data on weight, configurations, etc?"

The interviewees stated that because a significant portion of trucks get green lights and so bypass the weigh stations, more of the remaining trucks are being properly documented. Before Green Light, during high traffic times and with limited personnel, too many trucks would come to the sites to all be weighed. Trucks would pass through the station without anyone reading the scale, or in some cases bypass the station entirely. This happens much less frequently with the Green Light system in place, and because Green Light still weighs and measures trucks that are bypassed, a higher percentage of trucks are being documented.

3.8 Question Eight: Successes of Green Light

"In your opinion, what have been the successful aspects of Green Light?"

All five interviewees gave answers to this question. Several commented on the increased ability to focus on problem trucks, the possibility of easily redistributing staff to cover problem spots, and the ability to handle more traffic without expanding facilities because of decreasing traffic. Another indicated the advantages of having a new advance tool, where a weigh master will know ahead of time what to expect coming into the scale. Also mentioned were the time and money saved by compliant carriers that get to bypass the stations, and that those carriers rightly deserved those savings.

3.9 Question Nine: Lessons Learned

"What have been some lessons learned in the inception of Green Light, and what have been deterrents to its complete and successful operation?"

Interoperability was commented on as a problem, specifically regarding the differing business models between different systems and the competitive politics surrounding the issue. It was stated that only the federal government has the power to enforce cooperation, but they have not. The technology is not a real problem, but the political resistance is. The program also has had installation and assimilation problems because of the lack of a central coherent training or marketing plan. Training was done piecemeal all over the state, so the same battles were fought over and over again. A comprehensive and organized introduction and training program would have increased early acceptance and eased the transition. The trucking industry as a whole is not an early adopter of technology, and a solid, timely marketing program should have been implemented. Some of the marketing that was done was done prematurely, which let carrier interest fade before the system was up and running. An important lesson is that by giving out free transponders to new members, the startup risk of new technology was shifted away from the truckers, so they became much more agreeable to the program. While this method may not be appropriate everywhere, it is important to note that carriers want to save time and money, but an untried system that fails will cost them more than it saves, so they are wary about investing in it. Reducing transponder costs as much as possible will diminish this reluctance. Ultimately, the system should be nationwide. This will reduce the costs to truckers the most, and so will be the most accepted, used, and useful. The Oregon system is up and running, but at present multiple transponders must be purchased to use systems in multiple states. Overcoming the barriers between systems is necessary for the system in any state to fully mature and achieve its potential.

4 CONCLUSIONS AND RECOMMENDATIONS

This study intended to document how Green Light met its initial objectives in the eyes of the personnel that work with the system as well as those that developed and deployed it. Conducting interviews with key ODOT personnel, provided an opportunity to document the lessons learned during Green Light's deployment. It was intended that the results of this part of the evaluation would provide a valuable resource to those deploying similar projects. The summary of responses shows a high level of agency acceptance as well as an understanding of the benefits gained and recognition of lessons learned.

There was a uniform agreement among the interviewees that the Green Light program was successful in reducing the traffic entering and exiting the weigh-stations. All agreed that this effect would only increase as more Green Light sites were deployed, and consequently more carriers enrolled in the program. Interviewees were in agreement that the vehicle stream entering the weigh stations was one more likely to have compliance issues. With the screening of Green Light participants compliance history during the enrollment process, carriers with a clean bill of health were bypassing the weigh stations. The result being that carriers more likely to have compliance issues were populating the weigh station queue. Furthermore, interviewees agreed that this altering of the profile of carriers entering the weigh station served to enable enforcement personnel to better target problem carriers.

In terms of changing the way business is conducted at the weigh stations in terms of credentialing, weighing and inspecting of trucks, the effects of Green Light had mixed reviews. Most felt that that the Green Light system increased the efficiency of the inspection and weighing process because the decrease in traffic entering the facility. Trucks that were compliant, or did not have size and weight issues, remained on the mainline. In terms of credentialing, there is no real effect. Trucks without proper credentials are ineligible for the Green Light program, so would pull into the station anyway.

The interviews helped to illustrate the success stories of Green Light such as the progression of weigh station pre-clearance and application of ITS technology to CVO nationwide. As one interviewee stated: "To Green Light's credit, a direct spin-off from Green Light was the IOU project that involved initially Utah and Idaho, and Oregon, which grew into the MAPS project, the Multijurisdictional Automated Pre-clearance System, which involved Washington, Idaho, and Utah, which absolutely then grew to include the ATVO states and grew into NorPass, the North American Pre-clearance and Safety System." These systems, beginning Green Light's initial vision, have helped mainline preclearance move to a nationwide audience.

Other success stories were the way carriers have reacted to the system. There has been a profound effect on many Oregon carriers who bypass the facilities daily in terms of the dollars saved due to fuel and time savings. All of the interviewees were in agreement on this.

Interviewees described the deterrents to making Green Light more effective. Key points were the disparaging business models, and the fights over political issues such as the weight mile tax, that kept carriers from using the system effectively. There was consensus that the marketing to carriers was carried out to early, and that the efforts would have been more successful early in Green Lights deployment had more of the sites been operational.

5 APPENDIX

INTERVIEWS

5.1 INTERVIEW ONE

Q: Our first topic has to do with some of the initial objectives that were set forth early on in the formulation of Green Light. Kind of an idea of what ODOT wanted to see Green Light achieve with the technology.

A: Ok.

Q: One of the objectives of Green Light was to see a decrease in traffic at the sites. Do you believe this objective is being met and to what extent?

A: We can't affect the traffic on the interstate but I guess you mean the traffic going into the weigh stations. I think it's clear that the program has been successful in meeting its objective of decreasing the amount of traffic that enter and exit weigh stations. And we are seeing that in the monthly transit reports that shows the number of green lights that we give, the number of trucks that we pre-clear at weigh stations, and those numbers, as you know, are climbing dramatically now that we've got transponder placement and more trucks, and it's clearly showing that fewer trucks are going through the weigh stations. In fact, if you look at the ratio of green lights to red lights, at most stations its practically 9 out of 10 trucks are getting a green light and about 1 in 10 are getting a red light. So the program is highly successful at pre-clearing trucks, sending them on their way if they don't need to come by the station.

Q: Another of the objectives of Green Light was to alter the profile of the typical vehicle entering the stream of traffic into the weigh station to one that was more likely to have compliance issues. Now, these may be more difficult for you to answer since you don't deal with the system quite the same way that maybe some of the people out in field do, but from your perspective, do you believe this objective is being met?

A: It must be, based again on the green light-red light report. We are seeing 1 in 10 trucks having to pull in and so there must be something amiss. They couldn't all be having trouble aligning themselves on the weigh-in-motion scales or improperly crossing the pre-clearing system. They must have some compliance issue. And so it is sorting even the transponder-equipped trucks and finding the 10% that need to pull in. And so then I imagine they are joining the other traffic stream that deservedly, and probably a higher percentage, need to be going through the station, either for a safety inspection or for static scale weighing that might catch some kind of overweight or other size problem. So, I would imagine the system's doing its job, complementing that traffic stream and directing the correct profile vehicle into the weigh station.

Q: Right. Which leads to, and you've partially answered, this third objective. The third objective of Green Light was enhancing the ability of the inspectors to target the problem carriers.

A: Yeah, they should be doing that. It should be much easier for them. Using the inspection selection system, surely they are getting more "hits." When they see a carrier go in the weigh station, they look him up in the ISS. Surely they must be seeing a greater occurrence of "hits" because we've cleared all the others, certainly the trusted carriers that wouldn't show up in the ISS. So we've left them with a traffic stream that is more likely to need inspection. I would imagine the program is again meeting an objective there.

Q: Can you tell us a little bit more about how your feel the Trusted Carrier Partner program that you brought up earlier that was not initially in the works when Green Light was developed. Can you comment on how that has enhanced the Green Light system and how that has helped the division carry out their goals of making it safer to operate out there?

A: I think what the TCP program has done is identify that percentage of the trucking industry that has always been there, that is highly compliant with regulations. And so, this group didn't come along, and it's not new, but there's always been a percentage that is in compliance. They are safe carriers and they meet all other regulatory requirements and the Trusted Carrier Program gives an opportunity to identify them, give them a mark of distinction. And then the Green Light program, incorporating the TCP into that Green Light screening process, gives us a chance to much more efficiently screen out that entire percentage of the trucking industry. As long as they are transponder equipped and in the program, then we can screen them out and give them a much higher assurance of the weigh station pre-clearance event happening for them. They are a group that we need to spend as little as we can of our time watching or checking. We know they are compliant. And then we monitor their records to make sure they stay compliant. So I think, it's just giving us a chance to screen, more efficiently screen, the truck traffic and sort them out.

Q: Ok. Has Green Light made it easier for you, being an outreach person? Has it had some kind of an effect on the kind work that you do, the public relations that you have to do? Has it made it easier for you to reach your carriers? I know that there has been a lot of going back and forth between the various trucking agencies and the State of Oregon because of Green Light, just trying to get it off the ground, and not all of that has been positive, but maybe in the end it's beginning to pull us closer together, meaning ODOT and your clientele. Can you expound on that in any way? Is that a success, would you say?

A: There's a whole lot of lessons learned, is what's happened. It's been really messy in the terms of the way that politics has come into play, and the program has been used to leverage certain other issues. And so, so that has been the messy part. What I have enjoyed is selling intelligent transportation systems. I mean, this topic is so sexy and fun to talk about. It's such a positive thing, introducing intelligent transportation systems. You know theoretically it should do nothing but good for the entire motoring public. And so, it's been a kind of win-win story that I love to tell. Now, people have been slow to catch on to the story and warm up to it, but surely in time they will. And certainly these carriers are beginning to warm up to it. I mean, especially now that we've removed cost as a factor in whether they join Green Light, they've warmed up to it, taken transponders, and now I think surely they must just love weigh station pre-clearance. I can't wait to do a customer satisfaction survey because there must be a lot of positive responses that we could get from the industry. Surely, if 9 out of 10 transponder equipped trucks are getting green lights, then they must be enjoying the system. It's been a rough road but telling the story of intelligent transportation systems has been what I've enjoyed most.

Q: What are the issues that you believe have deterred Green Light from reaching its objectives and what are the lessons that you have learned? Perhaps in the area of system integration, is there anything that comes to mind in that area?

A: The differing business models between the pre-clearance systems, the two major ones in the country, has been an impediment from the start, so there is huge institutional barriers there and they've done nothing but block the success of Oregon's program. Actually, there's even been officials who have "poisoned the water" around these pre-clearance systems. The competition between the two business models has just done nothing but hurt both systems. I would think that surely that's impeded the progress made. You can't have officials for an organization as huge as PrePass criticizing Oregon and you can't have that kind of activity going on without it hurting our program. And so that's played a big part, the fact that they won't accept our transponder and won't let us accept theirs. We haven't enjoyed interoperability, although it was described to us four years ago when C Vision was introduced and pushed on us. In the vision of C Vision, we weren't supposed to have those kinds of problems and officials were supposed to actually work together and not criticize each other's program and find fault with it. And so, nothing like the federal vision has come to pass yet.

Q: What might be some of the lessons learned from the marketing of Green Light ?

A: I'd say that the trucking industry is not an early adopter of technology. Transponders aren't really invasive, but they are in the fact that you have got to put it in the truck cab. And the industry as a group is not an early adopter of technology. So, I think that in terms of marketing we found that putting even a modest price tag on transponders actually slowed the effort to put a transponder in every truck and discouraged some truckers from even entertaining the idea of using the transponder. So, price was an obstacle and we didn't have the sales force that, say PrePass has, to go out and sell the program in the same aggressive way they do and so we couldn't overcome the barriers that even that modest price had put on transponder usage. So I think we did the right thing in the past few months when we took cost away as a factor and got these truckers to become adopters of the technology. And then the next big test will be when the batteries die and we'll see what percentage buy the transponder, replace theirs, and continue to use the system. I bet a large percentage will replace theirs, but not all.

Q: How much do those cost?

A: We think that, by the time the battery dies, there will be a transponder for about $45.00, and should be good for another five years. And there is, of course, just a lithium battery inside. We've opened them up and that battery looks very replaceable. I don't know what the battery itself costs, but it's possible someone will see how easy it is to just replace the battery and that could be lower than $45.00.

Q: Back to some of the success stories that can be taken from Green Light, in terms of some of the other safety enhancements that were part of the initial Green Light package, is there anything that you can think of that you think is successful lesson to be learned?

A: I think Green Light introduced a very valuable concept in its road and weather information system ideas. And it is in the idea of deploying these sensors that would record key information, climate information, and then pass it on to travelers. That concept has been hugely successful. As soon as Green Light introduced the idea of doing it in a very small way, many others around the Oregon Department of Transportation grabbed that idea and ran with it and developed a plan to deploy a wide network of these sensors statewide. Maintenance yards are using the information to help them trigger certain maintenance activities. Travelers are seeing some of this information on ODOT's Trip Check site. We just got an e-mail the other day from a trucker who had seen Trip Check and told us he thought it could be a valuable service. So, I think Green Light should get some credit for introducing that concept although it was probably inevitable, but we got it started and the program got others excited about it and they took and ran with it.

5.2 Interview Two

Q: One of the objectives of Green Light was to decrease traffic at sites. That was initially what they had hoped to achieve. Do you believe this objective is being met or would be met, and to what extent?

A: At Farewell Bend, at first, when the system first went into effect, we weren't seeing a lot of trucks equipped with the transponders for our Green Light system. So, it initially started out very slowly. I mean to a point to where when the system went in we … 8 to 12 trucks a day being Green Lighted past the point of entry was the norm. We did get a lot of comments from folks that were within other systems, like the PrePass system down south. We got a lot of inquiries as to why the system wasn't working on their transponders. But for the Green Light transponders it was a slow beginning. That steadily increased. We were bypassing 8 to 12 a day, and the next month we were bypassing 300 a day. But it was a steady growth to a point, over about an 18 month period to where we were bypassing probably 45 to 65 trucks a day. And at that point, prior to my transfer, it was having an impact. As more transponders are put out into the system, it will increase. You can see the trend. The trucks that we never had problems with were being allowed to go on by us which had the effect of my officers that see the trucks coming in were able to spend more time looking for problems with the trucks being called to the scale. I firmly believe it's going to reach its goal. And my understanding is now the State changed the way it is issuing transponders. The number of transponders, I believe, jumped from 7000 being issued a year ago to where they've put 12-14,000 out there right now. So, Farewell Bend, at this time, is probably seeing 100 trucks a day jumping by that scale, being allowed to bypass the scale, and that will have a significant impact.

Q: Ok. Another one of the Green Light objectives was safety related and its impact on safety. One of those was the altered profile of the vehicle stream that enters the weigh station, so that the typical truck in the scale is more likely to have compliance issues. Do you believe that this objective is being met or will be met?

A: Yes, it is. I can recall, just right offhand, two companies who's safety ratings had reached a level to where we were supposed to be inspecting their vehicles as they came into the scale. They initially were being Green Lighted past the scale and all of a sudden were being called in with a safety code as the reason why they were being called in. When my folks were doing Level 1 truck safety inspections, these were prime targets, these trucks that were being called in due to their safety histories. Yeah, it definitely met that objective. And it definitely helped the officer when he's standing there watching the trucks cross the scales as to which ones he might elect to pull out of line and do a full Level 1 safety check on.

Q: When we initially set up Green Light, we thought that one of the objectives that we should mark its success on would be its ability to enhance the inspector's ability to target problem carriers.

A: The report reason code is a great tool. You know when the vehicle that is crossing your scale was told to report because of a safety reason. You don't know by the message if it's a driver's log book problem history or if it's a vehicle mechanical type safety issues, but you do know that the gentleman did not get a Green Light due to a poor safety record. And it's a tool the officer uses that, "Hey, I want to look at him."

Q: How has Green Light enhanced the operations of the weigh station?

A: At this point in time it's not having a great impact on the number of trucks that have to be static weighed. What it does do, it decreases the percentage of trucks that are called into the scale and don't get weighed. It lets carriers that we have been weighing for months and years and they are running very legit, it lets them stay on the interstate system and a higher percentage of the trucks that are being called into the scale itself are being weighed. I had a goal of trying to hit 70% of the trucks. That was just kind of a ball park percentage that I came up with as the manager: 70% of the trucks that get called into the scale we should be static-weighing. And the reason I was satisfied with 70% is because you have two scales, two individuals sitting there weighing the trucks, but the minute you have to issue a citation or answer a telephone or they get called away from those seats and there are going to be some trucks that are going across the scale that are not being weighed. That percentage, that 70%, will increase with time.

Q: In terms of the credentialing that you do at your ports of entry, what impact has Green Light had on the day-to-day operations in that regard?

A: Well, when I was there, it didn't have a large impact. Farewell Bend Port of Entry is probably the busiest port of entry in the state of Oregon as far as folks coming in and not having credentials for the state of Oregon having to stop at that facility to get their credentials. One thing that is checked is the fact that they have had their insurance bonds submitted. You know they are recognized with their highway tax reports being submitted in a timely fashion, etc. It will assist with that because, like I said, the report reason code will tell the officer that's sitting there weighing that "Hey, here comes ABC Trucking and the reason he is being called in is because the carrier has been suspended by the State of Oregon due to lack of insurance or insurance has expired." So it will give the officer the tools to know the questions to ask when he's interviewing the driver. It gives advanced warning as to why that truck is coming in to see us instead of the officer having to say "Ok, I need to see your registration. Let me see this and let me see that." He will know if it is going to be a registration issue or if it is going to be an enforcement issue due to size or weight. And that helps the officer.

Q: One of the other things that you do out there at the port of entry is conduct these inspections. What impact has Green Light had on the day-to-day operations in terms of safety inspections?

