

## Commercial Vehicle Preclearance Program: Motor Carriers' Perceived Impacts and Attitudes towards Potential Implementation

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**Abstract:** Regulation of overweight trucks is of an increasing importance due to raising maintenance costs and compromised road safety. Minimising pavement wear is done by regulating overloaded trucks at weigh stations. However, due to lengthy inspections and insufficient capacities, weight stations tend to be inefficient. New practices, using Radio Frequency Identification transponders and weigh-in-motion technologies, called preclearance programs, have been set up in a number of countries. The primary aim of this study is to investigate the current issues with regard to the implementation and operation of the preclearance program. The investigation focuses on the motor carriers' attitudes towards potential implementation of preclearance program. Trucking companies in Queensland, Australia, are interviewed for their experiences with the current weighing practices and attitudes toward the potential preclearance system.

*Keywords: truck, truck weight, overweight, preclearance, weight compliance*

### 1. INTRODUCTION

Heavy vehicles have significant implications for the road network and thus, ensuring their mass compliance is important to keep the associated costs and accidents low. Roadside weigh stations regulate overloaded trucks by weighing each truck using static vehicle scales on certain highway segments. There are an array of factors inherent in the trucking industry around the world, which justify the implementation of these weigh stations. The low profit margins force trucking companies to increase productivity (Taylor *et al.*, 2000) and this is often attempted by overloading trucks, which allows more freight to be carried at once. However, this unlawful act

involves two potential risks. First, exceeding road design limits such as vehicle mass or volume, results in increased pavement wear, which may lead to premature pavement failures (Jacob and Beaumelle, 2010). This is especially true for overloaded trucks as the relationship between the vehicle weight and the damage to the pavement can be described as exponential geometric to the power of four (Taylor *et al.*, 2000). Second, overloaded trucks increase the risk of accidents because some vehicle components, such as the brakes, may malfunction due to heavier loads. These two aspects explain that trucks need to stay within their mass limits.

The effectiveness of weigh stations as an enforcement tool is only guaranteed when all trucks are weighed and all available resources are allocated efficiently. A number of studies have reported that that weigh stations tend to show inefficiencies and overloaded trucks are not regulated effectively mainly due to their insufficient capacities and lengthy truck scaling processes (Lee and Chow, 2011). This led to the approach to utilise weigh-in-motion (WIM) sensors in combination with radio-frequency identification (RFID) transponders, referred to as the preclearance system. This advanced method makes use of the WIM sensor installed on the motorway mainline, RFID transponders attached in truck and corresponding RFID readers installed along the motorway. When a RFID-equipped truck approaches a weigh station, the corresponding WIM sensor measures its Gross Vehicle Mass (GVM) and axle weights. Additionally, the RFID reader linked to the weigh station reads the required credentials such as the national safety code rating and valid insurance. If all the credentials are in compliance with the regulations, and the measured GVM and/or axle weights are under the legal limits, the truck may bypass the weigh station. If any violation occurs, the truck is pulled-in for an additional weighing and safety and credentials inspections.

The preclearance system enables weigh stations to inspect only apparent overloaded trucks and thus more efficiently utilises available resources. This approach eliminates the major disadvantages involved in the basic weigh station operations, such as increasing travel times of trucks including compliant vehicles, increasing emissions and accident risks in and around busy weigh stations. However, some drawbacks also exist. The main limitation is that existing preclearance programs are voluntary which means that trucking companies must obtain a transponder for their fleets to take advantages of the preclearance. Although trucking companies must purchase transponders to participate in the program, roadway agencies could waive the cost to encourage enrolment. The more trucks are enrolled, the more can be prescreened and hence contribute to the aforementioned benefits.

The primary aim of this study is to investigate the main factors influencing the trucking companies' decisions in participating in a preclearance program. The trucking companies in Queensland, Australia are interviewed for their experiences with the current weighing practices and attitudes toward the potential preclearance system implementation. This knowledge will enable managing agencies to establish appropriate approaches to promote their programs for increased participation rates and eventually preclearance benefits. The framework and study findings could be valuable inputs for others roadway agencies considering a similar preclearance program or looking to promote their existing ones.

## 2. LITERATURE REVIEW

This section reviews the preclearance program focusing on three aspects: the technology-inherent drawbacks, the interdependency between the penetration level of preclearance programs and the resulting benefits, and the adoption of new technology within the trucking industry.

