Development and Deployment of a Remotely Controlled Weigh Station

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Abstract

Transportation of goods by truck continues to rise in Canada while much of the highway infrastructure is aging and agencies are pressed to control costs and improve efficiency of operations. Highway preservation must include not only maintenance and rehabilitation work, but also protection of the highway infrastructure from damage due to overloading. As the infrastructure ages and becomes more susceptible to potential damage, it is even more important to ensure that overloading is not occurring. With the rise in economic activity in Western Canada and changes in the transportation industry, truck traffic has significantly increased. This increase puts the highway infrastructure at a higher risk of damage due to overloading if weights are not monitored and controlled. As the need for even more diligence in monitoring and controlling weights is increasing, agencies are being asked to do more with fewer resources.

A primary component of an agencies weight enforcement program has been a network of strategically placed permanent weigh station sites. However, agencies are constrained by budget and resource limitations to operate these stations on a continuous basis. Therefore, alternatives are needed that allow diligent monitoring of truck weights while more efficiently using available resources.

Through a joint funding arrangement, Saskatchewan Highways and Transportation has partnered with Transport Canada, Alberta Infrastructure and Transportation, and International Road Dynamics to develop and deploy a remote controlled weigh station on Saskatchewan Highway 14 near the Alberta border. In addition to be a funding partner, Alberta Infrastructure and Transportation will also be a partner in the operation of the system. The system allows the station to be operated from any remote location using an internet connection and a windows based operator interface.

This paper presents the background and need for this type of application, the design considerations in developing the system, and the operation and deployment of the system.

Need for a Remote Controlled Weigh Station

The highway transportation network is a vital link in the economy and life of many regions. This is true in the prairie region where a consolidation of rail transportation, a resource and commodity based economy, and a booming economy have all led to significant increases in transportation of goods, commodities, and people using the highway infrastructure (1). This increase in truck traffic, in both shear numbers of vehicles and size of loads, puts a strain on an aging highway infrastructure.

Weight enforcement has been a part of many agencies strategy for highway preservation for many years. The need for weight enforcement is based on two simple premises:

- overloaded trucks cause premature failure of roadways; and
- an active enforcement program can reduce the amount of overloaded trucks.

Previous research has verified that there is a direct relationship between the level of enforcement on a section of highway and the amount of overloading that occurs (2). Research has also indicated that there is an avoidance behavior by some commercial vehicle operators when a weigh station is open. As an example, a study in Virginia found that at two weigh stations 11 and 14% of the trucks on routes used to bypass the stations were overweight (3). At one of the stations, 50% of the runbys (which are trucks that travel past the weigh station without being weighed because the entrance lane to the station is filled with a queue of trucks) were overweight.

The importance of an effective and efficient weight enforcement program increases as the amount of truck activity increases and also increases as the infrastructure ages and becomes more susceptible to damage due to overloading. At the same time, available resources in terms of funds, people, and facilities are decreasing. Therefore, a need was identified to provide higher levels of enforcement in a more economical manner.

Weigh stations in remote rural areas face a number of challenges. Truck volumes are often not high enough to justify full time operation, so they are operated on a part-time basis. Part-time operation leads to several inefficiencies including:

- - travel time to bring staff in from other areas
- - concern for operator safety if a lone operator is used, or extra staff requirements
- - start-up and shut down time each time the station is open and closed
- - less than full coverage, resulting in many trucks not being monitored
- - avoidance of the weigh station by overloaded trucks during known operational hours

A study completed in 2005 examined the use of remote control weigh stations (RCWS) as a means of providing efficient and effective enforcement, especially in rural and low traffic volume areas (2). This study was funded by the ITS office of Transport Canada under the Strategic Highway Infrastructure Program. The findings of the study indicated that when agency and user costs and benefits were considered, the benefit-cost ratio varied from 1.23 to 32.8, depending on the technology deployed, truck volumes, and level of enforcement.