A: I think you are going to see a higher violation rate as far as safety violations due to the system because it is going to pre-identify carriers that have a poor safety history. A lot of these carriers are notorious. They are running on a shoe-string budget and they don't take care of their mechanical problems. That's why their safety rating is so low. Instead of an officer doing 12 inspections on a shift and maybe finding 2 out of service violations, I think more realistically you will see an officer doing 12 safety inspections on a shift and maybe finding 8 out of service violations of those 12 vehicles he's inspected. I think you'll see an increase in the out of service violations. I think you'll end up pulling more of the unsafe drivers or vehicles off the interstate, off the roadway.

Q: In terms of the data collection that can be done out at your port of entry, in ways does Green Light enhance your ability to collect data? … on size, weight, that kind of thing?

A: In a perfect world with a perfect system, every truck that runs down that interstate will be weighed and recorded within our system. Oregon makes a commitment to Federal Highway with our annual certification report as to what our projections are and what our numbers will be in the up-coming fiscal year. This will definitely help us meet those goals. Like I said, I, as a manager, as a local field manager, wanted to see 70% of the trucks on the interstate that were called into the port of entry static weighed and put into the system. Even if I maintain that level, the 100, 200, 300 trucks and in some cases, 4, 5, 6, 700 trucks a day going past Farewell Bend Port of Entry that are getting Green Lights and they are put into the system by the computer. It will assist my folks at Farewell Bend get higher numbers on a daily basis, as far as units put into the system. So it's going to help us in a couple of ways. More folks are going to be into the system, which will assist our auditors and our authority compliance type folks, etc. It assists the other people within the departments with crossing times to ensure, you know, that they are not violating or falsifying log books, etc. It will help us meet our goals that we set with Federal Highway each year in our certification.

Q: In general, if you had to describe a success story from your experiences with Green Light and how it's been installed and how it's been operating, what would you say is the most successful aspect of it?

A: It provides tools in advance that we did not have before. As a field manager sitting at that terminal weighing trucks coming across the scale, I know in advance that I've got an 8-axle set of doubles coming towards me. One thing the system does, it will indicate to me that there may be an overload problem. But, a big bonus the system gives me is the fact that I know what that 5-axle group bridge or that 6-axle group bridge is, what it measures prior to that truck even getting up to and starting to cross my scale. I can sit there and I've done this at Umatilla and Farewell Bend. I know that 5-axle group is 44 feet and it is allowed 74,000 pounds and I'm showing with the weigh-in-motion that he is actually weighing 78,000 pounds. So it raises a red flag and when that fellow crosses my scale I'm pre-warned that I am going to want to go out there and measure that group to find that overload. Another thing it has helped us do in the past is well, a set of triples is limited to 105 feet overall length in the state of Oregon, and it has identified for me certain companies that are running triples where the combination exceeds that length. It provides the enforcement officer tools in advance to catch more violators where without the weigh-in-motion you will see a set of triples limited to 105 feet and it looks ok to you so he might roll across your scale without you getting up and putting a tape measure on him to make sure that he is compliant. It provides tools that will raise the red flag for the enforcement officer to go out there and double check certain things. And that is the biggest success story:

the additional tools it gives the officer because he doesn't walk out and stop every single truck and throw a tape measure on every single truck.

Q: What are some of the things that we could pass on to other people who take on this endeavor in other states?

A: It hasn't impacted the flow of traffic during the installation process coming into the facility. We see a lot of trucks being weighed with the system, rolling across the screen. I mean, if you are in a weighing mode and you've got a weigh screen up and you've got the weigh-in-motion screen up, you have to be extremely alert and conscious and be watching both screens. Some things you don't see are like over-height problems. It would help if there was a better audible system, with the program so if a truck is detected as over height there is a bell or a buzz or a ding or something that brings it to your attention, built into the system. That would help. As far as the actual installation of the roll-out time, when they first put it in it's like any new technology. There's going to be some wrinkles in it. They need to be patient because those will come around. We had to submit a trouble report immediately after the initial installation because the calibration, for example, might run a little wild. Every day it's like it's allowing heavier, and heavier, and heavier weights to roll across it, so you would need to bring the techs back to recalibrate the program. And this happens really frequently right at first. It would seem to float on us there a little bit at Farewell Bend, but that's under control now. Initially it's just a whole learning experience. The folks will realize it's a change and, for some reason, people don't like change. At Farewell Bend you put in a multi-million dollar system. The officers disliked it at first, because of, say, the calibration problems or maybe the over height detector wasn't working properly and the tech had to come back out and tweak it here and tweak it there. You get a lot of negative comments from the folks using the system right at first until these problems are ironed out. But with time, you get a good operating system. What is amazing is being the manager. You watch and as time evolves and as these wrinkles get smoothed out and the system is functioning as it is designed to function, they would probably cut your head off if you took those additional tools away from them at this time. It is a slow change and acceptance. And each officer will find different areas that they really enjoy. The officers that are really into the safety aspect of it really pick up on, you know, the safety reasons why the vehicles are being brought in. Some people are really in to weight problems and they really enjoy the groups of axles, being able to know in advance what the distance is on those groups of axles, and that there may be a potential weight problem. Everybody has different personalities and they may pick out different tools. And I'll tell you, if the system needs tweaking in one area, there is still other areas, tools available, that the system provides. It's a slow acceptance process. You put it in. Initially people that were using it were hesitant and critical of the system. But you get six months into it and you find that more and more of them are accepting it. You get 12 months into the system and just about everybody on the crew is going to cut your head off if you try to take it away from them.

Q: In terms of interoperability with other weigh-in-motion bypass programs in the United States, what is one of the lessons that we can learn about the installation of Green Light?

A: The transponders are the same. The problem comes in is that, and you are seeing it right now with the PrePass system, the NorPass system, and then the Oregon Green Light system, within a radius of the neighboring borders to the state of Oregon there are three independent, separate systems up and running. They need to be interoperable if this is going to be a benefit for industry. We need to be able to read the PrePass transponders. But it is a political thing. Now, they want their money. They want their 89¢ or 99¢ every time one of their truck's transponders bypasses their system. NorPass has an administrative cost that industry has to meet. Hopefully, hopefully, some day Federal Highway will step in, and I don't know how they will do it, but make sure that these programs are interchangeable. If we could read the transponders that are registered in the PrePass system, you would see a doubling of the number of green lights given in the state of Oregon on any given day. Once NorPass gets more trucks enrolled into their system, Oregon should be able read those. You'll see an additional increase. There are enough trucks with transponders out there. The problem is they are registered in one system but not with one of the other two and they need to be interoperable so that a truck can go from the west coast to the east coast and back and their transponders will work in any type of system. And we need that. That's something that has to come about down the road.

Q: How about lessons learned in terms of marketing?

A: I tried to market the transponders when the system was fresh and new and I was successful to an extent. The problem being is… well, for example, one of the companies hauled liquids. Liquids are not a real good, compatible, commodity with a weigh-in-motion system due to the fact that it takes some skill on the part of the driver to make sure he is maintaining a steady speed and he isn't sloshing the liquid load when he goes over the weigh-in-motion.

There is a training aspect there. If they are going to be hauling liquids, the drivers need to know how to cross the system. They need to slow down, maintain a steady speed well in advance of going over the weigh-in-motion. Another commodity is hanging meat. Hanging meat can cause weights to shift within those semi-trailers and if they are coming around a corner or all of a sudden they come upon a weigh-in-motion and tap their brakes, that meat, the weight will shift forward and they are not going to be getting the green lights, they are going to be getting red lights. It is real hard to explain to a driver or a company owner who calls you up madder than heck wanting to know “Hey, we bought into this system and all of a sudden 4 out of 6 of my trucks are being called in, getting red lighted, with no real problems.” Well, there is an education process with certain commodities that has to be provided also and when we are trying to sell this system we need to be aware of the types of commodities the individuals are going to be hauling. Because, like I said, there are a couple that are not real compatible with the system and the drivers need to be aware of that.

5.3 Interview Three

Q: One of the objectives of Green Light was to, when it was first started, was to decrease traffic at the sites. Do you believe, in your experience with Ashland, that this objective is being met and to what extent?

A: I believe that the objective is being met to the degree of the number of carriers that have signed up for Green Light. At this location we have approximately 3-4 hundred trucks per day going by the scales, which decreases our traffic somewhere around one-fourth to one-fifth coming through the port. So, to a certain degree, I think it is. To increase that they need additional carriers signed up.

Q: Right. Another one of the objectives of Green Light was to be altering the vehicle stream to one that was more likely to have compliance issues. Do you believe this objective is being met and to what extent?

A: Can you go into a little bit more of an explanation on that?

Q: Sure. What I mean by that is that, initially, the way Green Light was designed was that it would be checking vehicles for their safety rating and trucks were unable to participate if they didn't meet a certain basic level. And then, furthermore, their credentials and their safety records would be checked real time on the freeway against a database that would say "this truck is more likely to have problems, pull them in." That kind of thing. And in doing so, it would alter the types of trucks that are pulling off the freeway into the Ashland port of entry to be those trucks that are more likely to have compliance issues. That was an objective. Now, they have had to change things as time has gone on and it has been developed. But that was still an initial objective and so I want to ask whether or not you think that objective is being met. If not, then you just can say "no, it isn't."

A: I think it's being met with the carriers. The screening method and the criteria they've established for carriers for the Green Light program and the Trusted Carrier Program. The carriers that they do have signed up, they are meeting that objective in that area. Again, there are a lot of carriers that we could sign up. Yeah, and I am sure they are out there and they're publicizing Green Light, but I believe they are meeting that objective with the carriers that they have due to the screening and the criteria that they do with the carriers.

Q: In terms of the final objective, which is closely related to the one that you just spoke of, they had hoped that it would enhance the ability of the inspectors to target problem carriers, either by reducing traffic or by, in relation to question 2, being able to alter the vehicle stream a little bit to more problem carriers are passing by the static scales. So do you believe as far as the objective of enhancing your inspectors and safety specialists, their abilities to target carriers for inspection, is Green Light having an impact on that?

A: Yeah, I believe that Green Light is having an impact on it because we are reducing the amount of traffic coming into the scale and because Green Light only allows carriers with good safety ratings to participate. We would have picked up those carriers and inspected them because of no decals or something like that. Now they are staying out on the freeway so that we are looking at carriers that either are not part of Green Light or do have safety problems. So, I think that it's meeting the objective, just again because of the criteria they are going under. It's having carriers that have poorer safety ratings, that have applied for Green Light and being denied membership to Green Light because of safety ratings. We're getting to look at those carriers more.

Q: Has Green Light in some way enhanced the operations down there, changed the way you're doing business in terms of weighing the trucks?

A: I think Green Light has enhanced our weighing of vehicles. In the past we've had to shut the light off and allow trucks to use by-pass lanes, or in some cases, have to shut the light off on the freeway because traffic got backed up. Now, with about one-fifth of the vehicles bypassing on a daily basis, we are able to continue our weighing operations instead of either bypassing the trucks or closing the scale completely to eliminate the traffic coming into the scale just to clear it out.

Q: The credentialing that you do, which is another part of the operations there at the scale, has Green Light enhanced the operation of your scale in terms of credentialing of motor carriers?

A: Well, I think, on the enforcement side, where we are dealing with the trucks for size/weight safety violations, we don't get so much into credentialing. The only credentialing that we really see is the no ODOT permits, and so on. Due to the fact that they are not in Green Light and they don't have the permit and they would come in anyway. So that would be more of a registration question.

Q: You bet. OK. In terms of the safety inspectors and their jobs and what they are doing, again this might be redundant to what we've said before, but that's ok. What impact has Green Light had on the day-to-day operations at the port of entry, in terms of conducting safety inspections?

A: As far as Green Light, the carriers, again, who participate in Green Light have good safety records and are going to stay on the highway. Thus, we are not going to have to, I wouldn't say waste time, but take the time to look at those trucks with the good safety ratings and that are members of Green Light. So it's reduced the amount of trucks that we actually have to look at. And, in some cases, if they have no safety sticker we would take a vehicle to inspect it just because that's part of our criteria of selecting a vehicle. It's helped us get the good carriers who are participating in Green Light out on the road rather than coming in and taking up their time and our time in inspecting a vehicle that already has a good rating.

Q: In terms of the data collection that goes on at Ashland, in what ways does Green Light enhance the ability to collect data on weight, or size and weight, that type of thing?

A: I think it has increased our ability. Basically, in going back to the previous question … Due to the traffic staying on the freeway under the Green Light program, it's reduced the amount of flow into the scale approximately one-fifth to one-fourth, depending on which day you are looking at. And, with the decrease in traffic, traffic is not backing up as much. We still have to bypass some trucks when we have one person working. However, with one-fifth of the traffic going by, the amount of time that we have to bypass trucks has decreased so we are actually increasing the number of static weighs at the scale.

Q: Ok. In your opinion, what have been the most successful aspects of Green Light, some of the success stories?

A: In my opinion, the success stories behind Green Light is the fact that we are able to focus our attention more on the carriers with the poorer safety ratings. We are able to help industry by keeping them on the freeway and reduce their costs as well as reduce the cost to the State. And, as Green Light increases and motor carriers participating in Green Light increases, we will be able to better cope with traffic coming into the ports without spending the money to expand the facilities, and so on. We are hopefully to some point … with Green Light growing on a daily basis to reduce the amount of staffing at the port where we could focus that staffing in other areas that we have a larger violation rate. So, those are, I think, some of the success stories involved with Green Light. We just wish we had a lot more.

Q: People are very interested in that. Federal Highway is very interested in that because they paid for the system here. In your opinion, what are some of the lessons that could be learned in terms of the installation process and how Green Light was rolled out at your site? Is there any advice that you could give?

A: Well, I don't know if I could give any advice. I think when they rolled out Green Light at this program, they did a real good job with it. I think they could improve on training in Green Light. By training I mean they could come in and inform the crews and get together with them a little bit more than what did happen … I think probably letting them know the strengths of Green Light and the weaknesses and/or limitations of Green Light. And, I think, in some areas, Green Light was not as positively accepted as it was here because we were involved in a previous program and we kind of went through the ups and downs of the program and we knew that it wasn't a perfect program and there isn't a perfect program but you just work with the limitations within Green Light or other programs that they rolled out prior to Green Light. And so we knew there were situations or things within Green Light that would work and we knew there were limitations. So, the people here were open to it and accepted it and they didn't expect more from the program than what it could do, I guess you might say, where other areas I think did and they didn't understand the limitations that Green Light has.

Q: How about some of the lessons learned in terms of marketing the program. Could you comment on that?

A: I think the lessons learned, just in my personal opinion, on marketing the program … The managers, I think, in the local area, who knew their carriers and the program reps in the local area could have participated more in recruiting companies for the Green Light program. We had an administrator come in and, you know, they did what I would consider a fair job … But, you know, the people in people in the district that knew the carriers and could have a personal contact pretty much on a daily basis weren't really given an opportunity to participate until later when there was a problem with the administrator. So … I think, in marketing, if you take advantage of the people that know the carriers in the local districts, we could have marketed it much better than what we did.

Q: Right. Lastly, some of the lessons learned in terms of interoperability. Can you comment on some of the lessons that can be learned of … of being able to have the carriers involved in multiple programs and things like that?

A: Well, I think there should be some type of an overall control over all the programs. It's like little stores having sales saying "yeah, we've got the best deal" and so on and then they're not sharing information. In order for the interoperability of the Green Light program, and PrePass and NorPass, all of these programs have to be able to work together and they have to have some standard set so that carriers have the ability to register their transponders with other programs. Otherwise, the C Vision highway of the future, of the carrier loading in Philadelphia and then unloading in Portland, Oregon, without stopping at a scale is not going to happen. The inability of Green Light and NorPass to get the cooperation of PrePass is difficult to understand. I know that we have done a lot to try and get the cooperation from PrePass and there is resistance there. And I feel that, in some way, because a lot of this is federally funded, that the government should step in and say, "you know, let's all play together; we all want the same thing," and get these programs to cooperate with each other. I think it's kind of one-sided at the time where Green Light and NorPass are trying to work with carriers to get them to the point where they will not have to stop at any weigh stations. And, from the information that we've received, PrePass is saying "Well we are not going to share our information. Period." I think something needs to be done with the PrePass program in order to have either pressure from the carriers themselves that are involved and saying "Hey, we can't use PrePass in the other areas because you won't allow us to register with them," or the government needs to come in and force that information out in some way so that the carriers will benefit, or the companies will benefit from all of these weigh-in-motion systems.

5.4 Interview Four

Q: One of the objectives of Green Light was to decrease the traffic at the sites. In your opinion, do you believe this objective is being met and to what extent.

A: I would venture to say there is probably not a singular response to that question. It would vary from site to site. Using the Woodburn port of entry, southbound on I5 as an example, I would say that it is indisputable that we have made a dent in the amount of truck traffic that is coming through that facility on a day-to-day basis. Other sites which have been less well established because they have been operational for significantly less time probably mirror the fact that we are not as far along the marketing curve and we haven't saturated the local market simply because there hasn't been an opportunity. So, I think what the evidence suggests to me is that where the Green Light facility is completed, as time goes by and the immediately surrounding motor carriers become increasingly aware of the availability of the service, our experience shows us that yes, we have been successful in diverting traffic. And in those locations where we have not yet witnessed that diversion, it's simply because we are not as far along the life cycle of the site.

Q: A second objective of Green Light was to alter the profile of the vehicle stream entering the weigh stations to one that was more likely to have compliance issues. How do you believe this objective has been achieved or is it being met?