### 2.1 Technology-inherent Drawbacks of Preclearance Programs

Some limitations of the preclearance program evolve from technology-inherent characteristics of the devices used and the concept of voluntary enrolment. Those drawbacks include the costs, the accuracy and the threshold of the WIM technology as they influence the results of the preclearance operation. Managing agencies of a weigh station typically have to work cost-effectively, giving little space for high-cost equipments (Ismail *et al.*, 2010; Brand *et al.*, 2004). Furthermore, the accuracy of WIM not only affects its associated costs (e.g., maintenance costs), but also the likeliness to detect overweight trucks. A study by Jacob *et al.* highlighted the importance of calibration and accuracy assessment of WIM (Jacob *et al.*, 2000). Gu *et al.* (2004) found that although the WIM accuracy itself does not guarantee the successful detection of overweight, correct adjustments of the weight threshold lay the base for their penalization. The weight threshold defines indirectly the proportion of trucks to inspect and to bypass. This parameter can be adjusted in accordance to the WIM accuracy level if a static threshold is used. A threshold that is lower than the legal weight limit is commonly used to compensate for low accuracy levels. This could however lead to oversaturation as more trucks will be weighed. In contrast, if the threshold is set too high, not all violating trucks might be detected (Lee and Chow, 2011). A dynamic threshold strategy was suggested by Lee and Chow (2012) to control the threshold setting in relation to the mainline truck volume to maximise the weigh station capacity. In Europe, video capture of the vehicle is used to supplement inaccurate WIM measurements (Henry, 1999; Brozovic *et al.*, 2005).

The penetration rate of preclearance programs is the most critical factor determining the weigh station's effectiveness. The more trucks are participating in the preclearance program and thus are equipped with a transponder, the more are granted the legal bypass of the weigh station, which consequently increases the system benefits. However, if only few trucks are participating, the weigh station would operate as a basic version, causing the same problems that were meant to eliminate in the first place. Therefore, the success and extent of benefits generated by preclearance programs highly depend on the participation level of trucking companies (Lee and Chow, 2011; Kamyab, 1998).

Another technology related limitation is the lack of interoperability between preclearance programs. In the USA, for example, only 14 States are not using preclearance programs. Given the fact that significant freight movements are long hauled, meaning interstate, difficulties have been reported such as the need for enrolling in multiple preclearance programs and thus their

vehicles must equip with multiple transponders. This drawback restricts the current practices from further expanding to have more participants.

## **2.2 Research into the Critical Aspect of Participation Rate in Preclearance Programs**

The analyses relating to the critical aspect of the participation rate have been twofold. On the one hand, research has investigated into the extent of benefits as a function of the participation rate. On the other hand, studies investigated into the factors influencing the penetration of technology within the trucking industry.

In order to determine the critical participation rate, at which preclearance programs become more beneficial than basic weigh stations, a number of studies focused on the extent of the produced benefits to the three involved parties, which are the trucking industry, the government and the preclearance programs themselves, and the general public. Those benefits are expressed in terms of the travel time savings, increased capacity of the weigh station, improved safety for motor vehicle drivers, reduced fuel consumptions and environmental effects. In overall, the extent of these benefits is heavily dependent on the participation rate. Kamyab (1998) estimated that the participation rate needs to be greater than 45 percent to make preclearance programs more efficient than the physical expansion of weigh station. Gu *et al.* (2004) simulated the weigh station operations with different transponder rates and came to the conclusion that at least 35 percent of the participation rate is required to achieve the travel time reduction. Results from Lee and Chow (2011) further show that a 50 percent participation rate results in almost no queue spillover due to the increased truck queue in the weigh station. Safety around weigh stations may improve as more trucks participate in the preclearance program according to Barnett and Benekohal (1999). They suggest that the relationship between the participation rate and the accident reduction follows an S-curve. Low participation rates still cause high potentials for accidents because of the potential queue spillover of trucks onto the motorway mainline whereas the increase in the participation rate could create a sudden drop in the accident risk as a result of reduced truck queues and queue spillover.

## **2.3 Adoption of New Technologies within the Trucking Industry**

Other studies have researched into the motivations for truck drivers to adopt new technologies, which included RFID transponders for preclearance programs and toll collection systems. Holguin-Veras and Wang (2010) found that the disseminating information about the device and technology significantly influenced the penetration of the transponder technology. The U.S. Department of Transportation (U.S. Department of Transportation, 1997) further investigated a number of technologies and concluded that the usability and usefulness of the device contribute to a positive attitude towards it. Chakraborty and Kazarosian (2001) researched into the interdependency of the business strategy and the technology acceptance. Their study found that on-time performers used more sophisticated equipments in order to meet the customer demands quicker. Golob and Regan (2000) and Regan and Golob (1999) focused on the effects of

congestion on the technology usage. They found that if companies see congestion as a critical interference of their business, preclearance programs can be seen as a favourable solution against this problem.