The study identified the following features as necessary for the operation of an RCWS:

- Weight and dimensions enforcement
- Company / carrier / operator licence check
- Company / carrier / operator permit check
- Vehicle licence / registration check
- Vehicle mechanical fitness check
- Vehicle visible mechanical defects check
- Drivers hours of service log check
- Load tie-down / containment check
- Safe loading check

Implementation of a Remote Controlled Weigh Station

The feasibility study concluded that an RCWS is a viable concept for jurisdictions that meet one or more of the following criteria:

- roads with lower traffic volume
- a limited monitoring program
- agencies with remote hauling operations
- high-volume sites that have high enforcement costs
- a vast road network

Many of the above criteria are applicable to commercial vehicle operations in Saskatchewan. In 2006, a joint funding arrangement was reached including Transport Canada, Alberta Infrastructure and Transportation and Saskatchewan Highways and Transportation to proceed with the implementation of an RCWS. International Road Dynamics of Saskatoon, Saskatchewan was contracted for the development and deployment of the system at an existing site on provincial Highway 14 near Macklin. The site is in a rural area approximately 150 km from the closest major urban centre. The development of oil and gas resources in the area has led to a significant increase in truck activity in recent years. The RCWS will be completed and operational in 2007.

The existing equipment at the site consisted of a permanent static scale and electronics cabinet, three digital weight read-out signs, and four static signs situated on highways that lead to the site. The existing static scale, electronics cabinet and scale readout are shown in Figure 1. There is no station building or other facility on site to support long term operation of the facility by enforcement personnel. Therefore, this site has typically been used for periodic short-term operations only.

Four static open / closed signs were located on highway 14 eastbound and westbound, highway 17 southbound and highway 31 northbound, as shown in Figure 2. Trucks can be directed from any of the four approaches to the single scale site. The signs are a simple static sign with two flashing beacons to indicate when trucks are required to report to the inspection station. Figure 3 provides a picture of one of these open / closed signs. The signs can be turned on individually or in any combination to target specific highway

accesses. Communication to each sign location from the RCWS is via wireless RF technology.

Vehicle classification and imaging capabilities were added on each of the four approaches to the station at the existing static sign locations. The classification system determines the axle configuration and class of each vehicle, and identifies those that are required to report to the static scale. At the same time that the vehicle is being classified, a camera captures an image of the side of the vehicle. This provides a visual identification of each vehicle that is expected to report to the static scale, so that compliance can be monitored.

At the scale site, an RCWS kiosk has been added near the static scale to house the system electronics, credentials camera and a communications device for driver information verification purposes. Two cameras with pan/tilt/zoom capabilities have also been added at the scale site. One camera is located to capture images of the license plates of approaching vehicles and the other to capture images of vehicle details as it is weighed on the static scale. The image from the camera at the scale site can be compared against the image captured on the mainline to verify that vehicles directed to report are complying with instructions. VMS signs were installed at the scale site to direct drivers while they are at the RCWS.

Remote monitoring of the Macklin site is provided via a windows based user interface on high speed internet. Authorized personnel can log on to the RCWS and turn on any of the four report locations singularly or in any combination. The user display window has the capability to display vehicle records from any of the four approach locations. Static weight data is also displayed, allowing the remote operator to verify vehicle weight.

Once a vehicle travels over a monitored access route, the inroad WIM classification determines if it is a commercial vehicle/truck and makes a report decision accordingly. All commercial vehicles/trucks are directed to report via the existing static signs. The classification and imaging systems create a vehicle record of all vehicles instructed to report, with information on site identification (one of the four remote locations), time and date of passage, axle spacing, weight of all axles, code for invalid measurements, and vehicle speed.

Once a vehicle has reported to site, the operator can identify the appropriate vehicle record from the list at each location. The operator can also control each of the two onsite cameras to view license plate information and vehicle details of vehicles approaching the static scale. The static weight of vehicles is displayed in the user interface for enforcement purposes and instructions to the driver are relayed via the VMS signs. Once the operator is satisfied with the vehicle, a message to exit station is displayed. If the vehicle requires further inspection, the driver is signaled to park and approach the kiosk. A driver may be asked to produce credentials, documentation and permits to the operator via the imaging system and if further communication is needed a telecommunications device is provided.