A: The only objective indicator we would have to address whether or not the truck traffic being diverted to a weigh station was more or less compliant would be to look at the statistics of size and weight citation issuance, or warnings given, or legalizations required. And if you simply were to use those as the objective diagnostics, I would have to say that we have not witnessed an increase in the amount of noncompliant truck traffic because citations have not increased, warnings have not increased, legalizations have not increased. Now, it could be the case that there are other constraining variables here which are impacting this analysis. While we have in fact implemented Green Light, we have changed other variables so that the analysis has not been maintained constant. We do not have a scientific… We don't have a laboratory to work in; we've got the real world. During the same period of time that we've implemented Green Light, we've had to, for work related reasons, we've had to engage our staff in various training activities which we had not anticipated. We've taken them away from the ports of entry and we have weighed fewer trucks because they have had to take, for instance, high speed pursuit training; because, for instance, they have had to go and receive training around violence in the work place and how to deal with a member of the public that is becoming aggressive, how to deal with them in a nonviolent manner, how to de-escalate, how to disengage, how to deal with them on a verbal level. That is just illustrative of some of the things we've had to do that have taken staff away from the business of interdicting the truck traffic as it comes across the scales. We've also made a conscious decision to increase the amount of time that the motor carrier enforcement officer staff is spending on other aspects of their day-to-day job and we have included, for instance, 15% of their current position description is devoted to doing truck safety inspections. As a result, we actually have seen a decrease in the number of trucks that are receiving static weighings across the state and we have seen a decrease in the enforcement activity as measured by citations, warnings, and legalizations. I don't think, therefore, that you can conclude that Green Light has or has not had that intended effect.

Q: Another objective of Green Light was to enhance personnel's ability to target their carriers.

A: Once again I'm going to go back to telling you that we're not working in a static laboratory and another circumstance and another couple of variables have changed. Initially, Green Light was intended to affect that performance factor. However, we have migrated to other tools provided to us from the Federal Highway Administration to influence our selection of trucks for on-highway truck or driver safety inspections. For instance, we use the federal supplied Inspection Selection System which is a software-based selection algorithm which is looking at past carrier behaviors, accidents, citations, and inspection records, and generating a probability or a likelihood of selection for inspection that is guiding our selection choices. We also use another software tool that has been provided to us by the federal government call PIQ. It's a past inspection query and while the ISS system tells us whether or not a particular motor carrier warrants attention, the PIQ system then, once we've decided yeah, we're going to probably look at this carrier, the PIQ system then tells us of all the vehicles in that carrier's fleet when was the last time this particular vehicle has been inspected and if it was inspected recently by someone else, somewhere else, we would make a "no inspect" decision. If it hadn't been inspected any time recently, we'd probably make an "inspect" decision since the ISS selection parameter said this carrier is worthy of attention. Since we got those pieces in place, in the land of inspections that Green Light anticipated occurring happened to a lesser extent. It's probably the case that Green Light has not significantly impacted our targeting choices. Green Light didn't anticipate the advent of the Inspection Selection System or of the Past Inspection Query system. Green Light assumed we would be taking motor carriers that are not worthy of a bypass, perhaps because of an adverse safety rating, and diverting them into the queue for a static weigh and subjecting them to the random safety inspection. But, what I am saying is that the world changed and there is not so much of a random selection transpiring so that Green Light is not effectively sorting on that basis.

Q: How has Green Light enhanced the operations of the Transportation Division?

A: I'm going to give you a bifurcated response. I'm going to tell you what it has that may eventually accrue to us when the system is operating and being operated by all parties in the manner in which it was intended. But I am going to start by telling you that it my observation that many of our motor carrier enforcement officers in the field do not know how to maximize the effective use of the new tools they have been given and, as a result, they are experiencing some degree of frustration. Not so much at our ports of entry, but at weigh stations like Booth Ranch, Roseburg, and Wilbur. There are continuing reports of the inadequacy of the system. By and large, from what I have been able to garner, it seems to be that those results from employees that are not sufficiently familiar with the operation, or the strategic operation, of the new tools they have been given. As staff has the equipment and gain experience in using it, they become more and more familiar, and I believe it is the case that we are winning converts to the philosophy that Green Light has enhanced the operation of the weigh station. And there is a certain skill set to it, to know how to balance the various equipment settings that determine what the threshold is for obtaining a mainline bypass as opposed to… Woodburn southbound, again, has the additional dimension of in-ramp sorting and there's an in-station kind of a slow-speed bypass lane as well as the two static lanes and there's a skill set in knowing how to direct the traffic. And I think it comes with experience and absence that experience, staff are somewhat frustrated if they are confronted with something that's new and different and difficult to manage at the outset. There are a lot of different things going on and there's a lot of information presented to the employee. And if they haven't opened all the appropriate windows and sized them appropriately so they can have them all concurrently available to them, there is the opportunity to be somewhat at a loss as to what is transpiring. So there is an educational piece and there is a training piece. And once everything is in place and staff has become accustomed to it, I think it is significantly impacting the operation of the station in a favorable kind of way. Where, though, we haven't had the time for the staff to mature and become seasoned in the use of the system, the inverse would probably be the case. I think there is some staff in the field that would take both positions today and that's just a reflection of how long Green Light has been installed and active in their particular domicile location.

Q: About the success stories that can be taken from the Green Light project. One might be the Trusted Carrier Partner program. Would you consider that one of the success stories that have come out of this program?

A: Actually not. The Trusted Carrier Partner plate is nothing more than the equivalent of what the Inspection Selection System, or the ISS system I spoke of earlier. It would conclude the same about a given motor carrier. It uses the same selection parameters. And the original intent here was for motor carriers that either are not Green Light participants or for facilities that are not equipped with Green Light or not equipped with the availability of Inspection Selection System connectivity We would give them a visual indicator to the truck inspector that would be the same conclusion that would have been reached had they had access to ISS. And as we sat down and we were thinking about how can we market this to motor carriers and how can we make Green Light more attractive to motor carriers, we purposely decided to use the Trusted Carrier Partner plate as something that only a Green Light enrolled motor carrier could have. And so, I don't think it's something that Green Light evolved, quite frankly. I think it's a marketing function or a marketing offering that we sat down and conceived to make Green Light attractive to motor carriers that were not participating. And, frankly, we stole the idea from the Partners in Compliance program that's operating in Canada. In that particular scenario they offer a license plate that is a PIC, or Partner in Compliance… a vanity plate. And so we kind of built on that and looked for a 3 letter acronym and settled upon TCP, a Trusted Carrier Partner. So, I actually think that might have evolved even without Green Light. In fact, I'm sure it would have as we were trying to provide the equivalent of an ISS selection when we don't have ISS connectivity. And we simply then saw that as something that was available and in our tool bag that we could use to market Green Light.

Q: How about other success stories?

A: Perhaps, arguably, the biggest success story is decreased traffic at Woodburn. We set out to achieve that and we did in a big way and we can demonstrate that we did with clear objective evidence. And its growing at a phenomenal rate. The other goal of focusing scarce inspection resources on less compliant trucks, we actually achieved that goal through other avenues and I'd say that is a much, much lesser achieved Green Light goal.

Q: About lessons learned, one might hope to use Green Light with other systems, for instance, NorPass, and to get other states involved which was a clear objective from the get-go.

A: I would say this in response to that. There is no question in my mind that the Oregon Green Light program, in all of the ancillary dialogue around the various issues, around the operation of Green Light, have progressed the business of weigh station pre-clearance and application of ITS technology to CVO at a much faster rate than would have occurred absent Green Light. To Green Light's credit, a direct spin-off from Green Light was the IOU project that involved initially Utah and Idaho, and Oregon, which grew into the MAPS project, the Multijurisdictional Automated Pre-clearance System, which involved Washington, Idaho, and Utah, which absolutely then grew to include the ATVO states and grew into NorPass, the North American Pre-clearance and Safety System. Green Light was the seminal thought in thinking beyond… behind all of that. It is actually ironic that, as of this date, Oregon now stands apart from all of those things because the students have moved away from their teacher. That may sound self-serving, but it is the case that we guided and nurtured all of that development and then there came a point in time where the judgment of others was substituted for our judgment and we have now pursued separate paths. And so it will remain for the national audience to judge who has the clearer vision down the road as we see which system garners the greater usage. But today the Green Light system dwarfs the total participation in all the other states that comprise NorPass. Oregon alone dwarfs the combined participation of all motor carriers and trucks in all that is NorPass. We'll see how that stands the test of time.

Q: Right. Lessons learned and potential issues that have deterred Green Light from reaching its objectives. I have three main bullets here that I'd like you to try to focus on. One of them is system integration which can also include the role out of the sites. What lessons can be learned from Green Light in terms of that? Is there anything you would like to comment on from just that standpoint?

A: Well… The only thing that really comes to mind in terms of the actual site construction… ODOT is a significantly complex organization and I do not believe that there was a generalized understanding of what was being built and why at the outset. And we have had to reinvent the wheel and have that discussion repeatedly in the various regions and districts that make up ODOT. I think, had we known at the outset, the kind of struggle that would amount to and the kinds of discussions we would have to have, we would have been well served to have insured that we had a greater clarity around the mission and the project that ODOT was undertaking. Because it almost became the case … I think Randall would support this that … He almost felt as if he was combating with others within the department to conclude the construction of a given site. As if he was a nuisance to the otherwise transpiring construction activities that were going on within a region. And I think we might have done a better job up front had we done a better job of instilling the vision and communicating what we were setting out to do as opposed to doing that kind of instructional work piecemeal.

Q: What about the marketing efforts? Are there any lessons one could learn about how you reached out to your carriers?

A: Yep. I would tell you there, first and foremost, and it's not an original thought, in fact it's been expressed probably best by others before me who said "We will sell no wine before its time." And the mistake we made, and it was a crucial mistake, was we went out and we hyped the program and we sensationalized a little bit, and we tried to stir up significant motor carrier interest when we only had one or two sites operating. And it is of little to no value to a motor carrier unless it is robust in the number of sites in which pre-clearance can be obtained.

A: We should have concentrated more on construction and deferred marketing until we had more of an operable system.

Q: What about interoperability with the other systems. What are some of the lessons that you see Oregon can pass on to others in that area?

A: That probably is the most frustrating aspect of this entire saga for me personally. I would say that those folks in a position to provide national leadership have dodged this issue. Our partners in the Federal Highway Administration have stuck their heads in the sand. And, while they talk about interoperability, they have limited the discussion to simple, technological interoperability. And that is only half the problem. If, in fact, the business models are not interoperable, that is as much of a stumbling block as technological interoperability shortcomings. And what we have today is anything short of interoperability. Motor carriers today in Oregon that are getting Oregon transponders are not permitted to enroll that transponder in California and they can only enroll those transponders in Washington if they pay an additional fee per truck. The motor carriers are in a position of having to have multiple transponders per truck to operate on the simple length of freeway, I5, from San Diego to Washington to the Canadian border. It is an imponderable situation in my mind, something that the federal government easily could have intervened in. But we see the effective lobbying effort of other private sector firms that are attempting to influence ITS deployment in this country for their individual financial concerns and, in my view, that is the single most prevalent reason that ITS infrastructure is not more fully deployed in this country. It is all a question of leadership. Oregon cannot affect policy outside of Oregon effectively. The federal government clearly is positioned to do so but they have foregone any reasonable attempt, or meaningful attempt, to do so. We do not have interoperability today. It is not on the horizon.

5.5 Interview Five

Q: One of the objectives that Green Light when it was first developed several years ago was that it was to decrease the traffic at the various sites that it would be installed at, the traffic of trucks actually entering weigh stations, which at the time was a considerable problem. Do you believe that this objective is being met from your perspective?

A: Yes, at this point. With the volume of transponders that are out there, I think the truck volumes we are able to handle sets us up well now but will set us up even better in the future. So I think we have handled the customer base fairly well.

Q: Another one of the objectives of Green Light was to alter the profile of the stream of vehicles that leaves the highway to one that was more likely to have compliance issues. That was because vehicles were pre-screened in order to participate in Green Light. Their credentials and their safety ratings were checked. Do you believe that this objective is being met, from your perspective?

A: Yes. We've been able to target our enforcement staff on the folks that don't have a good record. And what we've shown also is that we've had a decrease in truck-related accidents as a result of the screening that has gone on, I think, and the targeting and putting up our staff to go after to the folks that are the scoff-laws or at least taking out the folks that don't cause problems so we get a better bang for the buck, from the public's point of view. Our safety officers are sent where there are safety problems, or more likely to be safety problems. So it has been very effective in that way. Probably more effective in that way than it has been in taking traffic off the road at this point.

Q: Ok. My experience has been that that element has been lost along the way. That was one of the defined objectives when the project was started. I think that the champion of Green Light has been more the decreasing in traffic and the fact that Oregon won't have to expand their facilities and that sort of thing and that the safety is like an added benefit.

A: Well, we've had a 23% reduction in fatalities in the state. We have been emphasizing safety and I think the truck is part of that. Because you've taken the bad guys off, the unsafe trucks off, off the road, then the mix of fleets that's out there is in much better shape. In ’99 the decrease in fatalities was in the vehicle category, you know, motorcycles, bikes, all categories, but I think truckers … it was an absolute reduction in fatalities when in fact the traffic has gone up and so, I think, that the mix of trucks is safer. That has been a contributing factor in a major way.

Q: The last of the three initial objectives of Green Light was the enhancing of the inspectors to target problem carriers at the scales for the inspection process. Another safety related objective.

A: Yeah, the manager of people. That is probably the most key in terms of the productivity gain. You’ve let technology process normally the folks that are following all the rules and regulations and you’ve given the manual, bad apples if you will, to the staff to deal with. It’s just an efficient use to let the folks that know what they are doing keep moving. And they’ve agreed and they’ve agreed to set some standards, so we are bound to get a better return on our dollar that way. I just think it is a key part to the whole safety piece in what we are trying to deliver to Oregonians.

Q: In your opinion, what have been the most successful aspects of the Green Light project from the perspective of the motor carriers?

A: I’m not a motor carrier, so from the perspective of the motor carriers I can only guess. We have participated with OGA off and on this program. They’ve changed their position. It has been a little hard to follow sometimes, but I think they too, when you talk to the organization, they appreciate that the good guys are allowed to do their job more efficiently. The industry can move quicker, faster, and better. With a freer flow, and then the dollar value, we thought it was $1.10 per minute per truck stuck in traffic. That same number would apply to trucks stuck in a weigh station, so if you lose 5 minutes, you lose $5 and you lose time at the other end, and so that’s very important. So, I think from their point of view, letting the good guys move efficiently is probably the biggest gain. And then, they also are quite good at monitoring our staff, monitoring meaning they appreciate what our staff does and so I think the industry knows our staff is going after the bad guys. And that helps their image by having fewer truck wrecks on the road and by taking care of the bad guys in their industry. Which helps from the competitive point of view to make sure that the good guys are left, good guys meaning those that follow the rules. The insurance, keep their rates up, in shape, and that sort of thing. I think that's the key thing, the speed issue. It took us a while to get the things set up. It took us longer to get things set up and it took us longer to get the transponders out, due to some political issues really. And, so, in terms of absolute efficiencies, we could have saved some capital investments earlier, I think, on Woodburn had we been able to distribute these earlier, but you know, politics. It could be other states won't have to handle these same politics. You know, those might get a hand out. As for the technology itself, it's there to be used. You just have to work through the politics of it.

Q: In terms of the roll out of Green Light and how it was brought into the Motor Carrier Division and their day-to-day operations, what are the lessons that can be learned from that process?

A: It takes guts to implement this thing. And guts and bureaucracy don't often go hand in hand. And guts and multiple bureaucracies assuredly don't go together too well. It's a multi-bureaucracy thing to implement this, Federal Highway Administration, a state Department of Transportation, and it may be two or more aspects of that state that have to be engaged. It may be a PUC function, it may be a Department of Transportation function. We're lucky that they're together. I'm not sure Motor Carrier appreciates how lucky we are. What we ran into time and time again was not a technical issue. It's not the technical stuff that's the problem. It's really the political stuff that's the problem. And, I think, in the future, if you can get rid of the political stuff, I don't think the technical stuff is going to be that hard once you master it. And the third leg of that is the trucking industry. There are new industries coming in, the Lock Heed and Help Inc, and all that stuff, all good companies and good organizations, but they are sort of fighting for their survival through political means. It's caused unnecessary black eyes but it's good technology. I think the lesson I learned is just because it makes sense from a technological point of view doesn't mean that the political wherewithal is going to be there to see it through. You've got to fight like heck to make it work because "it's always something," as Gilda Radner would say.

Q: The marketing effort that you had to use to get the trucking industry to buy into this idea. What are some of the lessons that can be learned by other states that implement this type of technology?

A: I think that the marketing efforts are too hard to judge in Oregon because they were hampered by other political battles going on. We had the weight/mile battle, and so the Oregon Trucking Association used the weight/mile battle as a reason to not engage constructively in their original agreement to help support this thing. They knew this thing was to their advantage and they didn't pursue it … because … and they actually tried to support it. They did try and … they did support it… Because of their own political interest in the weight/mile battle. So, I'm not sure if what happened in Oregon is translatable, other than the lesson learned would be politics can enter into it. You know, I suppose those in favor of it won't vote against it is what we've seen. I don't know in another state if they want to go after the same battle that it might not be much easier to do. The other obstacle that we found wasn't political at all, but there were a lot of people who, with the system not up and running, or only up and running in one or two places, you couldn't get them to get it. The savings were such that they didn't want to put out of pocket $45 on every truck, not knowing what the savings were, so they need to go through a test period. And this idea of giving the transponders away needs to be pursued to get the technology going. It's not uncommon. Telecommunications has done that before, given phones away, given computers away, and such, to get the people accustomed to the use of the technology and take the risk out of the customer's hands. Once they are used to what's going on they go out and buy the next piece of piece of equipment and we're off and running. The fact that we ended up giving these things away to get things going, I think once people experience the benefit and then if they have to pay the $45, I bet very few of them go back to being stuck in traffic, as it were. Cause this is really, you know, congestion pricing. As long as you are a safe trucker, why would you want to get stuck in that thing, is it worth it to you to pay $45? There may be some that choose not to, but I would suspect that a bunch of them do it that way. Transponder numbers have really taken off, but we gave them away for free, and free turned out to be a very good price. But, I'm not sure everyone can afford to do that. And so if you do charge them, I mean it may behoove you to work your finances in such a way that the whole thing is set up to give them away and that gets people in the mix. An electronic license plate, so I think whatever we pay for the license plate generally, we might want to think about just including in that electronic identification so that we have the ability to identify them electronically if we need to.