### **3. SURVEY ON THE TRUCKING INDUSTRY**

To reveal the trucking companies' attitude towards the existing overweight regulation programs and potential preclearance system in Queensland, Australia, a survey was conducted by phone interviewing trucking companies. Phone calls were made from Monday to Friday between 9 a.m. and 5 p.m. A total of 153 calls were made in the months of April and May 2011. Within these 153 calls, 122 companies could be contacted. The higher number of calls results from repeated calls. These were necessary as the corresponding person who can answer the survey questions was sometimes not available. Typically the manager of the company or branch, or a truck driver answered the questions. Finally, 38 fully filled-in questionnaires were obtained from phone interviews. The results which are demonstrated as follows were gathered from 40 different transport companies located in Queensland.

The advantages of phone interviews are flexibility, higher response rates and an increased rapport between interviewers and interviewees (Kotler and Armstrong, 2010). The latter was especially helpful to gather further information on general opinions that were not covered by the questionnaire. The flexibility allowed the interviewer to obtain a broader insight into the industry and to reword some questions if necessary. There are also some disadvantages involved with person administered surveys. The conduct via phone is time consuming and relatively expensive. Moreover, it may lead to biased responses as the interviewee could feel uncomfortable answering questions that tend to be socially sensitive. The latter problem was counteracted by speaking with interviewees in the same approach every time and by further commenting on the questionnaire only if absolutely necessary.

#### **3.1 Purpose of the Survey**

In order to evaluate the potential preclearance program in Queensland, two main aspects were investigated. First, the attitude towards existing weigh stations in general and experiences made by trucking companies were enquired. The feedbacks on this question would provide an idea of the general position the majority of trucking companies has and what plans or countermeasures could improve or further strengthen their viewpoint. Second, knowledge of and attitudes towards the described preclearance or similar programs were gathered in order to detect possible obstacles for implementation. Thirdly, the sources of industry information by trucking companies were investigated.

#### **3.2 Analysis of the Results**

##### **3.2.1 General characteristics about the companies**

The 40 companies participated in the survey include: general trucking transport companies (19), heavy haulage transport (8), refrigerated goods transport (8), intermodal transport (1), and logistics service firms (4). Table 1 summarizes some characteristics of those companies categorized by the company size. The fleet size is comprised of rigid and articulated trucks. On average, all companies have more articulated than rigid trucks.

Table 1. Share of company size

	Small	Medium	Large
Number of Employees	1-10	11-50	>50
Number of Companies	10	19	11
Average Fleet Size	5.0	21.6	71.8

The dominant truckload within the participants is full truckload (FTL) with 28 answers. Also, most of the companies (30) offer nationwide transport services. The likeliness of their trucks to encounter a weigh station is therefore very high. Furthermore, 27 of those companies stated that they follow a customer-oriented strategy that considers the on-time performance as the most critical service aspect. Medium-sized companies also stated that meeting the customer needs is vital. Refrigerated goods transporters claimed to find on-time performance and temperature most important.

Slightly more than half of those companies are part of a trucking association and larger companies are more likely to be a member of associations. About 73 percent of large-sized and only 30 percent of the small-sized companies belong to a trucking association, which is either the Queensland Trucking Association or the Australian Trucking Association. They reported that the dominant sources of information such as new technologies are the internet, industry forums, and mails/brochures. Trucking associations and the transport ministry are also an important source to obtain new information. However, their roles in disseminating the information were relatively insignificant as also displayed in Figure 1.

