

# Under pressure

Around the world authorities are beginning to rely more heavily on portable weigh-in-motion systems. **Saul Wordsworth** discovers in which situations they are proving most effective, and asks if the days of static scales may be numbered

**W**eigh-in-motion (WIM) systems are generally permanent, requiring expensive roadwork and time-consuming installation. Less is heard about portable systems, yet they are viewed by some as the surprise weapon in the WIM armory.

Our story begins in Minnesota, where in 2009 the legislature issued a ruling that all state roads, unless labeled otherwise, were to be a 10-ton design. The authorities suddenly started to take more notice of how many overweight vehicles were on their roads and think about what kind of damage they were inflicting.

"Not only was the state concerned about general road use, it was also worried that new aggregate mining might see certain routes suddenly overloaded with heavy commercial vehicles," says Ben Timerson, transportation data and analysis program manager with the Office of

Transportation System Management at Minnesota Department of Transportation (MnDOT). "We looked for a low-cost portable WIM system."

The University of Minnesota Duluth teamed with Timerson and the MnDOT Office of Transportation System Management to develop such a portable WIM system (see page 41).

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**Ben Timerson, transportation data and analysis program manager, MnDOT**



"We could install four low-cost WIM systems by the university for less than US\$220,000," says Timerson. "We even demonstrated our pre-screening WIM system for the Minnesota State Patrol. Unfortunately it was too much work for them to install and in the end the project was mothballed."

## Portable purchase

Enter Captain Jon Olsen, commander of the commercial enforcement division, Minnesota State Patrol. "After ruling out the university option, we investigated a number of portable WIM systems and purchased three," he says. "We saw this as our own little research project on how we could conduct enforcement better and take the focus away from fixed scales."

Portable WIM could be considered an unusual choice, particularly in the USA. The most common worldwide combination is high-speed WIM on highways providing pre-selection, followed by static weigh stations or portable scales for vehicles suspected of being overweight.

"We don't use portable WIM every day, but once or twice a month we'll head to a chosen location and do a saturation," continues Olsen. "This means setting up at unannounced, unplanned sites with as many personnel as possible and weighing every truck that passes. That gives us









## US\$25m

The world's biggest ever traffic fine, reported to have been levied on Chinese trucker Mr Zhang for driving his vehicle, overloaded with sand to around 120 tons, onto a bridge near Beijing on July 19, 2011, causing it to collapse

the ability to screen and weigh 1,000 trucks a day that otherwise would pass by such remote locations. We focus on areas away from fixed scale facilities or use them in places where we know there's a high probability of commercial vehicles trying to bypass them. When a commercial driver knows they are overweight they may attempt to find a route around a fixed scale. Some truck stops have maps showing the location of all the scales and information regarding hours of operation. The USP of portable WIM is the element of surprise."

Olsen sees the solution as a low-cost, effective way to screen trucks, though crucially not to enforce. Enforcement is left to the five fixed-scale facilities across the state that screen 70-80,000 trucks per month, along with portable weigh scales. Under North American Standards Handbook 44 (Specifications, Tolerances, and Other Technical Requirements for Weighing and Measuring), enforcement via high- or low-speed WIM is not allowed in the USA, thereby limiting their application to pre-screening. However, recent OIML (Organization Internationale de Métrologie Légale) certification for certain WIM systems has led some jurisdictions around the world to set up the legal framework necessary for such setups to be used for enforcement.

### User experience

"I wouldn't say we found low-speed portable WIM ineffective, but there were definitely some pitfalls," says

Vehicle weight spot checks being carried out by in Minnesota State Patrol, using portable WIM



“When a commercial driver knows they are overweight they may attempt to find a route around a fixed scale... The USP of portable WIM is the element of surprise

Captain Jon Olsen, commander of commercial enforcement division, Minnesota State Patrol



Olsen. "If the driver brakes or steers over the WIM strip it can disrupt measurement. You also require a true surface. Plus, weighing a truck roadside via a weigh station or static scales only takes one person, but at times we needed up to six people with the portable WIM: one to run WIM system itself, one to explain to the driver to move across the scale at 10 miles per hour and another to notify the first person if the vehicle is overweight. After that you still need others behind the scenes using portable scales to weigh the vehicles that have been flagged."

