

## **Saskatchewan Rural Partnership Haul Program**

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## ABSTRACT

Saskatchewan Department of Highways and Transportation is a leader in road and short-rail transportation initiatives that facilitate efficient commercial transportation to remote northern and rural areas. A recent initiative undertaken by Saskatchewan Department of Highways and Transportation is a public-private partnership with commercial carriers to allow larger truck configurations to haul primary axle weights on select secondary highways if the vehicle deploys road friendly vehicle technologies, such as air-spring suspensions and central tire inflation systems. The pilot partnership haul program has resulted in haul savings of between 20 and 50 percent over conventional configurations operating at secondary weight limits. The Saskatchewan Partnership Haul Program has generated approximately seven million dollars annually in haul savings, which is subsequently shared between the carrier and Saskatchewan Department of Highways and Transportation.

Initially, equitable distribution of partnership haul savings and compliance audits are determined manually based on submitted manual reports which include tack cards and waybills. Because this manual system is labor intensive and prone to accounting errors, the administration of the partnership haul program is only tenable for larger carriers with semi-automated administration systems. As a result, Saskatchewan Department of Highways and Transportation identified a need for a system that automatically allocates partnership haul savings and performs compliance audits, thus providing the enabling technology to expand the partnership program to small and mid-sized carriers.

Saskatchewan Department of Highways and Transportation partnered with International Road Dynamics Inc. to develop and implement an automated vehicle monitoring and audit system designed to facilitate the Saskatchewan partnership program. This paper discusses the Saskatchewan partnership program and describes the technological features and advantages of the automated vehicle monitoring and audit system. This paper also discusses other potential applications of the automated vehicle monitoring and audit system.

*Key words:*

Commercial vehicle operations, automated vehicle monitoring system, central tire inflation, geographic information systems, global positioning systems, transportation sustainability, road preservation, intelligent transportation systems, rural road management, public-private partnerships.

# **SASKATCHEWAN RURAL PARTNERSHIP HAUL PROGRAM**

## **Introduction**

The Saskatchewan road network is comprised of approximately 202,000 kilometers<sup>1</sup> of two lane equivalent roads, with an estimated value of seven billion dollars (SDHT, 1996). The export of bulk commodities such as grains, timber and mined ores generates approximately two thirds of Saskatchewan's annual gross domestic product (\$20.6 billion (SDHT, 1997)). As a result, efficient road transportation has, and will continue to have, a profound influence on the Saskatchewan economy. Therefore, preservation of Saskatchewan's capital investment in roads, while at the same time promoting improved transportation efficiency to facilitate provincial economic development is of paramount importance to Saskatchewan.

Currently Saskatchewan spends approximately \$300 million per year maintaining and rehabilitating Saskatchewan roads. However, recent rationalization of the grain transportation system and replacement of thousands of local grain elevators with a handful of regional inland terminals has shifted the assembly of grain from rail branch lines to the rural road network. This shift in the assembly of grain from rail to road coupled with economic diversification and value added initiatives within the Saskatchewan economy, such as development of the mining and oil sectors, has and will continue to, increase truck traffic on Saskatchewan roads. As a result, future traffic related damage inflicted onto the Saskatchewan road system is expected to increase dramatically over coming years. Of particular concern in this regard is the approximate 8500 kilometers of thin paved roads that were not initially designed to carry significant numbers of commercial trucks.

## **Saskatchewan Partnership Haul Program**

In efforts to promote efficiency in the Saskatchewan commercial carrier industry, while at the same time reduce truck related road impacts, Saskatchewan Department of Highways and Transportation (SDHT) is currently piloting a public-private partnership with commercial carriers. A public-private partnership is a cooperation between public and private sector entities with shared interests in a specific

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1. The Saskatchewan highway network consists of 11,578 km of structural pavements, 8,470 km of thin membrane surface (TMS) nonstructural dust free roads, and 5,640 km of gravel highways for a total of 25,688 km in the provincial highway network of which 14,110 km (8,470 km TMS and 5,640 km gravel) are nonstructural. The Saskatchewan municipal road network consists of 8,573 km of primary grid (3,040 km paved, 5,543 km gravel); 12,641 km of grid; 29,357 km of farm access; 2,654 km of special roads (435 km paved; 2,219 km gravel) and 63,388 km of local access roads for a total of 116,613 km. There are also 45,416 km of land access or bladed trails and 14,500 km of prairie trails.

project or venture. Public-private partnerships provide the advantage of increased financial resources available early in the project and equitably share the risk between the participating public and private sectors.