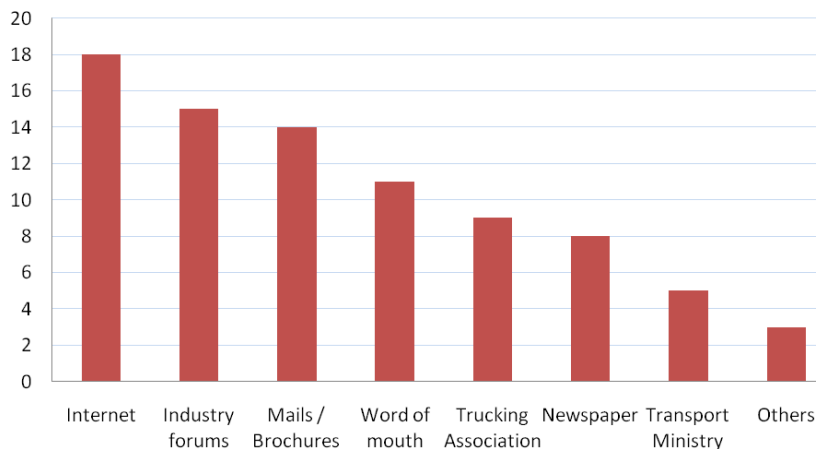


Figure 1. Share of information sources

### 3.2.2 The companies' experience with weigh stations in Queensland

The interviewed companies stated to 55 percent that weigh stations cause noticeable delays to their transport service. This concern is especially evident in medium (68 percent) and small (50 percent) sized companies. In total, more than 77 percent of the interviewed companies stated that their trucks are inspected at least once a week. Although this number reflects only a general trend since it does not reveal how many trucks of each company are inspected at WSs, the times spent per WS stop are significant as shown in Figure 2. Most of the companies responded that their drivers spend between 10 minutes and 1 hour at an inspection site and more than 25 percent of the companies estimated the time spent at WSs is greater than 30 minutes per stop. One quarter was unsure about the answer because they were not drivers themselves, the company was not affected by the weigh station or they could not remember specific numbers. In spite of the considerable time spent at WSs, only three companies admitted that they used to or are still using alternative routes to avoid weigh stations.

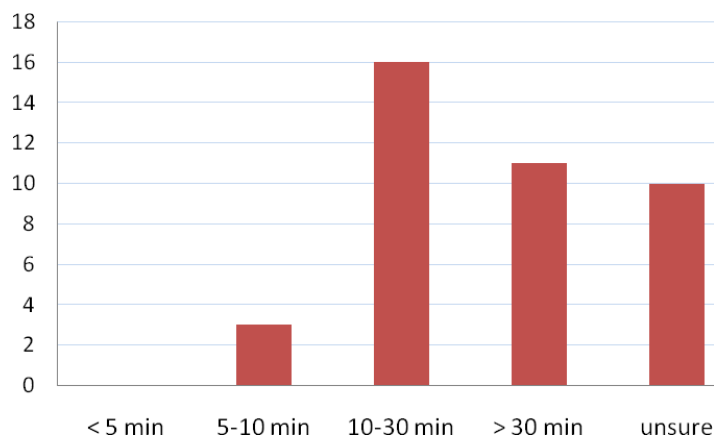


Figure 2. Time typically spent at weigh stations in Queensland

### 3.2.3. Attitudes on preclearance programs

The responses to the potential preclearance program were very different by companies. At 75 percent, the majority would like to know more details about those programs. However, only 7.5 percent would be willing to pay for that service. Another 15 percent would condition their decision on the cost and the government's influence. Furthermore, all the small-sized companies (22.5 percent of the total) stated that they are not willing to pay to participate in the preclearance program.

Although the operating principles of the preclearance program have been explained to the interviewees briefly, the reserved attitude could be affected by the lack of knowledge. Only 35 percent of the companies have heard of the preclearance program before the interview. However, this does not indicate that the rest 65 percent interviewees had an extensive knowledge of the benefits and requirements. Again, no small-sized company has heard of preclearance programs.

The main sources for such information are industry forums and private conversations according to the interviewees from the small-sized companies.

The knowledge of the IAP is slightly higher. More than 45 percent of the companies have heard of this program, but only two of the small-sized companies were part of this group. The Queensland Transport and Main Roads and the trucking associations are the main sources of information about the IAP. Only three companies from the interviews are enrolled in the IAP. Their reasons for participation differ greatly. One company thought it was obligatory, another one reasoned that the IAP can positively increase their load limits, and the third answered that they have had a better network access after joining the program. About 40 percent of the companies considered the IAP, either not suitable for their business or not cost-effective.

Additionally to the questions asked in the survey, some companies talked openly about their opinions and views regarding their industry and the systems putting control on their operations. Some interviewees mentioned their concerns about governmental influence though such programs. Some companies openly stated that cost as well as the government's control directly shaped their opinions.