Terry Bergan is president and CEO of International Road Dynamics (IRD) and an old hand at WIM. He acknowledges the rarity of portable WIM use in the USA but stresses their usefulness when there are rapid changes in circumstance, such as when exploratory drilling rigs are set up, creating the need to react quickly, especially on secondary roadways.

"Portable WIM is very popular in Latin America on remote roadways where they're not going to build a weigh station," he says. "They find a space at the side of the road and pull the vehicles in. The European and North American concept of highway safety doesn't necessarily exist elsewhere. We supplied a low-speed portable WIM to India and they placed it on the shoulder of the road. There were inches between the operators and the trucks going by."

"Most road damage is caused by overloaded axles," says Kees Hersback, chief inspector at the



## University challenge

**Academics are helping to power the drive toward lower cost, portable WIM**

The University of Minnesota Duluth was tasked with designing a low-speed, portable weigh-in-motion (WIM) system in 2013 that could be installed on county roads and lower-volume trunk highways. The sensors deployed were RoadTrax Brass Linguini class 1, encased in the same material that is used for conveyor belts. The belts were 1in (25mm) wide and 24in (610mm) long, and were secured to the pavement with anchors drilled into the bitumen. The prototype could

be installed in just over half an hour.

"To install the system you need to perform a lane closure with traffic control and a crew of at least two," says MnDOT's Ben Timerson. "In 2013 we tried to run the tests for seven days. Almost half of the setups didn't make it. Several were pulled up accidentally and at least two were deliberately removed from the road pavement. In 2014 we went down to a 48-hour test. We didn't lose any data that way."

Though the project was shelved, the university remains

in discussion with the State Aid office with a view to installing a low-cost system on county routes for US\$50,000.

"For MnDOT, a typical two-lane WIM in a new location with Kistler piezoelectric quartz sensors and an IRD WIM controller costs about US\$220,000 and the weight data would be 90-95% accurate, compared with our 80%," says Timerson. "We have had information requests from a couple of DOTs but they haven't gone beyond the initial conversation."

### 400 tons

The weight of the heaviest load ever to have been transported on US roads – a power station generator



Human Environment and Transport Inspectorate (ILT) in the Netherlands. "Most damage to viaducts and bridges is caused by overloaded total weight. Portable WIM systems make it possible to weigh each axle separately, one at a time. Other systems only weigh the total weight. However, we have chosen not to use portable WIM because of the lack of enforcement."

Like many other operators, ILT uses high-speed WIM for pre-selection followed by portable weighing scales that have been sanctioned for enforcement but bring their own challenges in terms of time and manpower.

### Enforcement at low speeds

While low-speed WIM is not used for enforcement in North America and much of the western world, it has been sanctioned as a means to penalize overweight vehicles in tiny pockets of South America, the Middle East and Eastern Europe. Brazil started its partnership with Haenni at the start of 2000 and ordered its first portable sensors five years later. Felipe Fernandes de Paula is an electrical engineer for Politran Tecnologia e Sistemas Ltda, provider of Brazil's enforcement solutions:

"In Brazil we are highly reliant on road freights. Thus the best choice for our scenario is portable low-speed WIM sensors. They are necessary to weigh trucks without a great impact on the road traffic

Right and top right: The first field test of the portable WIM, designed by University of Minnesota, was on US53 near Cotton, Minnesota



**“**High-speed enforceable WIM is a technical challenge for manufacturers and it is a legal challenge to get it accepted. But it does exist

Hans van Loo, weigh-in-motion consultant, Corner Stone International, Switzerland



### 40 tons

The maximum gross vehicle weight normally allowed to travel on roads in the USA

and to minimize the increase in travel time to the destination. While we also use static sensors for many other applications, we think the advantages of the portable WIM system is the short weighing time. For example weighing a truck with five axles using our WIM takes 30 seconds whereas a static system may take three minutes."