Q: Lastly would be the lessons learned about the interoperability issues. That means the interoperability of the technological side of things and also in the business plan side of things.

A: The technology is there. The problem wasn't a technology question. The problem was a political question and the difference between the profits, who was looking for on-going profits. It's a question of the relationship between the various carriers and people finally getting their footprint on a bigger part of the market So, I think, the lessons learned are you need to identify the political battle, the lay of the land, in terms of who's looking for what market and just understand your state in trying to implement this. Understand what both sides offer. You have to look at your own ability to put infrastructure in place. And, if you are going to go the private sector route, understand what that means in terms of what they will and won't accept if you go with the brand that's out there right now. There may be other providers in the future and so you just have to scope out what is being offered by that particular carrier and then understand that interoperability is something you either need to exist or understand that it won't and what that's going to do to your system if you choose to go that route. That's entirely not a technology problem. It's entirely a political problem. The technology pieces you have to wade through but it's doable, very doable.

Oregon Green Light

CVO Evaluation

FINAL REPORT

DETAILED TEST PLANS 13 and 14

Mainstreaming and Interoperability Issues

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1 DETAILED TEST INTRODUCTION

1.1 BACKGROUND

This Report is the last report submitted as part of the independent technical evaluation of the Oregon Green Light CVO project. The Oregon Department of Transportation (ODOT) is near completion of the implemention of their Intelligent Vehicle Highway System Strategic Plan for Commercial Vehicle Operations (now referred to as ITS/CVO). Through Green Light, Oregon is installing twenty-one mainline preclearance systems featuring weigh-in-motion (WIM) devices and automatic vehicle identification (AVI) at the major weigh stations and ports-of-entry in the state. In addition, certain sites have been equipped with safety enhancements that regulate road conditions and speed. Examples are the Downhill Speed Information System at Emigrant Hill, and the installation of weather stations at three other locations.

The purpose of this report is to present the results of Detailed Test Plans (DTP) #13 and #14. There will be similar reports for all other Detailed Test Plans developed for the Green Light Evaluation. The Detailed Test Plans were published in 1997, "The Oregon 'Green Light' CVO Evaluation -Detailed Test Plans" [1]. Earlier documents providing essential background to the Evaluation are the Evaluation Plan [2], and, Individual Test Plans (ITP) [3].

Each of the tests conducted by the research team for the evaluation of Green Light addressed one of five goals of the evaluation as documented in the Evaluation Plan [2]. These are:

- Assessment of Safety
- Assessment of Productivity
- Assessment of User Acceptance
- Assessment of Mainstreaming Issues
- Assessment of Non-Technical Interoperability Issues

The objectives associated with each goal are given in detail in The Oregon “Green Light” CVO Project - *Individual Test Plans* (ITP) [3]. In addition, condensed one-page tables are contained in the appendices of the ITP, outlining the measures to be conducted for each of the stated objectives. The detailed test plan documents [1] expand on the information provided in the ITP and provide in detail the activities planned for each *evaluation measure* during the course of the evaluation in regards to the stated objectives.

1.2 PURPOSE AND SCOPE

This report presents the results of four test measures employed with the following **objectives**:

4.1 Document regional and national mainstreaming issues,

4.2 Document approaches to solve mainstreaming issues and final resolutions’

5.1 Document non-technical interoperability issues,

5.2 Document approaches attempted to solve non-technical interoperability and final resolutions

These objectives are in support of the **goals** of assessing mainstreaming and non-technical interoperability issues.

The evaluation **measures** used to reach the stated objectives are:

- **Measure 4.1.1 Identify, assess and document pertinent regional and national issues and assess the impacts to Green Light for customers and providers**
- **Measure 4.2.1 Document approaches attempted to solve regional and national mainstreaming issues as they arise, and final resolutions**
- **Measure 5.1.1 Identify, assess and document pertinent non-technical interoperability issues as they arise for customers and providers**
- **Measure 5.2.1 Document approaches attempted to solve non-technical interoperability issues as they arise, and final resolutions**

A description of the hypotheses to be tested as well as the test methodology and deliverables is given in Chapter 2. Chapter 3 summarizes the results of this part of the evaluation, and, Chapter 4 presents Conclusions and Recommendations.

1.3 DISCUSSION

Major changes at the federal level of government have greatly impacted the use of highways by commercial vehicles, principally large and heavy trucks. The sea change was initiated in the Intermodal Surface Transportation Efficiency Act (ISTEA) and advanced in the Transportation Equity Act for the 21st Century (TEA-21, the $175 Billion reauthorization of ISTEA). A primary driver within ISTEA and TEA-21 is the national priority assigned to Intelligent Transportation Systems (ITS) and Commercial Vehicle Operations (CVO) programs. Exhibit 1-2 is a summary (presented in DTPs 13 and 14 in 1997) of a few of the milestones for ITS and CVO anticipated from 1995 through 1999.

EXHIBIT 1-1 Anticipated Milestones for ITS and CVO by Year

YEAR	EVENT
1995	Complete the ITS/CVO architecture design for an international “CVOnet Backbone” to support an Information Exchange System (IES) among public regulatory agencies, private trucking firms, and other stakeholders.
	Develop preliminary standards for procedures, training, data requirements, communication protocols, software, and hardware to support the deployment of ITS/CVO services—electronic clearance of safe/legal trucks, automated roadside safety inspections, electronic purchase of credentials.
	Organize the CVOnet Backbone, IES, model states, model motor carriers, existing electronic clearance projects, CVO institutional issues, and existing national safety databases for a prototype national CVO information system with priority placed on electronic clearance of safe/legal commercial vehicles.
	Six electronic clearance sites operational on the HELP Inc. system in California.
	Equip 30 sites along the Advantage I-75 corridor and initiate the beta test of electronic clearance with 4,500 transponder equipped vehicles.
	Conduct the second round of multi-State ITS/CVO Institutional Issues projects in a total of 40 states to continue to facilitate regional: public/private forums, agreements on electronic data sharing and requirements, uniformity of regulatory requirements, etc. Use these to ensure widespread acceptance of and participation in the ITS/CVO program by the states and motor carrier industry.
	Initiate and participate with NHTSA in researching and testing on-board safety devices that monitor the safety status of trucks/buses for hazards such as fatigued drivers, vehicles with unsafe brakes, unstable cargo, etc.
	Continue efforts begun in early CY 1995 in the area of hazardous materials incident response (HMIR) specifically the Congressional mandate for a HMIR operational test with the National Institute for Environmental Response and the expansion of the DOT interagency partnership (RSPA, FRA, and FHWA) project—Operation Respond intermodal HMIR effort—from Houston, TX to Laredo, TX and other sites.
	Initiate research to identify and evaluate smart card technology applications to the ITS/CVO program. Develop a draft concept for integrating smart cards into the national CVO architecture.
	Make substantial progress (60 percent complete on deliverables) on the three operational tests for electronic one-stop purchase of motor carrier credentials and the operational test for electronic out-of-service verification.
	Complete preliminary analysis and recommendations of advanced brake testing technologies. As part of our ongoing test and evaluation program, we will continually re-evaluate our data collection requirements for each type of technology (i.e., roller dynamometer, flat-plate, torque, etc.) and proceed accordingly. For example, if sufficient data has been collected and evaluated for a particular technology during the evaluation process, we will expedite our final recommendation, and begin the integration phase of the program.

EXHIBIT 1-1 Anticipated Milestones for ITS and CVO by Year (Cont.)

1996	**Initiate the Green Light electronic clearance project by equipping sixteen sites to support electronic clearance and other applications ready for integration.**
	Equip 100 Motor Carrier Safety Assistance Program (MCSAP) inspection sites with communication technologies to facilitate the periodic electronic transfer of files of interstate carrier safety data from an existing national truck/bus safety database to roadside inspection sites.
	Deploy credential/safety clearance prototype in one model State with a finite number of model motor carriers for concept and system test. This prototype will integrate the roadside safety data access projects at 100 MCSAP sites with the roadside electronic clearing of safe/legal vehicles and with the tested technology applications for electronic one-stop purchasing of credential and out-of-service verification.
	Complete the evaluation for the application of advanced brake testing technology devices at the roadside to expedite the truck/bus inspection process and increase the total number of annual inspections. Begin integration of these technologies with the single-State prototype.
	Complete the evaluation for the three electronic one-stop purchasing of credential tests and the out-of-service test. Take the lessons learned and begin the integration of the technology applications with the single-State prototype.

1997	Finalize standards for procedures, training, data requirements, communication protocols, software, and hardware to support the deployment of ITS/CVO services.
	Deploy prototype electronic clearance system in model states. These states will represent various regions, various levels of automation, international border crossings, HELP Inc., Advantage I-75, Green Light, and I-95.
	Equip an additional 100 MCSAP sites for a total of 200 sites, and expand the national safety database to include intrastate carriers.
	Begin integration of Smart Card technology in the ITS/CVO program if appropriate.
	Continue work on the components of the ITS/CVO program to ensure interoperability within the CVOnet and IES in model states prototype for expansion to the all volunteer states in CY 1998.

1998	**Begin the integration of all CVO components in all volunteer states and carriers.** These include electronic one-stop purchase of credentials, out-of-service verification, hazardous material incident response, advanced brake testing, the 200 MCSAP sites, and (if proven feasible) Smart Card commercial drivers licenses for drivers.
	Deploy basis credential/safety clearance in all interested states.
	Achieve a 10 percent motor carrier market penetration using ITS/CVO application.

1999	Continue deploying complete configuration in all volunteer states.
	Achieve a 20 percent motor carrier market penetration using ITS/CVO applications.

The Oregon DOT, with a business plan for CVO in place, has exhibited leadership in embracing some of the national ITS/CVO user services. The six national ITS/CVO user services are:

- Commercial Vehicle Electronic Clearance
- Automated Roadside Safety Inspections
- On-board Safety Monitoring
- Commercial Vehicle Administrative Processes
- Hazardous Material Incident Response
- Freight Mobility

Many of the components of these user services have been made elements of CVISN (commercial vehicle information systems network), a high-level infrastructure that supports the electronic exchange of CVO credentials and safety information. Oregon teamed with Washington as a model deployment of this concept.

In essence, these activities form the **mainstreaming** initiative that officially began in September 1996. Oregon has teamed with California, Colorado, and Utah as a regional consortium with Oregon DOT as the lead. The primary goal is to engage in the deployment of ITS/CVO technologies nationwide. A target date of 2005 was set for accomplishing the goal.

The special objectives of **mainstreaming** are:

- emphasize safety, clearance, and credentials activities
- encourage automation of networks and facilities that support ITS/CVO deployment consistent with CVISN architecture
- establish the appropriate foundation for future integration and implementation of the CVISN architecture

As stated previously, Oregon had a head start in the **mainstreaming** initiative with an ITS/CVO business plan in place, established regional consortia via **MAPS** and CVISN. ODOT also had an effective working relationship with the motor carrier industry of the state, as well as a financial program in place to support the initial phases of deployment—perhaps the only state with such a commitment at the time the project was initiated.

A series of non-technical **interoperability** issues has surfaced from time to time that require appropriate consideration. Whether institutional, financial, legal, political, bearing on the customer or public, acceptance of these issues must be placed in perspective and effectively resolved. It has proven to be an important effort for successful programs and requires an on-going effort throughout the life of the project.

2 TEST METHODOLOGY

2.1 PHYSICAL DESCRIPTION

This section discusses the activities carried out in the documentation of mainstreaming and interoperability issues and the approaches attempted to solve those issues.

2.1.1 Purpose

Mainstreaming of ITS/CVO strategies by definition is the deployment of technologies and process statewide. The activity is to consider the deployment of Green Light as a significant step in that direction as well as considering the ITS/CVO activities outside of Oregon and the effect on the Green Light.

The identification, definition and evaluation of non-technical interoperability issues is the second purpose of this report. Included is the documentation of the issues, outcomes, and implications.

2.1.2 Hypothesis

The following hypothesis is given in support of the four measures:

4.1.1 Knowledge of pertinent regional and national issues will increase the effectiveness of the Green Light program

4.2.1 Participation in pertinent regional and national issues will contribute to the effectiveness of the Green Light program

5.1.1 Knowledge of pertinent non-technical interoperability issues will increase the effectiveness of the Green Light program

5.2.1 Documentation of participation in, and approaches used to resolve pertinent non-technical interoperability issues will contribute to the effectiveness of the Green Light program

2.2 PRE-TEST ACTIVITIES

Planned and actual pre-test activities are summarized in Exhibit 2-1. As shown, the first three activities planned were not conducted. This was because of delays experienced during the early part of the project and a decision made by the steering committee to concentrate the evaluation effort in other areas. It was decided to simplify this part of the evaluation by focussing on the collection of all relevant documentation and by identifying and discussing issues.

EXHIBIT 2-1 Planned versus Actual Pre-Test Activities

PLANNED ACTIVITY	ACTUAL ACTIVITY
1) Preparation of a directory of participants	
Participants in this activity will include stakeholders of the Green Light program as well as key individuals representing groups (public and private) outside of Oregon. Participants list will be developed in consultation with the evaluation team and ODOT representatives.	None
2) Initialize the interview guide	
With input from the evaluation team and ODOT staff, a draft interview instrument will be designed reflecting the primary issues targeted for consideration. These issues will be identified from national, regional and state observations, review of secondary sources and experiences in other systems. A scaling technique will be used for a performance rating format.	None
3) Conduct a test interview	
Once the interview instrument is reviewed and finalized for external review, a pilot field test will be performed. Modifications will be made based on the results of the pilot test. Subjects for the pilot test will be selected in consultation with members of the evaluation team and ODOT staff. The project steering committee must approve before implementing.	None
4) Collect, catalog and summarize existing documents	
An on-going literature review of secondary sources will be part of this activity throughout the project. An annotated bibliography on key issues will be cataloged and integrated with project reports as appropriate.	The planned activity was conducted
5)Identification and Discussion of Non-technical Issues (Interoperability only)	
The primary and secondary data (prior studies, existing documents and survey results) provide the basis for this task. A typology approach will be used to array the issues and their evaluation.	The planned activity was conducted insofar as the issues were identified and discussed

2.3 PLANNED AND ACTUAL TEST CONDUCT ACTIVITIES

Below are the steps taken in this part of the of the Green Light project.

2.3.1 Descriptions/Participants

- Gregg Dal Ponte, Oregon Motor Carrier Transportation Branch was initially intended as the sole contact for this part of the evaluation. However, Randal Thomas became significantly involved as the project progressed.
- CM Walton, WHM Transportation Engineering Consultants, Inc. was initially intended to take the lead for the evaluation team. However, Chris Bell of Oregon State University assumed this role.

2.3.2 Procedures

Planned and actual activities are summarized in Exhibit 2-2. As shown, the first three activities planned were not conducted. As with the pre-test activities, this was because of delays experienced during the early part of the project and a decision made by the steering committee to concentrate the evaluation effort in other areas. It was decided to collect all relevant documentation and to identify and discuss issues, i.e. conduct a seamless continuation of the pre-test activities.

EXHIBIT 2-2 Planned versus Actual Test Activities

PLANNED ACTIVITIES	ACTUAL ACTIVITIES
1) Establish the interview schedule	
1a) The list of key contacts and stakeholders for programs and organizations within the state and elsewhere will be compiled for each of the issues and activities to be explored.	None
1b) The process, which may involve passive and active interview procedures, may be organized to focus on issues that would require one schedule and a process focused on activities (or regional projects) may require another. At this point, a schedule will be structured to meet the process to be approved by the steering committee.	None
2) Conduct Interviews	
As previously referenced, the interview process may include active and passive procedures. With active procedures appropriate techniques will be provided to interviewers and training provided to insure a highly professional and effective process.	None
3) Analyze the results of the interviews	
Various techniques of performance ratings and opinion based input will provide the basis of evaluating and tabulating the survey results. Several forms of displaying the findings will be considered for effectiveness and efficiency.	None
4) Listing and priority ranking of non-technical issues	
A set of ranking criteria will be developed as appropriate for placing in perspective the rank order of non-technical issues. The criteria and procedure will be developed with input from the evaluation team and steering committee. The evaluation process will be performed by the project staff and presented to the steering committee as deemed appropriate.	The activity conducted was a continuation of item 4) described in the pre-test activities.
Preparation of Strategy Document	
Documentation of the issues, their definition and implication, consequences, and resolution (successful, attempted or failed) will be the product of this task. The product will be of high utility in shaping subsequent internal programs and in guiding national efforts.	A document as described has not been produced, rather, an evaluation of the issues in incorporated in this report.

2.4 POST-TEST ACTIVITIES: REPORTING

2.4.1 Reporting Procedures for Individual Test

A report will be prepared for these test measures according to the guidelines given in the Evaluation Plan [1] and will proceed as follows:

1. Preparation of a draft report for each test to be submitted to the steering committee (SC) for their approval.
2. Approval of the SC at a scheduled meeting.
3. Preparation of a final test report, incorporating SC recommendations.
4. Submittal of 1 hardcopy original, 1 electronic original, and ten bound copies of the report to ODOT's project management team.
5. Transmittal of the report by ODOT to FHWA.

2.4.2 Reporting Schedule

The reporting schedule for the individual test reports is shown below:

Exhibit 2-3 Reporting Schedule - Individual Test Reports

Deliverables	Schedule	Scheduled Due Date*	Modified Due Date
Drafts of Individual Test Reports	July 1-August 30, 1999 (60 days)	September 1, 1999	April 30, 2000
Review of Individual Test Reports by Steering Committee	September 1-30, 1999 (30 days)	October 1, 1999	May 31, 2000
Final Test Reports	October 1-November 30, 1999 (60 days)	December 1, 1999	June 30, 2000

2.4.3 Data Retention/Archival Procedures

Data collected and documents produced over the course of the evaluation will be archived and submitted to ODOT project management. In addition, a document summarizing the data and reports will be produced as follows:

1. Preparation of a summary document describing data analyzed and reports prepared over the course of the evaluation.
2. Submittal of a data archive containing raw data files and all reports in compressed format.

