Agency-wide Benefits

Significant growth in domestic and international commerce, coupled with ever-increasing traffic congestion and delay on surface transportation networks, challenges the ability of industry to move freight economically without the use of larger and heavier loads. This trend, in turn, challenges limited enforcement resources tasked with monitoring commercial motor vehicle (CMV) size and weight compliance in the interest of infrastructure preservation and in response to the structural constraints of the existing infrastructure.

The outcomes are costly and widespread; attributable to operational inefficiencies and ineffectiveness and resulting infrastructure damage, compromised safety, and unnecessary associated delay and harmful emissions. At fixed weigh station facilities, estimated overweight violation capture rates on U.S. Interstates approximate 1%. Annual costs attributable to overweight CMVs range from $8 billion to $144 billion at the state level and from $265 million to $1.11 billion nationally. Single tunnel or bridge/overpass "hits" by oversize CMVs commonly result in between $150,000 to $350,000 in infrastructure damage, roadway closures lasting from two weeks to two months, and traffic detours up to 45 minutes in length. The review, approval, and issuance process for oversize/overweight (OS/OW) vehicle permits is labor-intensive, time consuming, and prone to human error, with an ever-increasing volume of permit requests from the motor carrier industry. In 2007, 72,524 of U.S. bridges in the National Bridge Inventory were classified as "structurally deficient", with repair estimates totaling $65.3 billion. A lack of coordination, integration, and data sharing between and within agencies tasked with CMV size and weight management adds to the cost of performance.

During the 2006 Commercial Motor Vehicle Size and Weight Enforcement Scanning Study - sponsored by the Federal Highway Administration, the American Association of State Highway and Transportation Officials, and the National Cooperative Highway Research Program - a team of U.S transportation experts observed notable technology-based European policies and procedures for CMV size and weight management leading to enhanced efficiency and effectiveness in operations. This informational brief describes these policies and procedures and considers the potential for U.S. application, including the necessary supporting technologies. Anticipated benefits and associated cost savings related to operational enhancements, infrastructure preservation, increased safety, and reduced congestion and harmful emissions are also described.
Unique Partnerships

An overarching factor contributing to the success of many of the European policies and procedures for CMV size and weight management is the high level of collaboration between similar agencies of different jurisdictional levels (e.g., national and regional law enforcement agencies) and between different agencies (e.g., transportation and law enforcement agencies). In The Netherlands, for example, primary responsibility for CMV size and weight enforcement rests with the Ministry of Transport and National Police Agency. To ensure that CMV size and weight enforcement is a continued and consistent priority among the two agencies, the Ministry of Transport funds approximately 100 additional limited capacity police officers. In addition, these two agencies work closely with the Transport Inspectorate, who monitors and enforces regulations on vehicle insurance, fleet maintenance, vehicle safety, and environmental conditions and Public Prosecution Service, who ensures that confirmed CMV size and weight regulation offenders are called to account with the law. Transportation and law enforcement agencies in the U.S., responsible for CMV size and weight enforcement, often do not share the same level of collaboration.

Commercial Motor Vehicle Size Enforcement

Infrastructure Preservation

Both Switzerland and The Netherlands utilize technology to enhance CMV size enforcement with a focus on tunnel infrastructure. The Swiss use roadside infrared sensors and traffic signals placed upstream of tunnels to detect overheight vehicles and direct drivers to divert from the current route. The Dutch are experimenting with joint height detection/weigh-in-motion (WIM) systems in an effort to reduce overall implementation costs.

Pre-selection

Germany utilizes a gantry-mounted, laser-based vehicle profiler system and supporting pre-selection procedures to enhance CMV size enforcement. As a vehicle passes under the gantries at mainline speeds, accompanying software creates a three-dimensional model of the vehicle. If a vehicle is identified as potentially oversized, vehicle silhouette and license plate images are sent downstream using dedicated, short-range communications (DSRC) to mobile enforcement units. Roving enforcement personnel direct the driver off-route for manual measurement and subsequent enforcement action.