In order to use portable WIM for enforcement in Brazil, the site must first be certified by the regulatory agency, which uses its own rules based on those of the OIML. All vehicles are required by law to visit the weighing sites – or face a fine – and unless informed otherwise it is





## 893 tons

The fully loaded gross weight of the BelAZ 75710 – the world's biggest, highest capacity haul truck. Not suitable for use on normal roads anywhere

obligatory for heavy goods vehicles to enter the weighing area.

"We use dynamic WIM systems at four sites," says Fernandes. "The sites are made exclusively for weighing. We have 60m [200ft] of extension and less than 3% of inclination to ensure the greatest accuracy. Because of that we cannot do 'surprise' operations with dynamic WIM systems."

### High-speed solutions

All vehicle weighing systems have pros and cons. Portable WIM gives flexibility but is personnel-heavy and not always enforceable; weigh stations are extremely accurate but they are also very expensive; portable scales are flexible but cumbersome and time-consuming; high-speed WIM is efficient but unenforceable. Or is it?

"High-speed enforceable WIM is a technical challenge for manufacturers and it's a challenge to get it accepted legally," says Hans Van Loo, an independent WIM consultant focused on both user and vendor. "But it does exist."

Above: Customs officials use WIM systems to help in their task of checking for people traffickers

In 2011 the government of the Czech Republic passed a law enabling the deployment of high-speed WIM for direct enforcement. A system created by Camea in conjunction with Kistler was subsequently approved for direct enforcement by the Czech Meteorology Institute (CMI). Since the start of the year, high-speed WIM has been certified as being able to create legally valid data for enforcement.

"There have been test cases in the Czech Republic's high court where the legal acceptance by CMI has been deemed sufficient," continues Van Loo. "The system is based on Kistler sensors. Great sensors are important but they're only one aspect of the system. What you can't afford to do is to ticket a truck that is not overloaded."

**“We have a number of stations in the Czech Republic based on direct enforcement that have been operating since January**

Emil Doupal, MD of RST Consulting, Switzerland

The need for high-speed enforcement cannot be underestimated. A small-scale project has been established in Russia, with tickets already being issued. High-speed enforceable WIM is also being used to protect the city of Prague. Pilot projects have been rolled out in a clutch of African countries, plus Brazil. Kazakhstan is soon to embark on the legal enforcement stage.

"We have a number of stations in the Czech Republic based on direct enforcement," says Emil Doupal, managing director of RST Consulting and instrumental in the Czech project. "I am not at liberty to say how many penalties have been enforced, but we finished certification last November followed by a two month trial. We have been operating direct enforcement since January."

Over the past decade France has invested heavily in sensor technology, and according to Doupal, the authorities have expressed great interest in the Czech project. Were France to certify the use of high-speed WIM for enforcement, a major precedent would be set.

### Fast forward

According to Timerson a new static weigh station was recently installed in Minnesota at the cost of US\$10m. Meanwhile rehabilitation on an existing site cost taxpayers US\$100,000. Such decisions look increasingly anachronistic and hard to justify against the backdrop of budget cuts. For this reason it is likely that portable WIM and, in time, high-speed enforceable WIM may become commonplace. ○



## Body check

### Weigh-in-motion can be used to check for stowaways

Are there uses for portable, low-speed weigh-in-motion technology, beyond simply catching overweight vehicles? On the border between Afghanistan and Pakistan, one has been found. A short-term portable

low-speed WIM system was installed in 2009 by the US military. The weighing process was less to detect goods, more to detect people. People-smuggling was a problem at the time. A truck may be able to hide a person, but it cannot

hide weight. Vehicles would roll over the WIM system at 10mph or less and inspectors would check for unusual numbers based on the weight listed for the vehicle. Any disparities could be investigated further using heat-sensitive cameras.