2.4.4 Reporting Schedule for Data Retention/Archival Procedures

The reporting schedule for the archiving of data and the preparation of a summary document is given below:

Exhibit 2-4 Reporting Schedule - Data Archiving

Deliverables	Schedule	Scheduled Due Date*	Modified Due Date
Draft of a Data Summary Report	Dec 1, 1999 - Jan 30, 2000 (60 days)	February 1, 2000	April 30, 2000
Review of Data Summary Report by Steering Committee	Feb 1 - Feb 28, 2000 (28 days)	March 1, 2000	May 31, 2000
Data Summary Report (Final) and Data Archive	Mar 1 - Mar 30, 2000 (30 days)	April 1, 2000	June 30, 2000

2.4.5 Test Summary Report Procedures

A test summary report will be prepared highlighting findings from all of the test measures. The document will be produced as follows:

1. Preparation of a draft report summarizing the results of all the individual test reports for submittal to the SC.
2. Approval of the SC at a scheduled meeting.
3. Preparation of a final test summary report, incorporating SC recommendations.
4. Submittal of 1 hardcopy original, 1 electronic original, and ten bound copies of the summary report to ODOT's project management team.
5. Transmittal of the test reports by ODOT to FHWA.
6. Reporting Schedule for Test Summary

A reporting schedule is shown below for the test summary report:

Exhibit 2-3 Reporting Schedule - Test Summary Reports

Deliverables	Schedule	Scheduled Due Date*	Modified Due Date
Drafts of Test Summary Report	Dec 1, 1999 - Jan 30, 2000 (60 days)	February 1, 2000	April 30, 2000
Review of Test Summary Report by Steering Committee	Feb 1 - Feb 28, 2000 (28 days)	March 1, 2000	May 31, 2000
Test Summary Report (Final)	Mar 1 - Mar 30, 2000 (30 days)	April 1, 2000	June 30, 2000

3 SUMMARY OF MAINSTREAMING AND NON-TECHNICAL INTEROPERABILITY ISSUES

3.1 COLLECT, CATALOG AND SUMMARIZE EXISTING DOCUMENTS

An annotated bibliography of appropriate documents is presented in Appendix A. This bibliography is presented chronologically and draws predominantly from national and international publications as well as local sources (ODOT press releases, publications, and, local newspaper articles). The bibliography is weighted heavily towards interoperability issues, because those issues have proved to be significant in delaying market penetration of mainline pre-clearance technologies. On the other hand, mainstreaming has proceeded in a steady and non-controversial way. The bibliography supports this conclusion; there are many articles that report on the widespread adoption of the technologies.

In addition to the bibliography, a summary of the development of **interoperability** issues from ODOT's perspective is presented in Appendix B. This summary has been reproduced from a slide presentation prepared in early 2000, and, is also chronological.

The following section highlights significant developments and draws on key articles, such as those written by Slevin in ITS World in the last three issues of 1999 (refs 81, 92 and 93).

3.2 SIGNIFICANT DEVELOPMENTS

In the author's opinion, all the major developments were related to interoperability issues. Interoperability is therefore the emphasis here and in subsequent sections of this report.

The major events relating to the path to interoperability are summarized in Exhibit 3.1. The key stages are as follows:

- The Oregon Trucking Associations have endorsed the Green Light program for nearly four years. Other than a temporary setback when ODOT considered mandating transponders in late 1997/early 1998 their support has been constant.

- ODOT was a founder member of MAPS, an interoperable partnership among Oregon, Idaho, Utah and Washington.

- Oregon was a member of NORPASS for about six months (8/99 to 1/00) until withdrawing when the other NORPASS states signed a one-way interoperability agreement with PrePass. Oregon's withdrawal is because the agreement violates its principle that transponder users do not need permission of the owner to use their transponder in another system.

- Green Light carriers continue to be interoperable with NORPASS.

- Oregon has been unable to reach an interoperability agreement with PrePass.

- Florida is reported to have reached a two-way agreement with PrePass. The details are not known at this time, so it is not possible to tell if the form of the agreement would work for Oregon.

EXHIBIT 3.1 Major Events Relating to Interoperability

Date	Event
1995	GreenLight Project initiated. The Help Inc. (PrePass) program is also launched.
1996	The state of Washington joins Idaho, Oregon and Utah to form MAPS – the Multi-Jurisdictional Automated Preclearance System.
June 1996	Oregon Trucking Associations (OTA) endorse the program.
July 1997	ODOT selects TransCore as the transponder administrator
October 1997	The 1st of 21 sites (Woodburn Port-of-Entry) opens
December 1997	OTA withdraws support because of reports that ODOT is giving serious thought to mandating the use of transponders and concern they intend to use the system for enforcement and collection of the weight-mile tax.
January 1998	ODOT indicates that their consideration of mandating transponders is very tentative.
January 1998	Advantage CVO and MAPS agree to make their systems full interoperable.
March 1998	Tennessee joins HELP program (PrePass), ACVO & MAPS sign agreement
April 1998	In an interview for ITS America, Joe Crabtree of ACVO indicates that ACVO/MAPS will not retain data on electronically processed trucks that isn't retained on manually processed ones.
June 1998	OTA restores its support for the Green Light program.
June 1998	ODOT announces its "Trusted Carrier Program" to recognize exemplary carriers participating in Green Light. The program starts in August.
June 1998	At a western region CVO mainstreaming conference, Dick Landis (president of HELP) is quoted as saying that HELP is concentrating on marketing and deployment and that interoperability wiith other systems was not their primary focus.
July 1998	It is announced that ACVO & MAPS are considering a merger.
December 1998	In response to requests from several PrePass carriers, Oregon enters their transponder codes in the Green Light system. PrePass ends Oregon a litigationwarning letter. Oregon agrees to suspend processing PrePass carriers pending a meeting with PrePass. A ruling from Oregon's Dept. of Justice indicates that there is no cause for action. Oregon does not continue to process PrePass carriers.
May 1999	Legislation to repeal Oregon's Weight-Distance tax is introduced. This was subsequently approved but not implemented because of a ballot measure introduced by AAA of Oregon opposing the changes.

August 1999	Oregon joins NORPASS, a merger of ACVO and MAPS states. NORPASS has a similar business model to Green Light – carriers pay a $45 annual fee and are not charged any subsequent fees. NORPASS is seen by some as a significant challenger to PrePass whose business model is to charge their carriers 99 cents per pass basis, up to 4 passes per day.
October 1999	The board of HELP Inc. develop an interoperability policy for the Use of Carrier-Owned and Third Party Transponders Within PrePass, The dominant feature is that a carrier cannot be enrolled in PrePass without the transponder owners permission
January 2000	Oregon withdraws from NORPASS after the other member states vote to accept a on-way interoperability agreement with PrePass. The agreement allows PrePass qualified carriers to be processed at PrePass sites for the same user fees assessed PrePass carriers. As yet no provision is made for PrePass carriers to be processed at NORPASS sites. Oregon's withdrawal is because the agreement violates its principle that transponder users do not need permission of the owner to use their transponder in another system.
February 2000	Oregon ends its contract with TransCore and assumes all aspects of administration of the Green Light program. Ownership of transponders is given to carriers already enrolled in Green Light, i.e. almost 5,000 transponders. ODOT will distribute another 7,500 transponders to carriers free of charge.
April 2000	It is announced that Florida and PrePass will sign a tw0-way interoperability agreement allowing PrePass carriers to be processed at NORPASS sites and vica versa.
April 2000	By the end of April, ODOT has distributed all of the 7,500 transponders and several more. They will continue to do so at no charge until 25,000 Green Light transponders are enrolled.

3.3 DISCUSSION OF KEY ARTICLES AND EVENTS

The background to and path towards two-way operability are well described in a series of three articles in "ITS World" by Jonathon Slevin. The first article (reference 81) explains the two different business models that have emerged in the automated pre-clearance field. One is the public/private approach used by NORPASS with infrastructure financed by public funds, a private transponder administrator funded by annual fees ($45), and, no fee for each preclearance received. Since withdrawing from NORPASS, Oregon's Green Light program is funded totally by a public agency. The other model is a totally private operation with no annual fees, but a cost per clearance of 99 cents with a maximum daily cost per truck of $3.96.

Slevin points out that there is a lot at stake as well as different philosophies. He indicates that the investment to date in the PrePass infrastructure may be as high as $80 million. Similarly, the NORPASS states have invested considerably; Oregon alone has spent $25 million on Green Light. The revenue for PrePass depends on the number of trucks enrolled, number of PrePass sites and number of daily preclearances. PrePass currently has about 129,000 trucks enrolled (May 29, 2000 form their website at: PrePass.com). Based on Oregon's experience with the number of monthly preclearances when the number of transponders was at a near steady state, PrePass revenues are estimated at about $1 million per month. Revenue will be much higher as market penetration grows. At stake for the NORPASS states and Oregon are principles regarding how they regulate trucking and how they invest public funds. In Oregon's case, they believe that they have the right to read any transponder that passes a Green Light site – a transponder is an electronic license plate. If the transponder user wishes to be enrolled in Green Light they should have that right (for an annual fee, currently zero) and have the opportunity to be cleared each time they pass a Green Light site. Oregon believes that their carriers be able to receive preclearance when operating in another system, if the carrier is willing to pay whatever fees apply. There is currently an impasse between Oregon and PrePass because even though Green Light carriers now own their transponders, PrePass will not enroll them.

In Slevin's second article (reference 92), he continues the analysis of the two business models. He indicates that some carriers are resistant to the PrePass model, and, that some major companies, notably UPS, have dropped out. A UPS executive indicated that they considered the cost per pass as another tax, with the profits going to Lockheed. UPS is a member of NORPASS and Green Light. Slevin poses the question, "Why pay up to $4 per day when you can get the same service for $45 a year"? He goes on to say that to protect their customer base, PrePass had to drive a wedge between the trucking industry and the competition, i.e. they set out to discredit the Green Light program and Advantage CVO program led by Kentucky. In Slevin's words:

"The pitch goes something like this. "This is a great technology. Your drivers are screened without stopping. It saves time. You can't trust the states, especially Oregon and Kentucky. If you let them have all this electronic data about your business operations, you're going to expose yourself to increased enforcement. And better tax collection. You'll be penalized just for trying to be more efficient. But don't despair. We've got the solution. In the PrePass program, we control the data."

As a result, according to a state official who asked not to use his names "There are carriers who say, 'I have nothing to hide.' Others are sold on the Big Brother issue and don't trust government. They flock to HELP."

Oregon and the NORPASS states have consistently stated that they do not use the electronically collected data any differently to data collected maunually at their weigh stations. Slevin also includes the following quote from the president of the Georgia Motor Truck Association:

"We see providing electronic clearance as a technological advance in the duties of the state. We don't think carriers should pay extra to use it. Use should be voluntary. And we believe the data should be protected. It needs to be destroyed, and they need to collect the same data electronically that is collected manually—no more. Kentucky fits our policies," said Crowell. "PrePass does not."

In his third and final article (reference 93), Slevin further examines the two models and reviews how the public sector countered PrePass, first by lining everyone up beheind the principle of interoperability, then forming NORPASS, and, finally bringing Lockheed to the negotiating table. This did lead to the one-way interoperability agreement between PrePass and NORPASS, but caused Oregon to withdraw from NORPASS.

Since the publication of Slevin's third article, more progress has been made towards two-way interoperability agreements. To date, only Florida and PrePass have formed such an agreement. Other positive factors have also occurred, such as the demise of Oregon's weight-mile tax that further diffuses any discomfort that Oregon and out of state trucking companies may have with regard to the use of data by ODOT. However, there is still much to be done before the two business models can be totally reconciled.

Throughout the arduous process described above, the USDOT has been notably passive in their involvement. As noted in the bibliography (reference 109) their approach has been that this is a public issue, and, different needs and ideas need to be debated in an open and public environment. They have taken some leadership in the development of a so-called "sandwich" transponder. However, many of those involved in the interoperability conflict would like to see the DOT more involved.

4 CONCLUSION AND RECOMMENDATIONS

4.1 CONCLUSIONS

The discussion in chapter 3 is weighted heavily towards interoperability issues, because those issues have proved to be significant in delaying market penetration of mainline pre-clearance technologies. On the other hand, mainstreaming has proceeded in a steady and non-controversial way. The literature supports this conclusion; there are many articles that report on the widespread adoption of the technologies.

It is clear that achieving interoperability between different programs is very difficult. Even the MAPS and Advantage CVO states (with very similar business models) took four years from the start of Green Light to form an agreement.

Although a one-way interoperability agreement was reached between NORPASS and PrePass, it was unsatisfactory to Oregon, and, caused them to withdraw from NORPASS. Green Light carriers are still interoperable with NORPASS (they must pay the $45 enrollment fee) and, NORPASS carriers operate in the Green Light system free of charge. As yet, no satisfactory agreement has been reached between Green Light and Prepass for one-way interoperability.

A positive outcome of Oregon's withdrawal from NORPASS is that it transferred ownership of transponders to the carriers, and, distributed an additional 7,500 transponders in three months. There are now 12,500 trucks equipped with Green Light transponders. This is half their original target, but, considering the current progress, they could reach their target before 12/31/2000.

A satisfactory compromise needs to be reached between Oregon and PrePass before interoperability can be achieved. Oregon should hold to its principles, which are endorsed by other states and by many in the trucking industry. However, they will likely need to compromise, but, only to the degree to which their customers agree. The major principle is regarding HELP's limitation of the use of PrePass transponders.

An issue for many Green Light carriers is the fee structure used by PrePass. However, the market will determine if carriers are prepared to pay PrePass's fees. At this time (May 31, 2000) two Green Light carriers have enrolled in PrePass and pay on a per pass basis. PrePass may need to introduce alternative fee schedules to attract a diverse range of customers.

A longer term issue is reaching an interoperability agreement that will enable PrePass carriers to operate in Green Light. At this time there is an impasse with regard to PrePass obtaining some cost recovery as well as protecting there carrier's data privacy. However, there are several examples of PrePass carriers that have requested enrollment in Green Light (and NORPASS) and have been refused by PrePass. Carriers can enroll in each system seperately and obtain a transponder for each, but, there are problems when a truck has two transponders in the cab. Since the Green Light and PrePass transponders are the same, this situation is unnecessary!

4.2 RECOMMENDATIONS

Oregon has been very successful in the distribution of transponders since opting to withdraw from NORPASS and the consequent decision to act as their own transponder administrator. The two significant changes that Oregon introduced (as the administrator) were: a) transferring ownership of transponders to the carrier, and, b) providing new transponders at no cost. At this time (May 31, 2000), 12,500 transponders have been distributed. Another 12,500 will be distributed free of charge, before a carrier must purchase their own transponder. It is strongly recommended that ODOT continue the successful practice of targeting those carriers that would benefit the most from mainline pre-clearance, i.e. those that operate most in the Green Light corridors. To date carriers operating the most in the I-5 corridor in the Woodburn area have been targeted. ODOT should next target the carriers operating in the other corridors.

It is likely that 25,000 transponders will be distributed by the end of December, 2000. The state should consider continuing free distribution of transponders. A market survey may be appropriate to guide this decision. It is certainly likely that those enrolled in the program would be willing to pay (if they had to do over) but enrolling new carriers will become difficult at some point. Removing the best incentive (free transponders) may halt the rapid progress that has been made in market penetration.

5 REFERENCES

1. Bell, C.A., B. McCall, and, C.M. Walton, “Oregon Green Light CVO Evaluation – Detailed Test Plans”, GLEV9603, Oregon State University, Transportation Research Institute, March 1997.

2. Bell, C.A., B. McCall, and, C.M. Walton, “The Oregon ‘Green Light’ CVO Project, Evaluation Plan”, GLEV9601, Oregon State University, Transportation Research Institute, September 1996.

3. Bell, C.A., B. McCall, and, C.M. Walton, “The Oregon ‘Green Light’ CVO Project, Individual Test Plan”, GLEV9602, Oregon State University, Transportation Research Institute, October 1996.

APPENDIX A

ANNOTATED BIBLIOGRAPHY – INTEROPERABILITY & MAINSTREAMING (NOTE: I'm still in the process of editing this; some articles will be deleted, others added, some changed & then I'll separate into Interoperability and Mainstreaming)

No	Date	Author	Title	Publication	Summary
1	Jul-96		Trucking Assssociation Supports Oregon DOT's ITS/CVO Plan	ITS World	The first public endorsement from a private trucking association has been given. On June 10th, Michael Meredith, president of the Oregon Trucking Associations formalized OTA's support of ODOT's plan for integrating automated weigh-station bypass and other advanced technologies throughout the state.
2	Mar-97	Michael Meredith	Focus on ITS: There's No Devil In The Data	Northwest Transporter	The Oregon Department of Transportation (ODOT) introduces new technology to streamline trucking, the issue of data confidentiality looms like one mountainous obstacle. It's really just a molehill.
3	May-97	Bill McGarigle	Trucking into the Future	ITS World	The Connercial Vehicle Information Systems and networks (CVISN) program – which is as much about old fashioned cooperation as it is about advanced technologies – is already making strides toward its goal of **nationwide interoperability** and efficiency for motor carrier regulation.
4	Jul-97		Oregon Selects Transponder Administrator.	ODOT News Release	The ODOT is announcing the selection of a contractor to market and distribute transponders to motor carriers participating in a weigh station bypass program. TransCore and Northwest Transporter, Inc. has been selected.
5	Jul-97	Wayne Hansen	Oregon Keeps Trucks Rolling On Interstate.	Government Technology.	Oregon's highways now have fully automated truck-weighing stations, which integrate computer databases, automated vehicle identification and weigh in motion systems. The state is already planning to weigh trucks at fully highway speed.
6	Dec-97		OTA holding off on support of Oregon Green Light project	Express Weekly Hot-sheet for Oregon Trucking Associations' Members, 12-8-97	In response to reports that ODOT is giving serious thought to mandating the use of transponders, OTA's board voted that OTA could not support the Green Light project until OTA staff can work with ODOT staff to ensure their direction is consisitent with the original goals of ITS. OTA's concern is that ODOT intends to use the system for enforcement and collection of the weight-mile tax.