#### 4. SUMMARY AND CONCLUSIONS

The significance of truck driver participation in the preclearance program has been highlighted throughout this paper. Comprising the findings from both the literature review and the surveys, potential approaches to positively change the view of trucking companies are suggested in Figure 3.

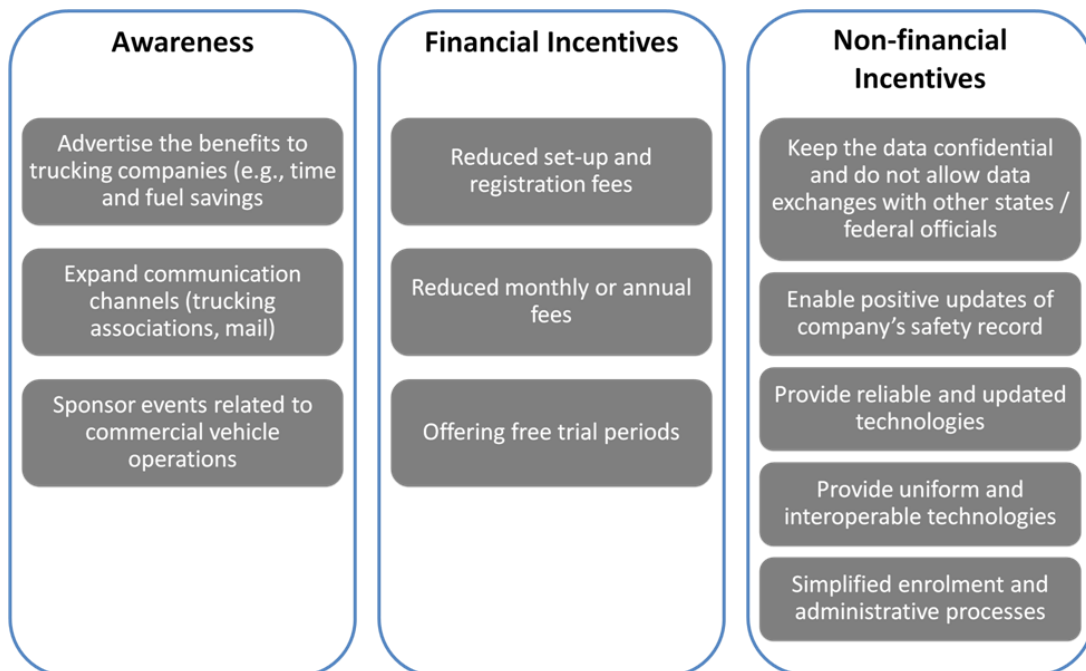


Figure 3. Approaches to increase the participation of trucking companies in preclearance programs



The proposed approaches are divided into three categories: awareness, financial and non-financial incentives. It is crucial to first increase the awareness of the programs. The survey results have shown that the awareness of such preclearance programs is still at the levels that need an improvement. The right choice of communication channels is important. Advertising the benefits at association events or in trucking magazines may be another bottom-top approach. Truck drivers are directly affected by the preclearance program. Acknowledging them with the positive aspects of it is important and they could spread their knowledge and opinions within the company. For trucking companies, highlighting the cost savings (time and fuel) is an effective strategy as well as that the social and environmental contribution would improve the company's reputation.

Another major concern is the costs. Although, the current costs for the enrolment in the preclearance programs are relatively low or even non-existent, this prescription might work as an excuse for companies that lack knowledge or fear control or surveillance of their operations. This negative perception also could be overcome by offering free trial-periods, which let companies experience the cost-effectiveness of the preclearance program.

The survey results indicate that there is a strong negative perception due to the traceability of transponders and the information that trucking companies must provide either intentionally or unintentionally by joining a preclearance program. This also might involve the privacy issue of truck drivers, which creates complexity to the problem. In order to overcome this issue, the data and information confidentiality must be guaranteed with possibly legislations prohibiting the data exchange within and between agencies. Creating interoperable programs will increase the participation. This requires collaboration between the program operators to set up a common framework. Simplified processing and ongoing administration works also reduce the complexities and confusions. Providing accurate and reliable technology is just as important as the other mentioned aspects.

In summary, for successful implementation of a new preclearance program, the followings are recommended to consider:

- The program must provide cost-effective benefits to trucking companies. The registration and ongoing administrative costs must be very low as evidently only a few companies would be willing to pay to join such programs. Providing financial incentives would also have to be arranged by the government.
- A balance must be created between the influence of the agency and the transport companies. Some transport companies would immediately refuse to join the program if the government had influence on the price, setup, or data of the program.
- Using appropriate marking tools and communication channels is critical for advertisement and promotion. The best communication channels are the internet, emails and brochures as well as industry forums.