Direct Enforcement

Switzerland uses the same gantry-mounted vehicle profiler system at off-route stationary enforcement locations. Mobile enforcement units escort suspected oversize or overweight vehicles into the facility. Once inside the facility, vehicles are directed to drive under the gantries at speeds less than 5 kph (3 mph) and onto a static weigh bridge that provides simultaneous axle and gross vehicle weight measurements. Size- and weight-related citations are generated automatically on-site for issuance. The driver may also be required to offload the vehicle before proceeding.

PERCEIVED AND REPORTED BENEFITS

- overall time savings and ability to process a higher volume of CMVs
- more efficient use of personnel and ability to focus on other enforcement duties
- increased measurement accuracies and higher certainty in court
- significant cost savings from single prevented infrastructure impact event
- reduced road closure-related congestion, emissions

Commercial Motor Vehicle Weight Enforcement

Pre-selection

Relying predominantly on mobile rather than fixed operations, several European countries utilize a combination of WIM and vehicle identification systems (WIM+VID) for real-time pre-selection of non-compliant CMVs. Enforcement personnel at a downstream mobile enforcement site receive weight data and vehicle silhouette/license plate images from an upstream WIM+VID site using DSRC. On-road colleagues intercept suspected overloaded vehicles and escort them to the downstream mobile site. On site, the vehicle is weighed using portable static scales. If a vehicle is confirmed to be overweight, the driver is issued a citation and/or required to offload the vehicle before proceeding. Violation capture rates are reported to be as high 80% in The Netherlands using pre-selection methods.

Resource Scheduling

With continued focus on enforcement efficiency, France, Slovenia, and The Netherlands use archived WIM+VID data to schedule mobile enforcement resources. In The Netherlands, reports containing the number of overloaded vehicles by hour of day and day of week for the most recent week and prior six weeks are automatically generated for each of the WIM+VID sites. From these reports, enforcement administrators can readily
determine the most productive scheduling and dispatch of resources. Quality Assurance Statements - that include the number of axles measured, period of measure, and inaccuracy (compared to static weights) - accompany each report. Applying similar technologies and procedures in the U.S., the Montana Department of Transportation reported a $700,000 annual infrastructure cost savings.

Preventative Contacts

Archived WIM+VID data is also used to direct preventive contacts with habitually non-compliant carriers in France and The Netherlands. Carriers with the highest historic overloading offenses are sent an initial advisory notice, meet with enforcement officials at their place of business, and begin a monitoring period. If loading behavior sufficiently improves, the carrier is reclassified as compliant. If it does not, roadside enforcement personnel begin stopping all carrier vehicles for inspection, regardless of load status.

Direct Enforcement

At mainline speeds, direct enforcement (i.e., the ability to issue citations based solely on WIM system data) could increase the proportion of CMVs monitored, overloaded CMVs detected, and non-compliant CMVs cited to effectively 100%. Off-route, at low speeds, French enforcement officials estimate a tenfold increase in the number of CMVs processed. Implementation challenges include attaining sufficient WIM system accuracy levels, gaining metrological certification, and modifying existing laws that require static weight measurements. The National Metrology Institute in France recently certified low-speed WIM systems for direct enforcement. Direct enforcement using high-speed WIM is estimated to be 5 to 20 years in the future.

Bypass Prevention

The use of mobile enforcement procedures and low-cost technologies better positions European enforcement officials to address bypass challenges. France and The Netherlands have integrated bypass considerations into their WIM system site selection process. The Netherlands has also integrated bypass considerations into site-level system plans. On multilane facilities, WIM sensors are installed in the right two lanes; remaining lanes are equipped with only electronic loops and overhead cameras to detect bypassing vehicles. As designed, overall system costs are reduced without significantly altering the effectiveness of enforcement efforts.