7	Dec-97		Director reveals about-face agenda for ODOT Green Light project	OTA Press Release, 12-18-97 & Express, 12-22-97	In a follow-up to the item above, OTA reiterated their opposition to mandatory transponders. The article indicates that Grace Crunican (ODOT Director) told reporters that mandatory transponders could reduce weight-mile tax evasion that could equate to $120 million in revenue. The OTA subsequently restored its support for the program in a June 1, 1998 letter from Mike Meredith to Grace Crunican. Meredith refers to 4 principles developed by OTA's ITS/CVO committee – the 1st calls for a 3 yr moratorium on mandatory transponders.
8	Dec-97	Jim Brock	Woodburn system makes weigh station stops a thing of the past	Motor Carrier News, ODOT & ODOT News Release, 10-29-97	Beginning October 29 it became possible for trucks at Woodburn to be weighed in-motion by scales installed under the roadway about one mile ahead of the weigh station on southbound I-5. Trucks with a palm-size electronic device (a transponder) mounted on the windshield can be automatically identified and sent a green light signal if they pass a quick computer check of records related to registration, safety, and truck size and weight requirements. The system sends a red light signal back to the transponder if the truck must pull in as usual. The system is the first in the world capable of weighing, identifying, and sorting truck traffic over two lanes. It is the first of 22 such sites that will be automated in the next two years in a modernization program called the Oregon Green Light Project.
9	Jan-98	Roger King	Oregon Eyes the Transponder as a Tax Device	Transport Topics Jan/Feb 1998	Oregon lawmakers are considering legislation to require truckers to use a windshield-mounted transponder in order to improve tax enforcement. An ODOT spokesperson indicated that the idea is very very tentative.
10	Jan-98		Oregon DOT Gives Away Free Transponders	Heavy Duty Trucking.	In an otherwise factually correct article, it was incorrectly stated that ODOT would giveaway 10,000 transponders. A similar article appeared in the Dec-97 edition of Truckers News. Randal Thomas of ODOT responded to both publications to provide accurate information.
11	Jan-98		Runaway success for IRD	ITS International	IRD has won new orders for its Downhill Truck Speed Warning system which is credited with reducing truck runaways by a quarter on America's most treacherous Rocky Mountains truck route, the I-70 west of Denver. Oregon DOT is installing a pair of systems at Emigrant Hill on I-84, and these will be integrated with the Green Light system. West Virginia has also ordered a system.
12	Jan-98		Advantage CVO, MAPS agree on ITS/CVO interoperability	ITS WORLD Jan/Feb 1998	Members of ACVO and MAPS have agreed to make their systems fully interoperable. A draft agreement lists 8 common goals, including that both programs will suppoirt the CVISN effort to develop an open national information system architecture and common data exchange standards.

13	Feb-98		Transponders could be replacing PUC stickers.	Log Trucker	The Oregon Department of Transportation (ODOT) is looking at replacing PUC stickers with mandatory transponders. With transponders, a truck's movements would be recorded electronically and provide auditors instant access to weigh/mile tax reports.
14	Feb-98	Richard Scrase	Weighty Matters	ITS International	Weigh-in-motion systems are commonly used in Europe and the USA, and their use is presently being extended to Asia. The author reports on the use of weigh-in-motion equipment in Hong Kong.
15	Mar-98		ODOT Develops, legislative proposals for 1999 Session.	Northwest Transporter	ODOT's Motor Carrier Transportation Branch has developed several legislative concepts it hopes to introduce as legislature during the 1999 Legislative Session. Included is an initiative to offer a 2% discount of weight-mile taxes to any carrier that equips the majority of its fleet with transponders for use in the Green Light preclearance program.
16	Mar-98		Tennessee Joins HELP Program; Advantage, MAPS Sign Agreement	Inside ITS	Citing economic reasons, the State of Tennessee, a member of the state-sponsored Advantage CVO electronic preclearance program, has joined HELP. Tennessee is the first member state east of the Mississippi that will deploy the PrePass system and the only state to be a member of both Advantage CVO and HELP, but probably will choose only one program in the future. **The situation gives greater urgency to the issue of interoperability between the two programs** **A similar article was in Transport Topics 3/2/99.**
17	Mar-98	Joe Crabtree & Alan Frew	State partnerships join hands to streamline truck regulation.	Advantage CVO - News Release Also in: Transcipt, ODOT's monthly Newsletter, 4/98	Two of North America's premier partnerships for automated screening of commercial vehicles at weigh stations have taken a gigantic step toward seamless motor freight movement in Canada and the United States. **The Advantage CVO Partnership and the Multi-jurisdictional Automated Preclearance System (MAPS) have signed an agreement to provide interoperability to their customers in the trucking industry.**
18	Spr-98		Q & A with Joe Crabtree	ITS America CVO UPDATE	In an April 1 interview Crabtree elaborated on the interoperability agreement between ACVO and MAPS. He indicated that each entity would publish their policies on how system data would be used and that this would be based on the curent approach – they will not retain data on the electronically processed trucks that isn't retained on the manually processed ones.
19	Mar-98	A.T. Bergan, Brian Taylor, Bob Bushman & Nancy Pon	Keep On Trucking: Safer commercial traffic with ITS	Traffic Technology International	Truck drivers, many of whom travel long haul and cross-continent, are susceptible to fatigue-related conditions, such as speeding and lack of attention.

20	May-98	A.T. Bergan, Les Bell, and, Rebecca Negere	Technological Aspects of the Partnership Program Audit	Transportation Association of Canada, Proceedings, 1998 Annual Conference	International Road Dynamics is designing and providing a vehicle tracking system to audit Saskatchewan Highways and Transportation's current Partnership program. The proposed system uses GPS satellite technology to automatically locate and track vehicles, and, will enable the highway authority to invoice road users for the distance traveled.
21	May-98		Weigh Stations made easy - The Oregon Green Light Program embraces transponder technology	Northwest Transporter - Summer 1998	The new Commercial Vehicle Information Systems and Networking (CVISN) system is using technology to pave the way to easier and more cost-efficient trucking. New high-tech devices called transponders are mounted inside truck windshields. The transponders can save each trucker up to 5 minutes per weigh station.
22	May-98	Anita Curnow.	States of Weight: Developments In Weigh-in-motion Applications	Traffic Technology International	It is estimated that one overloaded axle causes more road damage than half a million cars. This alone should be enough to spur use of integrated weigh-in-motion (WIM) technology.
23	May-98	Jim Brock	Road & Weather Sytem takes shape	NETS NEWS – ODOT's Safety Section News	By Winter 1998, ODOT plans to provide Internet access to real-time information from a statewide network of monitoring devices. The Road and Weather Information System (RWIS) will report everything a traveler needs to know before setting out across the state. Information will first be available form 12 sites over the Internet. Eventually information kiosks will be stationed in rest areas and truck stops. The concept of a RWIS was introduced as part of the Green Light project but it promises more widespread benefits for the traveling public.
24	May-98	Michael Rose	State's use of truck transponders on shaky ground	The Business Journal, May 8	The article reviews the misunderstanding between the Oregon Trucking industry and ODOT over "mandatory" use of transponders. Director Crunican is quoted as saying that the industry "jumped to the wrong conclusions" whenthe agency discussed various ways to increase transponder use. She recently informed the industry in writing that ODOT will not push for a mandatory program. See also references 6 & 7.
25	Jun-98		Oregon Recognizes its Most Trusted Motor Carriers.	Transcript – ODOT's Monthly Newsletter & Motor Carrier News	ODOT' s Motor Carrier Transportation Branch is ready to issue new "Trusted Carrier Partner." License plates that distinguish the most exemplary carrier taking part in the Green Light weigh station preclearance program.
26	Jun-98		Accident and Inspection can be accessed by anyone.	Motor Carrier News, ODOT	Carrier safety fitness info available on the Internet at: http://safersys.org/ anyone having trouble finding information about a carrier can contact MCTB staff at (503) 378-6166.

27	Jun-98		CVO Conference Sparks Discussion of Path to Interoperability	Inside ITS	A western region CVO mainstreaming conference provided a forum for the status of interoperability. Richard Landis, president of Help is quoted as saying that Help is concentrating on the marketing and deployment of its preclearance system and that interoperability with other systems was not a primary focus. Other partcipants expressed their disappointment. Joe Crabtree of ACVO indicated that he was not surprised and said, " I think it is fairly clear that interoperability is not a priority to them. You don't need to worry about interoperability if your goal is to be the only system". Landis indicated that interoperability needs to be discussed and worked on, but that present discussions are academic.
28	Jul-98		Green Light Transponder Update	Express Weekly Hot-sheet for Oregon Trucking Associations' Members.	Oregon DOT's 1998 schedule for bringing Oregon ports of entry and scales on-line for transponder pre-clearance is provided. Contact information is also provided for carriers interested in enrolling in the Green Light program.
29	Jul-98		ACVO, Maps Consider Merger; Help meets ACVO in Tennessee	INSIDE ITS	Advantage CVO and Maps aim to eliminate institutional barriers by eliminating separate institutions. Effort geared to make electronic screening simple for users to understand and interact with. This article reports on the early merger discussions between ACVO and MAPS. The article also reports that a meeting has been scheduled between ACVO and HELP Inc., to begin working on details of interoperability.
30	Sum-98		Revised: Fair Information Principles for ITS/CVO	ITS America CVO UPDATE	ITS America's CVO Policy Subcommittee revised its Fair Information Principles for ITS/CVO at its summer meeting on June 17 in Washington, D.C. Yhe subcommittee also continued work on developing a **national interoperability policy.**
31	Aug-98		Weigh Stations Offer Automatic Checks	Corvallis Gazette-Times, Oregon.	The state Department of Transportation truck weigh station is open 24 hours a day along this busy stretch of Interstate 5 in the farmland between Portland and Salem, but many truckers are cruising past without even slowing down. The only incentive Royce Young of Total Transfer and Storage in Woodburn needed came from a calculator. He signed his company's nine-truck fleet up and figures he's saving hundreds of dollars a week.
32	Aug-98	James Sinks	Truckers Welcome Express Service: Plan saves state money, trucker time	Salem Statesman Journal, August 22, 1998	A $25 million new weighing method is in the works. In a similar article to that above, the Green Light program and the Trusted Carrier Program are described. Royce Young of Total Transfer (one of the first four trusted carriers) figures he's saving hundreds of dollars a week from time saved bypassing the Woodburn Port-of-Entry – Total Transfer operates 9 trucks that may pass the PoE upto 3 times a day.

33	Aug-98	Mac McGowan	Oregon DOT Inaurates New License Plate Honoring Safe Truckers	ODOT Press Release	Oregon introduced the Trusted Carrier Partner Program on August 5, 1998. The new program will enable inspectors to concentrate on trucks that are less likely to have good safety records. The first four companies to earn the new designation were announced: Best Foods Baking Co., BiMart Corp., Distribution Trucking (Fred Meyer), Total Transfer.
34	Aug-98		ODOT to honor "Trusted Carriers"	Express, Weekly Hot sheet for Oregon Trucking Associations' Members.	See previous article
35	Oct-98		Oregon DOT to Issue Plates Identifying "Trusted Carriers"	The Guardian	The Oregon Department of Transportation (ODOT) is ready to issue "Trusted Carrier Partner" (TCP) license plates that identify the best motor carriers participating in Oregon's Green Light weigh station preclearance program.
36	Oct-88	S. Lawrence Paulson	National ITS Architecture	PUBLIC ROADS Sep/Oct 1988	The article provides an excellent overview of the ITS architecture. It indicates that the architecture was developed for DOT by a combined Lockheed Martin and Rockwell International team that used resources from the public and private sectors and from academia. It was completed in June 1996 after nearly 3 years of effort. The article concludes with a quote from a previous Public Roads article by Lee Simmons, "The architecture is the framework that makes possible a national infrastructure of integrated, intermodal, and, interoperable ITS. As such, its development is the cornerstone achievement of the national ITS program."
37	Oct-98		Weigh Station By-Pass: The future is here!	Northwest Transporter, Fall/Winter 1998	Most of the trucks just keep rolling and rolling on down the highway escaping the need to stop at redesigned automated weigh stations along interstate highways.
38	Oct-98		ODOT Automates Operations At Woodburn Port of Entry	News Release from Oregon Department of Transportation.	Several of the trucks that used to pull in for routine weighing and inspection are now cruising by the highway speed because of a new automated system installed by the ODOT.
39	Oct-98		New System takes wait out of weighing	Klamath Falls Sunday News October 4, 1998	The transponder, a small pager-like device that sticks to the inside of the windshield, triggers a set of scales hidden beneath the roadway, allowing trucks to be weighed and certified without the hassle of stopping at a weigh station.
40	Dec-98		Dispute could force jerry-rigged standards for transponders	Transport Topics Dec 21, 1998	There is more than one system on the market, but a single communication standard that would make all transponders "interoperable" has eluded private industry and the government is under pressure to step in and dictate a solution. That kind of intervention could result in a Jerry-rigged standard that could fall short of expectations for compatible transponder systems warns Mike Onder, coordinator of the FHWA's Joint Program Office for Commercial Vehicle Operations.

41	Dec-98	David LeFort	Sparring Over Transponder Codes	Transport Topics Dec 28, 1998	HELP Inc. said that the ODOT's Green Light program has obtained its transponder codes without permission. The Oregon Green Light Program, a state-backed transponder service administered by SAIC has acquired codes to allow PrePass drivers to operate within the state. In a Dec. 10 letter to ODOT, HELP asked them to immediately stop using PrePass codes and laid down measures for the state to follow to assure compliance. Gregg Dal Ponte of ODOT indicated the letter was forwarded to the Oregon Department of Justice for response
42	Jan-99	David Lefort	Truckers Caught in Transponder Dispute	Transport Topics January 18,1999	This article expands on the previous one and indicates that the dispute has prevented some truckers traveling through Oregon from using the in-cab devices that help ease their trip. Though both sides have expressed a desire to reach a settlement, they have yet to meet to work out the details. Oregon has agreed to suspend enrolling PrePass carriers until they can work out a settlement with HELP Inc.
43	Jan-99	David Lefort	Transponder Services to Hold Talks	Transport Topics Jan 25, 1999	Executives from two disputing transponder providers have agreed to work on a deal that would allow truckers to use the in-cab devices in both service zones. HELP Inc. will hold negotiations with the Oregon Green Light program on Feb. 11.
44	Jan-99	Jason Cisper	Electronic Scale Bypass Programs	Land Line Dec 98/Jan 99	The article compares the PrePass system of HELP Inc., and the soon-to-be-merged MAPS and ACVO systems.
45	Jan-99	Jason Cisper	Trusted Carrier Partners – Exemplary or Arrogant?	Land Line Dec 98/Jan 99	The article describes ODOT's trusted carrier program and includes comments from Jim Johnston, President of the Owner Operator Independent Drivers Association (publisher of Land Line). Johnson claims that the program is an effort to force the industry to accept electronic screening for the purpose of tax collection and enforcement. James Brock of ODOT indicates that the state is simply doing electronically what it has always done manually.
46	Jan-99		Overheight Detection, Safe, Fast, And Easy to Install	Sensor Technology "TODAY"	SAM-S offers optimum performance at an extremely low price for the detection of overheight vehicles approaching tunnels, bridges, etc.
47	Jan-99		Safety Check - Inspector sees tremendous growth in truck traffic but not in accidents	The Observer, La Grande, Oregon	One Woodburn trucking firm has estimated that it costs roughly $1.15 every minute a truck is running, whether it is on the highway moving, or broken down somewhere. That cost is also there for the time spent waiting in an inspection line - a big reason ODOT has put together a variety of programs to help smooth the flow of merchandise around the country.
48	Jan-99		Motor Carrier Transportation Trusted Carrier Partner Program	Transcript – ODOT's Monthly Newsletter	The Trusted Carrier Program, initiated last June, frees vehicles with exemplary safety records from routine inspections.

49	Feb-99		DOT Settles on Standard for Transponder Link	Transport Topics February 1, 1999	A national standard for transponders and other short-range radio communications moved a step closer to reality last week when the Department of Transportation announced it would promote a "sandwich protocol" for guiding the design of the technology, despite objections from some equipment makers. The Sandwich protocol includes three standards that together would dictate transponder design. It would combine already approved standards for application, messaging and radio transmissions plus specifications that the American Society for Testing Materialized has developed for date linkage, called the "ASTM Version 6." Congress is pressuring DOT to move ahead with a single national standard.
50	Feb-99		Pursuing the Universal Transponder Standard	Transport Topics February 22, 1999	There has been little resistance to the DoT's recent decision to promote a national standard for transponders and other short-range radio communications equipment. But that doesn't mean the Jan. 28 announcement that the department would promote a "sandwich protocol" a system that operate on multiple frequencies as the basis for this standard has not raised questions in trucking and other industries.
51	Mar-99	James L. Brock	Green for go: Oregon Embraces WIM, Pushing Interoperability	Traffic Technology International Feb/Mar '99	The northwestern state has arguably the country's most ambitious highway infrastructure modernization effort underway.
52	Mar-99	Bob Lees, Diamond Consulting, Peek Traffic and Michael Pietrzyk	Loops Over The Treadle	Traffic Technology International	Developers of the branded Idris loop algorithm are applying the software enhancement to new application areas.
53	Mar-99	Bill McGarigle	Trucking Into The future	ITS/CVO	The Commercial Vehicle Information Systems and Networks (CVISN) program, which is as much about old-fashioned cooperation as it is about advanced technologies, is already making strides toward its goal of nationwide interoperability and efficiency for motor carrier regulation.
54	Mar-99		Green-Light Objective	Traffic Technology International	One of Green Light's objectives is to establish a preclearance system that can be integrated with every other ITS system in the country.
55	Apr-99		HELP pulls the plug on PrePass transponders in Green Light system	Motor Carrier News, ODOT	HELP, Inc., has ordered Oregon to remove all PrePass transponders from the Green Light weigh station preclearance system until it receives some kind of compensation for their usage.
56	Apr-99	Tom Kelley	PrePass Heads East	ITS World	With deployment along the U.S.'s I-40 corridor nearly complete, weigh-station bypass transponders are seeing expanded use. PrePass, the US's first commercially available weigh-station bypass service was originally installed in California 1-5 scale houses in June of 1995, subsequently branching to arizona, New Mexico, Oregon and Wyoming. Oregon subsequently dropped out. The article continues to give a good summary of the first 4 years of PrePass.

