AN EVALUATION OF MONTANA'S STATE TRUCK ACTIVITIES REPORTING SYSTEM

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EXECUTIVE SUMMARY

Based on the results of this study, the Montana Department of Transportation's (MDT's) recently developed *State Truck Activities Reporting System (STARS)* has met three of its primary objectives, namely,

(1) improving the efficiency and effectiveness of truck weight enforcement activities performed by the Motor Carrier Services (MCS) Division of MDT,

(2) providing MDT access to improved truck-related data for use in pavement design and

(3) providing various divisions within MDT access to improved truck-related data for use in engineering and planning applications.

STARS consists of an array of weigh-in-motion/automatic vehicle classification (WIM) sensors deployed across the Montana highway system that feed data to customized software programs. At each *STARS* location, WIM hardware installed directly in the traveling lanes of the roadway unobtrusively and automatically collects information on the weight and configuration of the vehicles traveling on that roadway. This data is subsequently processed to characterize commercial vehicle operations at the site by vehicle classification and weight. Information of this type is essential to several MDT activities, from vehicle weight enforcement, to roadway design, to transportation planning. The quantity and quality of information provided by *STARS* for these various tasks is a notable improvement over existing data sources. In this evaluation, the impact of *STARS* and the information it provides was assessed relative to weight enforcement, pavement design and general data enhancements for other MDT activities.

In the area of vehicle weight enforcement, the MCS Division of MDT conducted a pilot project to investigate the use of *STARS* data in scheduling mobile weight enforcement activities. While WIM data may seem like an obvious source of information on overweight vehicle operations, it was discovered that little work has been done nationwide on its use in this application. Therefore, MCS designed their own methodology to incorporate this information into enforcement, and then engaged in a two year pilot program to determine its effectiveness. One of the primary objectives of the weight enforcement efforts of the MCS Division is to protect the highway infrastructure from damage caused by overweight vehicles. In support of this objective,

the weight enforcement methodology used in the pilot program was designed with the objective of reducing the excess pavement damage caused by overweight vehicles.

While there is an attraction to using *STARS* data in real-time to dispatch enforcement personnel to individual overweight incidents, the decision was made in the pilot program to address long-term patterns of overweight behavior on a coordinated state wide basis. The methodology followed by MCS in the pilot project began with using *STARS* data to identify those locations around the state that historically experienced the worst pavement damage from overweight vehicles. Instrumental in identifying these locations, which were then the object of focused enforcement, was the *Measurement of Enforcement Activity Reporting System (MEARS). MEARS* is a software program that processes the *STARS* data specifically to obtain information on commercial vehicle and overweight vehicle activity. Using information in the *MEARS* reports and engineering analyses, those locations historically experiencing the greatest pavement damage were identified over a baseline year (2000 to 2001). Enforcement resources were then directed to these sites in the following year (2001 to 2002) at the times when the greatest overweight vehicle activity was observed in the previous year.

During the year of focused enforcement, a statistically significant reduction was seen in the percent of overweight vehicles in the traffic stream. Statewide, throughout the extensive network of highways covered by *STARS*, the percent of overweight vehicles in the traffic stream dropped by 22 percent (from being 8.8 percent of the commercial vehicles in the traffic stream in the baseline year to 6.9 percent in the enforcement year). The average amount of overweight on each vehicle also decreased by 16 percent in the enforcement year. The overall reduction in pavement damage attributable to the *STARS* program statewide over the year was on the order of magnitude of 6 million ESAL-miles of travel. The cost savings associated with this change in pavement damage was estimated to be approximately $700,000.

STARS will continue to have a role in future MCS weight enforcement activities. The specific manner in which it will be used in this regard, however, is still evolving. While the approach used in the pilot project was effective in reducing overweight vehicle impacts, issues do exist relative to its continued effectiveness into the future. This evaluation has shown that *STARS* provides the data necessary to assess the effectiveness of an enforcement activity from a

performance perspective. That is, *STARS* data can be used to directly quantify changes in various aspects of overweight vehicle operations that enforcement is attempting to control (e.g., proportion of overweight vehicles in the traffic stream, average amount overweight, pavement damage from overweight vehicles).

In the area of pavement design, *STARS* was found to offer better information on the traffic related fatigue demands used in design, relative to the existing information that is collected for this purpose at permanent weigh stations. From a geographic perspective, *STARS* collects information at more locations around the state than is available at the existing weigh stations. From a temporal perspective, *STARS* collects data continuously at these sites, while weight data for pavement design purposes is only collected at the weigh stations at a few selected times during the year. Commercial vehicle operations on the State's highways generally vary significantly by geographic location and time of year. Thus, it is questionable whether the current vehicle weight sample being collected by weigh stations is able to accurately represent actual fatigue demands around the state and throughout the year. Evidence was further discovered that the weigh station sample is biased toward fully-loaded vehicles. These biases arise from basic problems associated with attempting to collect traffic data at facilities designed for other purposes. The *STARS* WIM installations unobtrusively collect information on every commercial vehicle in the traffic stream directly in the traveling lanes of the roadway at highway speeds.

In light of the above observations, MDT has started to use WIM data in the pavement design process, rather than weight data collected at weigh stations. In this regard, a comparison was made between the fatigue demands for design purposes that would be calculated from WIM versus weigh station data. Based on two years of data (2000 and 2001), fatigue demands calculated from the WIM data were 11 and 26 percent lower than those calculated from the weigh station data for the Interstate and non-Interstate NHS/primary systems, respectively. Note that part of this reduction is due to using data from different sources in the analysis process, and part of this difference is due to *STARS* focused enforcement. A projected cost impact of using *STARS* data in the pavement design process (rather than weigh station data) was determined from the changes in fatigue demands reported above. These changes in fatigue demands were found to result in changes in the facilities designed to carry them, which subsequently translated into

changes in the costs of the constructed facilities. The relationship between changes in fatigue demand and changes in subsequent project construction costs was determined by redesigning typical projects at various levels of fatigue demand. The resulting relationship was used at a network level to project annual changes in construction costs if WIM-based fatigue demands were to be used in the design process.

Following the methodology above, pavement costs were projected to decrease approximately $0.7 million and $3.5 million per year on the Interstate and non-Interstate NHS/Prirmary systems, respectively, if WIM-based fatigue demands were used in the design process. The change (decrease) in fatigue demands and attendant pavement costs determined in this evaluation indicate that existing highways were designed for greater fatigue demands than they actually will experience. While this situation might suggest that the service life of existing highways will be extended (in that they were over-built with respect to fatigue capacity), it is important to note that fatigue is only one of several mechanisms that initiates failures in highways, and often it may not be the controlling mechanism. Nonetheless, use of the fatigue demands from the improved WIM data should lead to pavement designs that are better optimized for the demands that they will actually experience in-service.

The final issue considered in this evaluation was the possible benefits *STARS* offers to traffic data users throughout MDT. A survey across the major divisions at MDT found that *STARS* data will primarily benefit planning, engineering, and commercial vehicle enforcement efforts.