Finally, the survey method used in this study did not consider the factors of influence to its full extent. As the weigh station operations tend to be unique, depending on the characteristics of

the road freight market, the infrastructure that is already implemented and the laws regulating the industry, the questions should be rephrased according to the current practices.

## REFERENCES

- Barnett, J. C., and Benekohal, R. F. (1999). Accident Reduction Effects of Using Weigh-in-Motion and Automatic Vehicle Identification for Mainline Bypass Around Truck Weigh Stations. *Transportation Research Record*, 1655, pp. 233-240.
- Brand, D., Parody, T. E., Orban, J. E., and Brown, V. J. (2004). A benefit/cost analysis of the commercial vehicle information systems and networks (CVISN) program. *Research in Transportation Economics*, 8, pp. 379-401.
- Brozovic, R., Vodopivec, V. and Žnidaric, A. (2005) Slovenian Experience in Using WIM Data For Road Planning and Maintenance. Fourth International Conference on Weigh-in-Motion, Taipei, Taiwan, 2005
- Chakraborty, A., and Kazarosian, M. (2001). Marketing Strategy and the Use of Information Technology: New Evidence from the Trucking Industry. *Transportation After Deregulation*, 6, 71-96.
- Golob, T. F., and Regan, A. C. (2000). Freight industry attitudes towards policies to reduce congestion. *Transportation Research Part E*, 36, 55-77.
- Gu, Z., Urbanik, T., and Han, L. (2004). Evaluation of Weigh Station Design and Operational Strategies Using Simulation. *Transportation Research Board* (pp. 1-20). Washington, D.C.: Transportation Research Board.
- Henny, R.J. (1999). Experimental Use of WIM with Video to Control Overloading. Second International Conference on Weigh-in-Motion, Lisbon, Portugal, 1999.
- Holguin-Veras, J., and Wang, Q. (2010). Behavioral investigation on the factors that determine adoption of an electronic collection system: Freight carriers. *Transportation Research Part C*, 1-13.
- Ismail, K., Lim, C., and Sayed, T. (2010). Simulation and Evaluation of Automated Vehicle Identification at Weigh-in-Motion Inspection Stations: Case Study from British Columbia, Canada. *Transportation Research Record*, 2160, 140-150.
- Jacob, B., and La Beaumelle, V. F.-d. (2010). Improving truck safety: Potential of weigh-in-motion technology. *IATSS Research*, pp. 9-15.
- Jacob, B., O'Brien, E.J., Newton, W. (2000). Assessment of the Accuracy and Classification of Weigh-in-Motion Systems: Part 2 European Specification, *International Journal of Vehicle Design - Heavy Vehicle Systems*, 7, pp. 153-168.
- Kamyab, A. (1998). Weigh Stations' Capacity Enhancement Alternatives: A Comparison of Mainline Electronic Screening and Physical Expansion. *Transportation Conference Proceedings*, pp. 29-32.
- Kotler, P., and Armstrong, G. (2010). *Principles of Marketing*. New Jersey: Prentice Hall.
- Lee, J. and Chow, G. (2011). Operation Analysis of the Electronic Screening System at a Commercial Vehicle Weigh Station. *Journal of Intelligent Transportation Systems*, Vol. 15, Issue 2, pp. 91-103.

- Lee, J. and Chow, G. (2012). Adaptive Metering Algorithm for Electronic Commercial Vehicle Preclearance Systems. *IEEE Transactions on Intelligent Transportation Systems*, Vol. 13, Issue 3, pp. 1116 – 1124
- Regan, A., & Golob, T. (1999). Freight Operators' Perceptions of Congestion Problems and the Application of Advanced Technologies: Results from a 1998 Survey of 1200 Companies Operating in California. *Transportation Journal*, 57-67.
- Taylor, B., Bergan, D. A., Lindgren, N., and Berthelot, D. C. (2000). The Importance of Commercial Vehicle Weight Enforcement in Safety and Road Asset Management. *Traffic Technology International*, pp. 234-237.
- U.S. Department of Transportation. (1997). *Driver Acceptance of Commercial Vehicle Operations (CVO) Technology in the Motor Carrier Environment - Executive Summary*. Washington D.C.: U.S. Department of Transportation.