The purpose of the SDHT partnership program is to maximize the benefits to all parties involved by allowing larger more efficient truck configurations and primary weights on select secondary rural roads if the carrier deploys air-spring suspension and central tire inflation road friendly vehicle technologies. In addition to meeting the carrier needs through increased haul configurations, the partnership provides SDHT with increased revenue for road maintenance and improvement. Because the partnership haul program is still in the initial trial stage, the costs and benefits have not yet been fully quantified, however, the potential benefits of the partnership program are:

- Support economic development through reducing commercial truck haul costs;
- Provide additional revenue for highway improvement projects;
- Encourage the use of road friendly truck equipment;
- Improve highway safety, and;
- Provide a mechanism to manage truck traffic on the highway system (i.e. select optional route and/or times of the year for moving commodities).

The partnership program may be expanded to additional small and mid-sized carriers and public road authorities to cooperatively route commercial traffic off the thin pavement system onto roads with higher load carrying capacity such as full pavement systems and/or roads with lower maintenance costs such as gravel roads. This ability to better manage the tonnage hauled on the rural road system could potentially mitigate millions of dollars per year in traffic induced damage on thin paved roads while at the same time, continue to facilitate and encourage efficient commercial transportation. The resulting haul savings coupled with road infrastructure preservation savings generated from the partnership program could be significant for the province of Saskatchewan.

Under current partnership haul agreements, SDHT and the commercial carrier enter into a multi year agreement to share in the haul savings generated by more efficient truck configurations. SDHT's portion of the haul savings are used for road improvements after covering the program's administration costs. The carrier's portion of the haul savings are used to recover capital investment in specialty equipment specifically designed for the partnership program and profit margin. SDHT is responsible for the overall management of the system.

Although vehicle weights and dimensions may change with specific client needs, most partnership vehicles fit within the regulations from a dimensions perspective and a primary focus of the partnership program is to allow primary weight limits on specified secondary roads. In some cases, larger vehicle configurations such as nine-axle B-Trains shown in Figure 1, and experimental twelve-axle B-Trains as shown in Figure 2, are permitted within the Saskatchewan Partnership haul program.

Figure 3 illustrates typical truck configurations and approximate haul cost savings incurred due to the increased allowable vehicle weights and dimensions. As seen in Figure 3, the Saskatchewan Partnership haul program configurations include a standard six-axle semi-trailer unit allowed to increase its gross vehicle weight from secondary load limits of 40,000 kg to primary load limits of 46,500 kg while operating on secondary roads, resulting in haul cost savings of up to 20 percent. The partnership haul program allows nine-axle B-trains to increase their allowable gross vehicle weight from secondary load limits of 54,500 kg to 70,500 kg, 77,500 kg, and 94,500 depending on the specific situation. These increases in allowable vehicle weights and dimensions using nine-axle B-Trains may result in haul cost savings of up to 50 percent for some products.

### **Need for an Automated Vehicle Monitoring System**

To date, the partnership program has operated under a voluntary basis and has generated approximately seven million dollars per year in total haul savings. These haul savings are subsequently shared between the carrier and Saskatchewan Department of Highways and Transportation. If the partnership program were to be expanded to include small to midsize carriers, SDHT estimates annual generated haul cost savings could increase to ten million dollars per year with expanded implementation. However, in order to maximize the benefits from the partnership haul program, there is a clear need to expand the partnership program to include the thousands of trucks registered in small to mid-size carriers, operating not only on the Provincial highway system but also municipal roadways where the authority has allowed them. In addition, there is the potential to include foreign carriers if the business case shows potential benefits for the agencies and carriers involved.

At the present time, equitable distribution of partnership haul savings and compliance audits are determined manually based on submitted reports, tack cards, waybills and typical elements of truck operator costs (i.e. fuel, equipment costs, driver, repair and maintenance, license and insurance, overhead and administration). Manual administration of the partnership haul program would become labor

intensive and prone to accounting and reporting errors if it were extended to smaller carriers operating on both provincial highways and municipal roads. The partnership haul program is more manageable for large carriers with automated administration systems. As a result, many small to mid-sized carriers and Saskatchewan public road authorities would have difficulty in participating in the partnership program. Given the inherent administrative barrier to entry into the partnership haul program, IRD proposed, and with help from SDHT have developed an automated vehicle monitoring and tracking system specifically designed to be the enabling technology that will facilitate expansion of the partnership program.