System Operation and Expected Results

Once the system is fully operational, it can be utilized either remotely or with personnel on-site. Although the operation strategy is still to be fully defined, and will be adapted to maximize effectiveness, it is anticipated to include a mix of on-site and remote operation of the system. The problem of weigh station avoidance can be addressed by operating the station remotely. During on-site operations, some drivers will quickly become aware that enforcement is taking place and will begin to avoid the station. However, if station operators need to travel significant distances, it is not efficient to have them operate the station for only short periods of time. The remote operation allows operation to occur over a wider range of times and for shorter periods when enforcement will be most effective in identifying violators.

The use of remote operations is expected to provide cost savings over traditional operations. The remote operator will not be operating the station full-time, and will be able to allocate time to other office and administration duties. In the future, one operator may be able manage multiple remote weigh stations throughout the province. The remote approach also saves on operational expenses such as a patrol vehicle, uniforms, fuel, equipment, meal and travel allowances, etc.

During remote operation, trucks will likely be directed from one or more of the four approach routes and directed to report to the scales. This will avoid confusion and delays at the scale site, since there will not be a manned presence. The truck will be directed through the process of static weighing by the variable message signs, with the remote operator assisted by the on-site cameras.

If the truck is found to be overweight, a safety problem is identified, or if there is a desire to check credential and licensing information, the truck will be directed to park and report to the kiosk. The remote operator will be able to communicate verbally with the driver at the kiosk and can view papers through a camera system. After reviewing the paper work, there are several options available to the remote operator:

- release the truck to continue
- hold the truck until an enforcement officer can reach the site
- issue a citation to the driver

Conclusion

The rural highway infrastructure in rural areas of western Saskatchewan is enabling economic development in the area. To maintain the aging infrastructure in a satisfactory condition, despite increasing levels of truck loading, Saskatchewan Highways and Transportation has turned to technology. A remote control weigh station being installed in 2007 will allow for more effective monitoring and enforcement of trucking activity, while limiting the demand on human and financial resources.

References

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3. Cottrell, B., The Avoidance Of Weigh Stations In Virginia By Overweight Trucks. Final Report, FHWA/VA-93-R2; VTRC 93-R2, 1993
4. Breker, J. , Feasibility Study of a Remote Control Weigh Station, prepared for Transport Canada, TP 14358E, March 2005

Figures

Figure 1: Existing static scale at Macklin enforcement site

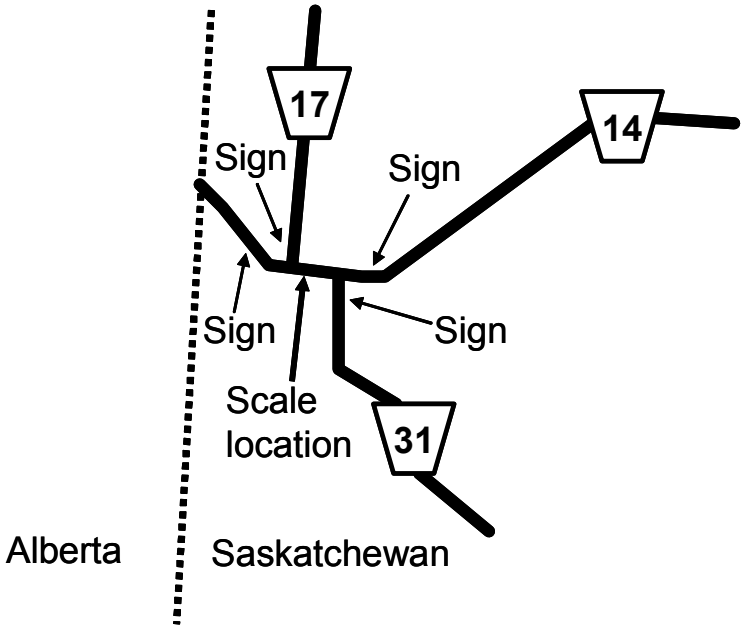

Figure 2: Layout of signs and scale at site of remote control weigh station

Figure 2: Existing inspection station open / closed sign