57	May-99		PrePass processes record number	Overdrive Online	For the first time since the system was launched in 1995, PrePass processed more than 100,000 trucks in one week.
58	May-99		Regional Rap - Oregon	The Guardian: Commercial Vehicle Safety Alliance (CVSA)	The Green Light Project is ahead of schedule modernizing Oregon weighs stations with weigh-in-motion and automatic vehicle identification readers that allow safe and legal trucks to proceed past them at highway speed.
59	May-99		Adding Up Oregon's Weight-Distance Tax Repeal	ATA Truckline: Transport News From Around the World	Legislation to repeal Oregon's weight-mile tax has been introduced in the state's General Assembly.
60	May-99		Road And Weather Information System Takes Shape.	Nets News.	Soon motorists interested in Oregon road and weather information will have easy access to far more than just a picture of conditions at couple sites such as: http://www.odot.state.or.us
61	Jun-99	Amy Zuckerman	In Pursuit of the Elusive Transponder Standard	Transport Topics	Business and Technology Debates weigh Electronic Clearance Under. The debate over on highway electronic clearance of commercial trucks has broken down into two major turf wars: the public versus private sector and the other arena is technology.
62	Jun-99	Randal Thomas	Transponder Debate, in Letters & Comments	Transport Topics	Oregon's preclearance systems collect no more information that is used for audit or enforcement purposes than what is already being manually obtained at static scales.
63	Jul-99	North American Preclearance and Safety System	States From ACVO, Maps Poised To Join New Bypass Program	Inside ITS	Prior to legal existence, NorPass is being promoted by TransCore, its transponder administrator. Six states will be initial members of non-profit organization. Sates will pay annual dues and carriers will pay annual fee for transponder registration and unlimited use. Meanwhile Illinois becomes the 15th state to deploy HELP's PrePass system. Approximately 80,000 PrePass tags now in use.
64	Jul-99		Oregon Senate OK's Gas Tax Bill	Transport Topics	Senators objected to parts of the 5-cent-a-gallon gas tax hike package, including a provision to repeal the weight-mile tax that's imposed on commercial trucks in lieu of a gas tax.
65	Jul-99	Kelvin Knight	Knight Transportation Opens PrePass Account	Transport Topics July 19, 1999	Knight, of Phoenix, will install the system in its entire western fleet and make it available to owner-operators working with the company.
66	Jul-99	Rodney E. Slater	Critical Standards	ITS AMERICA	Intelligent Transportation Systems: Critical Standards, as required by the Transportation Equity Act for the 21st Century (TEA-21)
67	Jul-99		Iowa Scheduled To Roll Out New Scales	Transport Topics July 29, 1999	Construction of the automatic scales has begun, and the new technology will be in use by the end of November. The new scales will weigh trucks at highway speed. Message signs will direct those suspected of being in violation of state weight and safety rules will be directed into the weigh-stations
68	Jul-99	Joseph R Cal, Northern Transportation Systems, USA.	Collector's Item: Site Selection And Piezo Sensor Uniformity"	Traffic Technology International	Without a smooth road surface and a uniform sensor, accurate traffic data collection is all but impossible. However this doesn't prevent these two essential elements from being overlooked. A senior traffic engineer has some helpful hints.

69	Jul-99		US DOT's hour Of labour	Traffic Technology International	The US Department of Transportation's Federal Highway Administration intends to award a multiyear labor hour contract to the Mitretek Corporation for technical support of the ITS JPO Operation Business unit.
70	Jul-99	Larry Yermack	Commercial Tolls In Favor	Traffic Technology International	Major toll agencies and other organizations have indicated broad but conditional support for a plan to process commercial vehicles electronically at tolls nationwide regardless of what type of transponders the trucks carry. The concept of an interoperable nationwide system is "an idea worth pursuing", says Larry Yermack, summarizing the general feelings of the 115 attendee's of a meeting.
71	Jul-99		Electronic Credentialing off to a Slow but Hopeful Start.	Transport Topics	Considerable savings expected once carrier-state computer link is established.
72	Aug-99		MCTD to begin citing truck drivers entering Oregon without credentials	Motor Carrier News, ODOT	Truck drivers entering Oregon without operating credentials issued by the Oregon Department of Transportation are subject to citation and a maximum fine of $250.
73	Aug-99		Fees to yield bulk of what is now collected by weight-mile tax	Motor Carrier News, ODOT	Oregon truckers will soon see new registration fees that are set to replace most of the revenue now collected by weight-mile taxes. The annual fees will begin July 1, 2000 and increase again in January 2002. The article provides details about the new fee schedule.
74	Aug-99		Weigh station preclearance interoperability now possible for some	Motor Carrier News, ODOT	At a meeting in July, HELP, Inc. officialls agreed to let carriers with Green Light transponders use them in the PrePass system. But they would not authorize the use of PrePass transponders in Oregon. They have not determined what they will charge for using a Green Light transponder at a PrePass station.
75	Aug-99	Daniel Whitten	Landstar Goes With PrePass System	Transport Topics Online, 8/6/99	Owner-operators hauling for Land-star System will soon be breezing past certain weigh stations without having to stop for credential checks, thanks to the Jacksonville, Fla.-based truckload carrier's enrollment in the PrePass program. Landstar will install transponders in 8,500 trucks and will pay a 10% discounted rate of 90c per pass after receiving the first month for free.
76	Aug-99		Landstar Provides PrePass to its Independent Drivers.	Transport Topics August 30, 1999	PrePass, a service offered by HELP Inc., enables drivers to comply with weigh station requirements electronically clearing them more quickly and reducing congestion around weighs station. The company handed out the devices for installation in 8,500 trucks.
77	Aug-99	Jeff Johnson	Repeal Of N.Y. Ton-Mile Tax Fails	Transport Topics August 23, 1999	The New York Legislature adopted a budget, but elimination of the state's ton-mile tax on trucking was not part of the package.
78	Aug-99		Oregon Joins NORPASS Group Of States	Transcript, ODOT's monthy Newsletter	Oregon will join the North American Preclearance and Safety System, also known as NORPASS, Inc. NORPASS states all use similar weigh station technology based on AVI equipment mounted at the roadside, and Hughes-Delco type transponders mounted inside truck cabs.

79	Aug-99		Now, big rigs can weigh in on the fly	The Bulletin	In Madras, the idea of being weighed while zooming down a highway at 55 mph might not appeal to most folks. But to trucking bosses like Scott Porfily of Prineville, it's time - and money - in the bank.
80	Aug-99		Truckers Welcome Express Service	Salem Statesman Journal, Aug-22	A new $25 million program from the state Department of Transportation allows many truckers to zip past Oregon's 22 weight stations without hitting the brakes. That translates into saving for truck drivers, who can avoid waits as long as 20 minutes during peak traffic times and potentially will save millions for the state because it won't have to expand roadside scales. The program is similar to ones developed elsewhere, including California and Canada.
81	Aug-99	Jonathan Slevin	PrePass And NORPASS.	ITS World – July/August	Throughout the country, trucks are required to pass through roadside weigh stations for weight, safety, credentials and sometimes tax collection purposes. Two different business models have now emerged for private-sector involvement in automating what has been a manual process. NORPASS has come into being because a number of states wanted it, and a private sector company, TransCore, decided that investing in this business made sense. HELP Inc./PrePass owes its origins to similar dynamics.
82	Aug-99		Norpass Inc. and the LYNX Preclearance System	Northwest Transporter	Combining the Oregon Green Light, the Multi-Jurisdictional Automated Preclearance System (MAPS), is forming NORPASS, INC.
83	Sep-99		Truckers given Green Light at Umatilla weigh station	East Oregonian Sept 1, 1999	Truckers coming into Oregon southbound on Highway 82 will soon be able to bypass the weigh station in Umatilla, thanks to the Oregon Department of Transportation's Green Light project.
84	Sep-99	Juer Kunz, Kistler Instrumente AG, Switzerland	Quartz-Based WIM Sensors	Traffic Technology International	The inherent properties of quartz make it suitable for use as a sensor material for weigh-in-motion applications. Just such a system has been undergoing cold weather testing in Sweden.
85	Sep-99	OTA	LYNX, Greenlight expand weigh-station bypass program	Oregon Truck Advisor	Seven eastern and western states have combined forces and formed the new North American preclearance and Safety System (NORPASS).
86	Sep-99		UPS Joins GreenLight Program	Inside ODOT	ODOT's Motor Carrier Transportation Division during this week they welcomed United Parcel Service to the growing list of companies using the "Green Light" program. UPS is the world's largest express carrier, serving more than 200 countries and delivering over 3 billion packages and documents a year.
87	Sep-99	James Hebe	Technology is Key to Future for Truck/Bus Safety	CVSA Conference Bits & Pieces, Portland OR	Freightliner's Hebe sees technology as key to future for truck/bus safety.

88	Sep-99	Julie Cirillo	Cirillo Stresses Data Collection Needs	CVSA Conference Bits & Pieces, Portland OR	Julie Cirillo Manager of FHWA's Motor Carrier and Highway Safety Program, stresses data collection needs.
89	Sep-99	David Barnes	No 'Silver Bullet' For Truck Safety	Transport Topics Sept 27, 1999	ODOT's David McKane interviewed at the CVSA annual meeting said,"With limited resources, it's important that we direct our enforcement resources toward the carriers with the worst safety records." The agency is encouraging carriers to enroll in Oregon's "Trusted Carrier" program, which allows trucks to be exempt from random safty inspections. Participating carriers must have a proven record of compliance with registration, safety and tax requirements. The more than 300 carriers enrolled in the program also receive transponders that allow their trucks to bypass weigh stations.
90	Oct-99		Worthington leads TranCore buyout	ITS INTERNATIONAL Online	ITS International is the leading publication for the intelligent transport systems industry.
91	Oct-99		Express carrier joins "Green Light" program	TranScript	United parcel Service is helping to ensure its trucks move more safety and efficiently in Oregon by equipping them with transponders so they won't have to stop at weigh stations.
92	Oct-99	Jonathon Slevin	Lockheed's Long March	ITS World – Sept/Oct 1999	Slevin summarizes the "battle" that pits Lockheed against a group of states. Lockheed through its non-profit subsidiary HELP Inc.,administers the PrePass program, acting as a third party between the states and the motor carrier industry. The states, led by Oregon, administer their own programs. Issues include: who owns the data, costs, and, "interoperability" - the ability of a truck to operate in any program without paying multiple times.
93	Dec-99	Jonathon Slevin	Seamless Truck Travel	ITS World – Nov/Dec	After six years of intensive effort, tens of millions of dollars in public funding and hundreds upon hundreds of meetings, a major milestone has been reached toward achieving the goal of nationwide, seamless travel for the nation's motor carrier industry. The milestone sounds simple enough: an agreement for something called "one-way interoperability" that allows trucks from one automated roadside inspection system to participate in another system. But to get there took political will strong enough to withstand a relentless attempt by Lockheed Martin IMS to own the market for privatizing and automating a number of state government regulatory processes.
94	Fall-99	Phil Hinshaw	The Green Light Program	Photo Gallery	Oregon Washington, Utah and now British Columbia are developing a scale bypass program called Green Light. Truckers Save at Least 5,000 Hours This Quarter.

95	Feb-00		HELP Inc. – NORPASS Reach Interoperability Accord Compatible Transponders to Operate Seamlessly	PrePass Press Releases February 2, 2000	An agreement was announced that carriers enrolled in the NORPASS electronic preclearance system may operate in the PrePass network. Prior to being admitted to the PrePass system, NORPASS carriers will be required to complete the same application required of all PrePass carriers. When operating within PrePass, NORPASS carriers will pay the same user fees assessed PrePass carriers and a one-time credential verification fee will be credited against future bypass usage within Prepass. A second stage interoperability agreement, in which PrePass carriers could access NORPASS sites, is the objective of both organizations and the subject of ongoing discussions.
96	Feb-00		Oregon withdraws from NORPASS	EXPRESS, A Weekly Hotsheet for OTA members February 7, 2000	ODOT has withdrawn from NORPASS following the signing of a one-way interoperability agreement between NORPASS and HELP, Inc. Oregon Green Light and NORPASS will continue to be interoperable, but Green Light operators will have to purchase a separate transponder to operate at PrePass sites.
97	Feb-00		Changes in Green Light program: transfer of ownership of transponders	Letter to Green Light carriers from Randal Thomas, program manager, February 24	Thomas's letter transfers ownership of the transponders to carriers at no cost as of 2/19/00. It also indicates that ODOT ended its contract with Transcore as of 2/19/00. ODOT will now act as transponder administrator. The changes have no practical effect on the use of transponders in Oregon or on the Trusted Carrier Partner program. As owner of the transponder, carriers should be free to use it anywhere. The letter included a copy of a 10/19/99 Interoperability Policy Resolution by the Board of HELP Inc., for the Use of Carrier-Owned and Third Party Transponders Within PrePass.
98	Mar-00		ODOT Sacks TransCore, Transfers Tag Ownership To Green Light Carriers	InsideITS	Oregon Department of Transportation says giving truckers tag ownership allows them to enroll devices in any preclearance system they desire. 5,000 tags already transferred, another 7,500 scheduled. TransCore was removed as the transponder administrator in February and ODOT says there will be no disruption of service as it assumes administrative tasks for running the program.
99	Mar-00	Erika Ohm	Lines blurred in weigh station bypass debate	Oregon Truck Advisor, Oregon Trucking Associations, March 2000	The article reviews the recent withdrawal of ODOT from NORPASS, cancellation of its contract with TransCore, and, transfer of transponder ownership to carriers. This will involve about 5,000 transponders. ODOT palns to distribute another 5,000 transponders to trucks with the most weigh station activity. ODOT withdrew from NORPASS following the signing of a one way interoperability agreement with HELP Inc. The agreement represented a compromise of Oregon's long-standing principle that transponder users do not need permission of the owner to use the transponder in another system. Giving ownership to the carriers gives them the opportunity to enroll in PrePass.

100	Mar-00	Jerry F. Boone	Green light program keeps rigs truckin'	The Oregonian March 27, 2000	The article gives a detailed description of the preclearance system at Woodburn port-of-entry. The article indicates that about 7,00 trucks are enrolled in the Green Light program. The article quotes Randal Thomas of ODOT – he said that the program and other innovations at weigh stations allow ODOT to reduce the number of people working along the busiest highways and move them onto roads that truckers use to avoid weigh stations.
101	Mar-00		Status of Oregon Green Light Program	Letter from ODOT Director Grace Crunican to Senator Mark Hatfield, 3/28/00	The letter indicates that of Oregon's 21 Green Light sites, 15 are complete and work is expected to be complete at the other six by Fall 2000. Transponders have been placed in almost 10,000 trucks. In the first two months of this year, 63,085 green lights were given to trucks that didn't need to stop at weigh stations, translating to about 5,000 hours of time saved. That number is expected to double in the coming months.
102	Mar-00	Mac McGowan	ODOT welcomes Interstate Distributor Co. to Green Light and Trusted Carrier Programs	ODOT News Release March 21, 2000	The company has equipped 900 of its fleet with Green Light transponders. It also qualifies for the TCP program.
103	Mar-00	Mac McGowan	ODOT welcomes USF Reddaway to Green Light and Trusted Carrier Programs	ODOT News Release March 27, 2000	The company has equipped 500 power units with Green Light transponders. It also qualifies for the TCP program.
104	Apr-00	Randal Thomas	ODOT Green Light Passes major Milestone: 10,000 Trucks Enrolled	ODOT News Release April 3, 2000	Since ODOT took over distribution of Green Light transponders, they have enrolled 125 new carriers and 5,200 additional transponders. A total of 912 carriers have enrolled 10,002 transponders. Thomas indicated that ODOT is working to secure another 12,500 transponders to continue to satisfy the demand.
105	Apr-00	Randal Thomas	Oregon Welcomes may Trucking Company to Green Light Program	ODOT News Release April 3, 2000	The company has equipped 570 power units with Green Light transponders. It also qualifies for the TCP program.
106	Apr-00	Randal Thomas	Oregon Green Light Continues to Build: 12,000 Trucks Enrolled	ODOT News Release April 3, 2000	A total of 930 carriers have enrolled just over 12,000 transponders.
107	Apr-00	Mac McGowan	ODOT welcomes Dick Simon Trucking to Green Light Program	ODOT News Release April 27, 2000	The company is equipping 1,662 power units with Green Light transponders.
108	Apr-00		Green Light Changes to Boost Usage, Ensure Interoperability	Motor Carrier News, ODOT April 2000	This article reviews the recent changes in the Green Light program – the content is similar to that covered in reference 97. It also covers the background to the changes.