### **Automated Vehicle Monitoring System**

International Road Dynamics Inc. (IRD) proposed and, in conjunction with SDHT, have developed an automated vehicle monitoring and audit system that is specifically designed to facilitate smaller carrier type partnership agreements. There are currently two general types of commercial vehicle monitoring systems. The first is an onboard monitoring system similar to an electronic log book. These systems monitor and record operator information, speed, departure, arrival, gear shifting patterns, engine functions, hours of service, etc. The second general type of truck monitoring systems are global positioning tracking systems that provide accurate tracking and real time two-way communication for dispatch administration and routing. Although these systems are readily available, they do not provide the administrative and monitoring capabilities required by the Saskatchewan partnership program.

The automated vehicle monitoring and audit system designed for the Saskatchewan partnership program, as illustrated in Figure 4 (Bergan, et al., 1998), employs four primary systems: onboard vehicle data collection/storage system, communication network, central administration system, and remote user query systems.

The onboard system can determine the approximate weight ( $\pm$  five percent) of the vehicle according to the pressure in the air-spring suspension system. The onboard system can be programmed to automatically monitor pressure readings whenever the vehicle stops for more than one minute. CTI sensors are used to monitor inflation pressures of all tires and are required on all secondary highways to reduce road damage. All onboard sensor information is automatically stored and cross referenced with position by the onboard data storage unit to determine if tire pressures and/or weights are correctly set in relation to the allowable axle weights corresponding to the type of road on which the vehicle is operating (i.e. secondary or primary) and the seasonal environmental conditions.

The primary function of the central administration system is to create and maintain a truck fleet database, perform compliance audits and provide details of vehicle trips including haul savings, and to perform user defined queries. Because many public road authorities employ a geographic information system (GIS), the central administration system is designed to interface with industry standard GIS systems to provide highway names and section locations referenced by GPS coordinates. Based on the highway identification and chainage, the central administration system can determine truck routing and the corresponding road usage and display this information graphically. When integrated with GIS, each vehicle trip can be traced to specific routes and automatically assign road usage and revenue generation allocation.

The automated vehicle monitoring and audit system employs an innovative approach to a communication network as shown in Figure 4. The data stored by the onboard units can be programmed to download to the central administration system several times per day. Vehicle data transmission is over circuit switched cellular network and can be programmed to transfer data only during off peak hours to minimize transmission costs.

Remote query systems provide the ability for commercial carriers and public road agencies to generate reports including vehicle routing, non-compliance, and audit reports. Routing reports are provided for billing and revenue allocation purposes and may include a summary of trips with a daily breakdown with respect to primary, secondary and municipal roads by route number, section number, and public road authority. Road usage reports can be provided across commercial carriers and road authorities by truck and/or road section.

Non-compliance reports may be viewed or printed from remote query systems. Trucks with non-compliance infractions are grouped according to carrier, with one report issued for each carrier with respect to the following categories:

- No driver identification/invalid driver identification;
- No configuration/invalid configuration;
- Speeding;
- Overweight;
- Excessive tire pressure corresponding to the specified weight and road section;
- No data received (unable to communicate with communications network);
- Malfunction of onboard units (sensors not working properly);

- Non-highway location (truck location is not on a highway), and;
- Permit violation (such as period of travel limitations).

The automated vehicle monitoring system has the ability to continuously monitor and sample data from a wide variety of onboard vehicle sensors. All information is transferred to the central administration system and may be queried at any time by the public road authorities and commercial carriers involved in the partnership program. For confidentiality, commercial carriers are not able to access information on other carriers and public road authorities are not able to query data regarding other road authorities.

Queries may be in the form of trip reports for shipper/issuer program contributions allocated on a per loaded km basis among all road authorities affected by each specific truck haul system. The second most important report is the non-compliance report that will provide information on vehicle speeding, overweight, wrong route, incorrect tire pressure, etc, as set out in the partnership agreement. In addition, public road authorities can use the assembled data to perform commercial traffic studies, road use evaluation, regional economic activity studies, and road preservation planning based on truck traffic and/or economic activity.

The primary advantages of the partnership program automated vehicle monitoring and audit system over other systems is its reduced communication costs and the system's inherent flexibility to be readily customized for small to mid-size fleets for diverse fleet management applications. These applications include: near real time vehicle tracking, dispatch and communication, traffic generation/destination studies, road preservation operations management, traffic data collection, onboard system monitoring, fleet logistics administration, and cargo tracking.

