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Briefing

Weight sensors for lorries: Effective, affordable, reliable

Summary

Overloading of lorries is one of the most common infringements found in road freight transport: One in three lorries controlled is overloaded by 10% or even 20% over safe legal weight limits.[i] This poses serious problems to infrastructure, road safety, driver safety, environmental impacts and not least a 'race to the bottom' in the road haulage sector and distortion of competition between modes.

This briefing summarises the findings of a new study by RappTrans, commissioned by Transport & Environment, the European Transport Workers' Federation, the Belgian federal state and Walloon Region, which shows how this problem can be tackled with an effective, reliable and affordable solution.[ii]

Mandatory on-board weight sensors (OBW) for lorries, currently under discussion under the Weights and Dimensions directive (review of 96/53/EC), offer a highly cost-effective solution for hauliers, manufacturers and especially for public authorities, who could make major savings in better-targeted controls, reduced infrastructure damage and better road safety.

Whereas the Commission's proposal asks Member States to encourage the use of on-board weight sensors, it stops far short of mandating them. This is a missed opportunity to simultaneously lower the costs to hauliers and public authorities and ensure the enforcement system becomes more effective at lower cost.

The study shows that the Commission had dramatically over-estimated the cost per vehicle of on-board weight sensors by around 10-20 times. Models are on the market today from €550-1200 per vehicle, and the cost would drop significantly if OBW become mandatory on new lorries. All major truck brands already offer them as an option today.

Today's sensors already have high levels of accuracy fit for the purpose of pre-selecting vehicles which can then be double-checked by authorities.

Mandating on-board weight sensors is a no-regrets measure as an important addition to the broad range of policies needed to reduce the environmental and safety impact of freight transport. Today three-quarters of freight in Europe is transported by road and HGVs account for a quarter of greenhouse gas emissions from road transport and are involved in almost one-in-five fatal crashes. As well as policies to stimulate a shift to cleaner and safer modes of transport, measures are urgently needed to make sure the European fleet of five million trucks becomes cleaner, safer and that the rules are strictly enforced.

Why are overloaded lorries a problem?

Overloaded lorries disproportionately damage road infrastructure. Because pavement damage is determined by axle weight, lorries cause far more wear than cars. Overloading exacerbates the impacts, e.g. the effect of loading 10% over the weight limit results in 46% higher pavement damage and one-third shorter pavement life. This means roads have to be repaired and resurfaces much more often, at a high cost to the public budget. Public-financed infrastructure, including bridges and crash barriers, is designed for legally specified weights and dimensions, and would require adaptation for safe use by heavier vehicles.

Overloaded lorries also undermine fair competition between hauliers and modes. For example in France, it was estimated that a 5-axle articulated truck operated at 20% above

the legal weight limit, generates a €26,500 benefit per year.[iii]

Weight limits are in place both to protect the infrastructure and safety. An overloaded lorry can be less stable and compromise braking efficiency, increasing crash risk and severity. An overweight vehicle can also be an indicator of other violations, e.g. driving hours, speeding or poorly secured loads. Overweight lorries may also cause congestion if struggling on uphill sections. Overloading affects the safety and working conditions for lorry drivers. The strain on the engine means higher emissions of CO2, air pollutants and noise, but it is the overall effect of the race to the bottom and unfair price competition in road freight (and vs. other modes) that is most damaging for the environment and safety.

How can weight enforcement be more effective?

The high number of overloading infringements shows that current enforcement is not an effective deterrent. Weight compliance checking is organised on a national basis, with different intensity and focus between Member States. With a few exceptions (Switzerland, Netherlands, France), checks are relatively rare and the risk of an overloaded lorry being caught is perceived to be low. Police checks for weight enforcement are very time-consuming and therefore expensive, both to the public authorities, but also to those hauliers respecting the rules who are needlessly stopped. Currently, vehicles suspected of being overloaded – usually only based on an officer's snap judgement of appearance or a random sample - have to be flagged down and stopped, and then guided to the closest available certified weighbridge. Organised compliance campaigns are more effective but require large teams of police to set up a control site. This is costly and also involves stopping a great number of vehicles that are respecting weight limits.

Radically improved enforcement would be possible through the use of technology to pre-select vehicles that are suspected of being overloaded. Automatic pre-selection would allow checking many more vehicles and would focus the actual enforcement effort on vehicles that are likely to be overloaded. This would reduce the burden of enforcement for the majority of hauliers that do respect the rules. In its proposal on weights and dimensions, the Commission therefore recommends on-board weighing (OBW) or weigh-in-motion (WIM) systems to single out vehicles which are likely to be overweight.

Both OBW and WIM can be used to screen overloaded lorries. However, a high number of WIM systems would need to be installed in the infrastructure by public authorities to reach a sufficient compliance check density. At around €100,000 per installation this is costly for the public purse. As WIM are installed at fixed locations they are easily avoided by overloaded lorries.