109	Apr-00	Jerry Werner	Nationwide Interoperability of CVO Transponders Takes a First Small Step	Newsletter of the National Associations Working Group for ITS - NAWGITS	The article reviews the recent one way interoperability agreement between HELP Inc., and NORPASS, Inc. Both parties agree that a two-way agreement will be a much tougher challenge. At the root of the problem is the fact that the two systems evolved into very different business models, one backed by a private sector investor, the other paid for by the public sector. Oregon's resignation from NORPASS is discussed – they don't agree that the transponder owner has a right to limit it's use, a restriction applied by HELP. NORPASS didn't agree either but went ahead with the agreementa s a matter of a business arrangement. The article concludes by asking if the USDOT will play a rloe in future interoperability agreements. Dick Landis of HELP thinks the parties should work out the thorny issues themselves. Thus far the DOT has stayed on the sidelines. Mike Onder of the DOT's ITS JPO indicates that interoperability is a public issue, and different thoughts and ideas need to be debated in an open and public environment. He indicated that AASHTO has agreed to try to bring the states together on this issue.
110	Apr-00	Jerry Werner	Florida Plans to Field the First "Two-Way Compatible" Preclearance System	Newsletter of the National Associations Working Group for ITS - NAWGITS	As of March 29, Florida was about to sign an agreement with HELP, Inc., to provide a full two-way compatible system. The agreement will allow PrePass carriers to be cleared on the NORPASS system on I-75 and NORPASS carriers to be cleared on the new PrePass sites on I-10, I-95 and I-4. All transponders should have a "recall" button that keep its memory about the most recent bypass activity for 15 minutes – a feature required by PrePass. NORPASS transponders that are not currently "HELP compliant" will need to be replaced.
111	Apr-00		Truck Weighing Goes High-Tech	Statesman Journal, Salem, OR April 5, 2000	An increasing number of commercial trucks are taking advantage of a program that uses high-tech equipment to determine truck weights, according to state officials. This article is based on the 4/3/00 press release (reference 104).
112	Apr-00	Mac McGowan	Free transponders help to expand Oregon Green Light	Transcript, ODOT's Monthly Newsletter April 2000	This article contains similar information to others from march and April. At the time of going to press, about 900 carriers have enrolled almost 9,000 transponders. Recent fleets enrolling are: Federal Express, Frito-Lay, Les Schwab (L&S Transport), May Trucking Co., Pepsico of Eastern Oregon, USF Reddaway, Wal mart.

113 Apr-00	Jim Brock	Survey Guages Interest in Computer Services	ODOT's Motor Carrier Transportation Division Webpage & Motor Carrier News, June 2000	Two surveys were conducted in March to ask trucking companies about their interest in using computers to do trucking-related business with the state. MTCD managers were looking ahead – if enough carriers said they would go "online" to do business with ODOT, MCTD would consider developing their services. Two groups of carriers received the survey: the 200 largest trucking companies operating in Oregon, and, 1,000 randomly selected Oregon-based companies from a list of 8,969 that have at least one heavy truck registered. The response ates were 57% and 49% respectively. Very briefly, the surveys showed that the large companies were more in favor of doing business online that the general cross-section of companies. The results of the survey are at: http://www.odot.state.or.us/trucking/special/eservice.htm
114 May-00	Randal Thomas	ODOT receives ITS America Award for Oregon Green Light Program	News Release, ODOT May 4, 2000	The Oregon Department of Transportation has won a coveted ITS America Award for its automated truck preclearance system. ODOT Intelligent Transportation Systems (ITS) manager Galen McGill accepted the award on behalf of ODOT's Motor Carrier Transportation Division. "The Green Light program received one of only seven awards presented this year," McGill said. "It won in the category of ITS Deployment and Market Development Shown to Save Money." The program saves considerable time for trucking companies each time they bypass a weigh station. The program also saves taxpayers money by protecting their investment in roadways from overloaded trucks, and by reducing traffic congestion at weigh stations and ports of entry, eliminating the need to add lane and scale capacity at those facilities.
115 May-00	Gretchen Fehrenbacher	ODOT wins national award for trucking program	Daily Journal of Commerce, Portland, OR May 11, 2000	This article is based on the press release in the previous reference. Royce Young of Total Transfer is quoted – by bypassing weigh stations his trucks save time and do not have to deal with rejoining the freeway traffic. John Sallak, director of safety for the OTA also indicated that truckers save time and money, reduce accident risk, and the program saves taxpayers money that would otherwise be spent on expanding facilities. Randal Thomas indicated that when the Woodburn Port-of-Entry was built in the early 80's, 2,500 trucks used it on a busy day. There are now over 5,500 trucks on a busy day. Sallak said, "The only disadvantage I have heard is people concerned about the government gathering information – the big brother aspect. To my knowledge, that isn't a factor. I think the state is gathering information they already have. They are just getting it electronically."

116	May –00	Jeff Johnson	Illinois CDL Problems Prompt Image Campaign	Transport Topics, May 15, 2000	The Illinois Transportation Association announced that carriers enrolled in PrePass (and that make it through their safety background check) will be able to purchase truck decals that declare they are "Driven by Safety". The ITA has made the move to raise public confidence in the trucking industry following a scandal over officials being bribed to provide CDL's. Chris Oliver of PrePass said similar programs are in the works for Alabama, Florida, Mississippi and possibly California.

APPENDIX B

OREGON DOT'S PRESENTION ON INTEROPERABILITY

Truck Transponder Interoperability — The Oregon Story

A briefing about the trials and tribulations of one state as it introduces intelligent transportation systems for the benefit of trucking and then tries to reduce institutional barriers to truckers using similar systems in other states.

In the beginning . . . the mid-1990s . . .

- States like Oregon that had experimented with high-speed weigh-in-motion scales and transponders begin to implement plans to automate truck weigh stations.
- Oregon gets $20 million federal funds for a demonstration project, tied to an obligation to contribute $5 million in state dollars.
- States that are members of HELP (Heavy Vehicle Electronic License Plate, Inc.) enlist Lockheed Martin to build and run their weigh station systems.

1995 - Oregon introduces Green Light

- Oregon's plan, called Green Light, originally considers giving transponders to truckers, with no extra cost for using the weigh station bypass system.
- HELP's plan, called PrePass, gives transponders to truckers, but then charges them a per-pass fee for using the system.
  - In 1996, Oregon almost enlists Lockheed Martin to administer Green Light and charge a per-pass fee, but can't come to terms.

1994 - Other states share Oregon's interoperability vision

- In 1994, Idaho, Oregon, and Utah form the IOU Project.
  - They answer a Federal Highway Administration (FHWA) call for states to identify and remove institutional barriers to trucking operations.
  - The states focus on streamlining the movement of freight, particularly in triple trailer operations, along Interstate 84 from Portland to Salt Lake City.

1996 - Another state shares the interoperability vision

- In 1996, Washington joins Idaho, Oregon, and Utah to form MAPS — the Multi-jurisdictional Automated Preclearance System.
  - The states agree to build compatible preclearance systems, open to all transponder users, with no per-pass charges for usage. MAPS represents an alternative to the PrePass system.
  - The MAPS plan supports an FHWA vision for Commercial Vehicle Information Systems and Networks (CVISN) that unite the country.

1998 - More states share the vision

- In 1999, the MAPS states join Florida, Georgia, and Kentucky, three states that were formerly part of a demonstration project called Advantage CVO, to form NORPASS — the North American Preclearance and Safety System.
  - The states agree to build compatible preclearance systems, open to all transponder users, with no per-pass charges for usage. NORPASS represents an even more viable alternative to PrePass.
  - NORPASS also supports the CVISN plan for interoperability of systems from state to state.

1997 - Meanwhile, Oregon privatizes its transponder marketing / distribution

- Through a Request for Proposal process in 1997, Oregon awards a contract to Science Applications International Corporation, now TransCore, to market and distribute Green Light transponders.
- TransCore's business plan calls for charging an annual administrative fee of $45 for each transponder, with no extra charges unless for value-added services. The vendor hopes to distribute 25,000 transponders by Jan. 2000.

Green Light empowers its transponders users to make interoperability happen

- From the start, Oregon believes that transponder users have the right to take their transponder to another state and use it there if they meet the terms and conditions of that state's preclearance system.
  - PrePass refuses, however, to enroll a Green Light transponder in its states' systems.
  - PrePass also refuses to let one of its transponders work in Oregon's Green Light system.

1998 - PrePass threatens litigation if its transponders are used in Green Light

- In 1998, when Oregon, at the request of several carriers, enters their PrePass transponders in the Green Light system, PrePass sends a litigation warning letter.
  - HELP claims Oregon mis-appropriates property when it enrolls transponders without its consent.
  - It further claims Oregon violates 18 U.S.C. 1029, a federal telecommunications law, whenever its automatic vehicle identification readers recognize a PrePass transponder signal.

Oregon complies with HELP's directive to cease using PrePass transponders

- But Oregon's Department of Justice reviews HELP's litigation warning and rules there is no cause for action. Reading a transponder signal should not require permission of the owner.
- The federal law HELP cited applies to cell phone-like point-to-point transmissions; not to unscrambled, unencrypted signals.
  - A transponder constantly broadcasts its number. The signal can't be turned off. In this case it is simply a heavy vehicle electronic license plate.

The Oregon DOJ's ruling about transponders is affirmed to be reasonable

- The FHWA's Chief Counsel reviews the advice of Oregon's Department of Justice and finds it "thoroughly reasonable."
  - Meanwhile, automatic vehicle identification readers in Oregon continue to read every PrePass transponder that passes a Green Light weigh station. The drivers always get a red light on their PrePass transponders, signaling that they must stop at the weigh stations, because the transponder identification numbers have not been entered in the Oregon database.

1999 - TransCore and NORPASS try to negotiate for interoperability

- In 1999, TransCore, representing NORPASS, met with Lockheed, representing HELP PrePass, to negotiate interoperability.
- Lockheed expressed willingness to consider "one-way" interoperability in which it would allow another transponder to work in the PrePass system.
  - It was still not willing to negotiate a way for a PrePass transponder to work in another state's system, enabling "two-way" interoperability.

Resulting agreement lets transponder owner decide about interoperability

- The first-of-its-kind interoperability agreement between TransCore and HELP includes the following condition:

… HELP, NORPASS, Lockheed Martin IMS and TransCore affirm that they will not use any transponder in their respective electronic clearance programs without first obtaining permission of the owner of the transponder..

2000 - Oregon withdraws from participation in NORPASS over the transponder issue

- In January 2000, after the other NORPASS states vote to accept the interoperability agreement with HELP, Oregon withdraws from participation in NORPASS.
- By continuing in NORPASS, Oregon would be accepting the agreement. The agreement represents a compromise of Oregon's long-standing principle that transponder users do not need permission of the owner to use their transponder in another system.

Summary of Oregon's objection to terms of agreement

- When the interoperability agreement recognizes the control of a transponder owner, it sets the stage for HELP to impose elements of the PrePass business model on independent states. It invites HELP to dictate further terms of use, or impose user fees.
  - HELP could assign value to a transponder signal that can't be turned off.
  - HELP could insist we adopt a fee-per-pass system here applicable, for example, to its users.

Repercussions of Oregon rejecting the interoperability agreement

- By rejecting the agreement and withdrawing from NORPASS, Oregon can't insist that its Green Light transponder work in PrePass. It can't give its permission to use the transponders there because that would be recognizing the right of the transponder owner — no permission needed; none given.
  - This puts TransCore in the awkward position of preferring to market and distribute a NORPASS transponder.

What's one option now available to Oregon?

- Now that Oregon is not bound by the NORPASS / HELP interoperability agreement, it could, at the request of carriers, again just proceed to enroll PrePass transponder numbers in Green Light. This essentially challenges HELP to take legal action if they really think they can prevail.
  - Oregon would force the issue and if challenged, the test case would determine once and for all who's right.

What's a second option also available to Oregon

- Oregon has 4,700 trucks equipped with a Green Light transponder. It has 5,000 more transponders in storage. It could transfer ownership of those devices, at no cost, to the existing users and the first 5,000 who want one.
- The carriers could then go to HELP and request to use their transponder in PrePass.
  - HELP is on record as saying it will enroll any compatible transponder that a carrier owns and wishes to use in PrePass.

. . . to be continued.

Questions?
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APPENDIX C

SEAMLESS TRUCK TRAVEL

(Article by Jonathon Slevin reproduced from ITS World, Nov/Dec 1999)

After six years of intensive effort, tens of millions of dollars in public funding and hundreds upon hundreds of meetings, a major milestone has been reached toward achieving the goal of nationwide, seamless travel for the nation's motor carrier industry.

The milestone sounds simple enough: an agreement for something called "one-way interoperability" that allows trucks from one automated roadside inspection system to participate in another system. But to get there took political will strong enough to withstand a relentless attempt by Lockheed Martin IMS to own the market for privatizing and automating a number of state government regulatory processes.

In the early '90's, this $500 million (US) a year information technology subsidiary of the nation's largest defense contractor saw a business opportunity in automating roadside inspection stations and collecting transaction fees from trucks. Lockheed established a beachhead in some western states including California, and then planned to roll out state-by-state across the nation. But they found the going tougher than expected.

Electronic screening initiatives are part of an effort by the U.S. DOT and leading state governments to move motor carrier regulatory functions into the information age. To make this happen, folks have been working through a myriad of technical, procedural and institutional issues for nearly a decade. Throughout the process, Dick Landis, former head of the Office of Motor Carriers of the Federal Highway Administration and president of HELP Inc.—the non-profit administrative and marketing arm of Lockheed's operation-has been Lockheed's principal agent of influence.

Over time, some of the non-Lockheed players developed common ground around the notion that they were not only working to make interstate truck travel safer and more productive. They also were working to prevent Lockheed Martin from capturing a market. People reasoned that a system controlled by the huge government contractor would drive up costs to industry and limit the operational flexibility of the states.

Countering Lockheed's first-to-market and deep pocket advantage at first was like trying to break up AT&T without a court order. But the historical American commitment to reasonably open markets began to kick in. Lockheed's strategy to control transaction fees through a national network built up through agreements, one state at a time, to sole-source electronic screening functions to the HELP Inc./PrePass program started meeting resistance. Concerned states—with notable industry support from the United Parcel Service-launched a counter strategy.

Tactic #1

They first got everybody lined up behind the principle of "interoperability." This means that electronic clearance for trucks traveling from state to state should be as seamless to the user as ATM machines, regardless of what transaction data and fees get sorted *out in the back room. By the end of 1997, resolutions from the American Association of State Highway & Transportation Officials (AASHTO), its western (WASHTO) and southern (SASHTO) regional associations and ITS America had made interoperability a sacred principle—*

- *"Jurisdictions shall work to establish business interoperability agreements among roadside electronic screening programs;"*
- *"A jurisdiction will make a motor carrier's DSRC transponder a unique identifier available to another jurisdiction upon written request and authorization by the motor carrier;" and*
- *"...interoperability between CVO electronic screening systems is essential for effective management of CVO systems."*

These "guiding principles" were adopted because they made sense, and with the awareness by some that Lockheed's practices were violating some of these very principles that they were agreeing to at the conference table. That's because in a business context, interoperability meant one of two things for Lockheed: they either had to establish themselves as the standard for interoperability through market dominance; or if they could not control the market, they would have to cooperate with competitors who could undercut their pricing structure to trucking companies. They couldn't say that they were for interoperability within their own nationwide PrePass system but against it if it meant sharing the market with competitors. That's why at the conference table Lockheed and HELP Inc. supported interoperability as a goal, while in the field, with their actions, they opposed it.

Interoperability became Lockheed's crutch. It taunted them. It threatened their business model and caused them to recast their income statements. It led them into contradictions, and obfuscation. Landis sought to deflect attention away from this stickiness. He tried to minimize the problem with statements like, "HELP Inc. does not have more than a handful of carriers asking for interoperability."

But in 1998, owners of companies with 112 vehicles enrolled in the HELP Inc. program in California and wanted to use their PrePass transponders for electronic clearance in Oregon's Green Light program. They asked HELP for assistance—and HELP said "no."

Carriers in Oregon's program who wanted to use their transponders when they crossed the border into HELP Inc.'s California territory got the same treatment. At least two carriers—Waremart Foods and Thomas & Sons quit HELP Inc. as a result. John Repetto, vice president of Waremart Foods, wrote to the California Trucking Association: "HELP doesn't want its PrePass transponders to work at other state's sites and it doesn't want other state-issued transponders to work at PrePass sites. I guess HELP is afraid if it cooperates with other states it will jeopardize its business model."

Tactic #2

Once Interoperability Principles were nailed to the church house door, the states of Kentucky, Florida, Georgia, Oregon, Washington, Idaho and Utah could craft a business model that was compatible with interoperability. On August 11, the North American Preclearance and Safety System (NORPASS) was incorporated with these states as *founding members and TransCore as the investor/contractor providing organizational, administrative and marketing support. NORPASS doesn't pay for the IT infrastructure, has far less money at risk than Lockheed, can co-exist with the PrePass program and charges an annual fee of $45 per power unit as compared to HELP Inc.'s $.99 a pass capped at $3.96 a day.*

Tactic #3

Backed by its state partners, NORPASS then had the leverage needed to bring Lockheed to the negotiating table. Michael Jackson, Chief Operating Officer for Lockheed Martin IMS, said: "We are committed to try and work through reasonable interoperability. There are two legitimately competing programs that the states can evaluate. We are working through the process of seeing these two systems out in the world."

After several months, Jackson and Gene Bergoffen of NORPASS worked out an agreement by which Lockheed agreed to "one-way" interoperability. This means that—subject to a state's safety criteria—carriers in NORPASS can be screened electronically in states whose roadside inspection stations are part of the PrePass program. The carriers pay a fee to HELP Inc. in a range 30-50% less than the $.99 a pass paid by carriers who belong to HELP Inc. Lockheed at this time will not allow carriers in its program to participate in the NORPASS program with its HELP Inc. transponder.

*One observer described one-way interoperability as "the chink" in Lockheed's armor because **s**ide-by-side programs let the industry compare what it can get from NORPASS for $45 a year to HELP Inc.'s $.99 a pass. Only the market over time will tell whether this is so.*

"The need for interoperability is common sense," said Landis. "But getting there has been much harder to do than we thought."