Weigh-In-Motion System Calibration

Continuous Calibration

France and The Netherlands utilize continuous, ongoing calibration procedures to ensure an adequate level of WIM system performance. Static axle weight records obtained during scheduled enforcement activities are relayed, in near real-time, to the WIM site using DSRC and directly compared for accuracy to the axle weight records captured by the WIM system for the same vehicles. If an unacceptable level of data error is observed, the problem is quickly corrected through system calibration or other remedial action.

Quality Assurance

Transportation officials in The Netherlands issue a formal Quality Assurance Statement – that includes the number of axles measured, period of measure, and inaccuracy (compared to static weights) - with every data request including routine data disseminations. Provision of this Statement allows individual data users to determine the sufficiency of data quality based on their individual needs. Both France and The Netherlands also utilize various data filtering processes to further ensure that WIM data is of sufficient quality.

Dynamic Calibration

Traditional WIM system calibration methods require conversion of the true dynamic load to a static measure, with a concomitant loss in accuracy. Through a unique public-private partnership in The Netherlands, a specially-designed vehicle was developed to allow calibration of a dynamic measure to the true dynamic load. The dynamic calibration vehicle measures the dynamic forces exerted on the WIM system with ±5% accuracy using strain gauges and axle-mounted accelerometers to correct for the influence of inertia.

PERCEIVED AND REPORTED BENEFITS

- increased overweight violation capture rates
- encourages self-monitoring by industry
- reduced fixed facility vehicle demand and mainline safety/congestion concerns
- reduced emissions from current in-facility static scale weighing process
- significant cost savings attributable to reduced infrastructure damage
OS/OW Vehicle Permitting, Routing, and Monitoring

Self Permitting/Routing
Motivated by a need to improve safety at tunnel approaches, limit the impacts of temporary road closures, and promote a national policy of shifting goods from road to rail, Swiss transportation officials developed a comprehensive website, www.truckinfo.ch, that allows CMV drivers to self-route based on origin, destination, and route restrictions. Transalpine piggyback rail service is offered as an alternative. Similar systems - that automate both permitting and routing functions - are currently commercially available and in use in several states in the U.S.

Bridge Safety Assessment
Traditional methods for calculating bridge load carrying capacity for OS/OW permit issuance are conservative to account for uncertainty in the structure’s response to the load. Bridge WIM systems provide direct measurements that support more accurate determination of influence lines, load distribution, and traffic impact factors. In France and Slovenia, calibrated influence lines derived from bridge WIM systems are used to calculate bridge safety under OS/OW loading.

Remote Field Verification
Slovenia and The Netherlands historically observed permitted OS/OW vehicle violation rates from 40 to 70%. Currently, WIM+VID systems are utilized to remotely verify non-compliant OS/OW movements. In-field CMV weight/configuration data and unique vehicle identifiers are captured and compared, in near real-time, to the approved permit application. If substantial differences exist or if no permit application is on file, mobile enforcement units are alerted to intercept the vehicle and assess appropriate penalties.

Bridge Infrastructure Preservation

Structural/Safety Assessments
To optimize their Nation’s bridge rehabilitation and replacement, Slovenia utilizes bridge WIM systems and resulting measured data to support determination of influence lines, load distribution, and impact factors. Noted improvements to theoretical assumptions afforded through bridge WIM systems enhance the accuracy of conclusions regarding existing bridge safety under general loading (i.e., structural assessment) or intended OS/OW vehicle loading (i.e., safety assessment).

Load Testing
Traditional load testing methods include proof load and diagnostic tests. Bridge WIM systems support less costly/intrusive “soft” load testing using normal traffic and observable structural behavior. Soft load testing does not require pre-weighed vehicles or bridge closure and does not risk overloading or damaging the structure. As such, it can be performed with little advance preparation or excess cost, particularly if the structure of interest is already instrumented.

PERCEIVED AND REPORTED BENEFITS
- increased permitting/routing efficiency, productivity, and cost-effectiveness
- increased accuracy in determining bridge safety
- increased permit violation capture rates
- significant cost savings from reduced infrastructure damage and/or premature rehabilitation
- reduced road closure-related congestion, emissions

Supporting Technologies by Functional Area

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