### **Other Applications of the Automated Vehicle Monitoring System**

The automated truck monitoring system employs the internet for a significant portion of its communication activities. As a result, communications costs are significantly reduced when compared to the costs associated with cellular and satellite based systems. This cost effectiveness and flexibility renders the automated truck monitoring system uniquely suitable for diverse fleet management applications and can be customized for small to mid-size fleets in both public and private sector

applications. These applications include: near real time vehicle tracking, dispatch and communication, traffic generation/destination studies, road preservation operations management, traffic data collection, routine maintenance equipment monitoring, onboard system monitoring, fleet logistics administration, and cargo tracking.

The private sector has expressed interest in enhancing fleet management and operations. The automated vehicle monitoring system can be customized to suit the carriers needs to include such features as near real-time truck tracking using GPS. A specific application in this regard is the monitoring of high risk and high value cargo. The transport of high risk goods, including wastes and hydrochloric acid for example, is quite regulated, however compliance is sometimes a problem. In order to improve safety, the automated vehicle monitoring system will monitor the trucks' speed, route, along with any other onboard systems necessary in the regulations. Monitoring the transport of high value cargo, including mail, tobacco and alcohol, is also of great importance to those involved.

Another potential application is deployment of road authority maintenance equipment and crews. Presently, SDHT spends considerable resources recording and administering maintenance and preservation activities for their asset management system. Because road preservation activity information is critical to accurate cost accounting of preservation expenditures and for financial optimization and performance prediction models, automated recording and compiling of road preservation activities could not only generate direct savings in manpower, but also improve the quality and efficiency of road asset management database information which is used to optimize the allocation of hundreds of millions of dollars spent on road preservation.

### **Summary and Conclusions**

Saskatchewan Department of Highways and Transportation (SDHT) has been a leader in innovative road and short-rail transportation initiatives that facilitate efficient commercial transportation to remote northern and rural areas. One of the more recent initiatives is a public-private partnership program with commercial carriers to allow larger more efficient truck configurations to haul primary weights on select secondary rural roads if the carrier deploys road friendly vehicle technologies, such as air-spring suspension and central tire inflation. These partnership haul agreements have resulted in haul cost savings of between 20 and 50 percent, generating approximately seven million dollars per year in total, which is shared between the carrier and Saskatchewan Department of Highways and Transportation.

Under the partnership haul agreements, SDHT and the commercial carrier agree to share in the haul savings generated by the increased haul efficiency. Eventually, the partnership program may be expanded to channel commercial traffic off the thin pavement system entirely and onto roads with higher load carrying capacity such as full pavement systems and/or roads with lower maintenance costs such as gravel roads. This ability to better manage the tonnage hauled across the rural road system could potentially mitigate millions of dollars per year in traffic induced damage on thin paved roads while at the same time, continue to facilitate and encourage efficient commercial transportation. The resulting haul savings and road infrastructure preservation savings generated from the partnership program could be significant for the province of Saskatchewan.

Although the partnership program shows the potential for significant benefits (up to 50 percent reduction in haul costs), current manual methods for determining haul cost savings and performing compliance audits are labor intensive and prone to accounting and reporting errors. Therefore, if the partnership program is to be expanded to small to mid-size carriers, and to other road authorities that are prepared to allow increased vehicle configurations on their road network, a system that automatically allocates partnership haul savings and performs compliance audits is needed.

International Road Dynamics proposed and, with assistance from SDHT, developed an automated vehicle monitoring and tracking system specifically designed to provide the enabling technology that will facilitate the economic benefits to be gained by expanding the partnership program. The advantages of the automated vehicle monitoring and audit system over other commercial systems is its reduced communication costs and the system's inherent flexibility to be readily customized for small to mid-size fleets for diverse fleet management applications. These applications include: near real time vehicle tracking, dispatch and communication, traffic generation/destination studies, road preservation operations management, traffic data collection, onboard system monitoring, fleet logistics administration, and cargo tracking.

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- FIG. 1.** Mining Sector Partnership Nine-Axle B-Train
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- FIG. 3.** Pilot Partnership Haul Vehicle Configurations and Respective Haul Cost Savings
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**Partnership Agreement  
Weights and Dimensions**

**Approximate Partnership  
Haul Cost Savings**