On-board weight sensors are more effective and at lower cost. Sensors are fitted to vehicles to enable the weight data to be communicated at any time and any location from a moving vehicle to roadside inspectors. The information can be read by authorities in the same way as the digital tachograph. OBW give drivers real-time information on the overall weight and axle weights. Current accuracy levels attained by OBW are well suited for pre-selection (+/-10% accuracy). Only those vehicles where there is a reason to double-check would then be stopped for testing at a weighbridge.

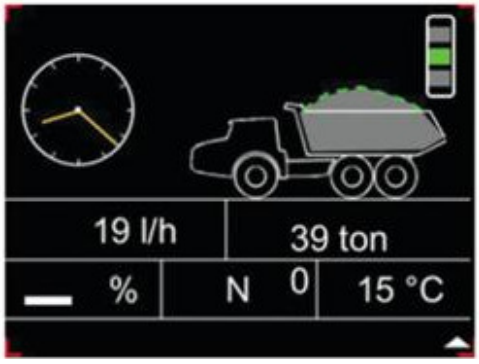

Figure 1: Volvo on-board weight sensor driver display

How much do weight sensors cost?

The Commission shied away from proposing mandatory OBW primarily on the grounds of cost. Their research concluded costs would be €3000-€12,000 per vehicle. This dramatic overestimate overlooked many models which are already available today.

Today sufficiently accurate OBW systems cost on average €600-€1200 per truck for hardware and installation (APT or strain gauge). Effective and affordable solutions exist for all commercial vehicle types. All of the major truckmakers currently offer OBW to customers as an option.[iv] For example, Daimler offers an air pressure system fitted to its vehicles for around €570.

Sensor costs would fall dramatically if these were mandated for new commercial vehicles due to economies of scale, learning effects and innovations in product and production methods. If mandated, weight sensors would be fitted as standard during production and in much greater numbers, costs are estimated at around €500 per vehicle. This represents an increase of 0.5% on the average purchase price of a longhaul lorry of around €95,000.

Retrofitting is also possible and currently estimated to cost around €2000 for a typical HGV including all sensors, cabling and the information display for the driver.

Enforcement authorities would have to be equipped with road-side readers to capture the short-range wireless (DSRC) signal each costing a few thousand Euros, potentially the same readers as for the digital tachograph. This is limited compared to the cost of constructing infrastructure-based weighing solutions such as WIM. The targeted controls of only vehicles where there is reason to suspect overloading would also save substantial time for inspection officials and so will be much more cost-effective.

Is on-board weight sensor technology mature and accurate?

Yes. There are several technological solutions on the market today from a number of different suppliers, as well as being offered by truck manufacturers as an option. The technology used for on-board weighing applications is usually guided by the type of vehicle being used (particularly the suspension) and the accuracy required. The three main sensor types are load cell (esp. in steel-sprung suspensions), air pressure transducer (APT, esp. in air bag suspensions) and strain gauge sensors.

Load cell sensor

Air pressure sensor

Strain gauge sensor

Accuracy levels of around +/-10% are required for pre-selection of overloaded vehicles. Different accuracy classes have been defined for weigh-in-motion (WIM) systems.[v] For direct enforcement (without follow-up weighbridge control) accuracy levels of below 5% would be needed.

Properly calibrated and used, all three sensor types can achieve a very high accuracy (<5%) in real use but needs regular calibration to maintain the initial accuracy over time. How often sensors need to be recalibrated depends on the type of sensor that is used and level of accuracy required. This is also similar to the new digital tachograph requirements, which requires periodic checks to ensure accuracy.

Sensors with accuracy levels of +/-10% are already readily available and are sufficient for pre-selection purposes. This level of accuracy can easily be achieved with existing weight sensor technology and – like the digital tachograph - would require recalibration once every two years. OBW can also be compatible with relevant ISO and CEN standards already in place in relation to short-range data transfer and privacy.

Given the organisational synergies between digital tachograph and OBW it would be logical to set a similar time-line for both. The technical specifications for the new smart tachograph have to be established by 2017.

Are weight sensors cost-effective?

In its impact assessment the European Commission assessed the cost-effectiveness of mandating weight sensors for new lorries. Improved weight enforcement through weight sensors was assumed to have benefits of ca. €900million but the costs of mandating the devices would largely exceed this and cost €2.3 billion.[vi]

However, the impact assessment assumed weight sensors would cost €7500 per lorry.[vii] The Rapp Trans study, which assessed the costs much more thoroughly, finds the cost is below €1000 today and will probably fall to €500 when mandated. That's 15 times less than what the Commission estimated.

If we take this into account, the estimated cost would be around €153 million with benefits still at €900 million – that's an excellent benefit-cost-ratio (6-1). Indeed, even with a more conservative cost estimate, e.g. cost of sensors €750 or even €1000, the benefit-cost ratio would remain very positive.

Conclusions

Lorry overloading is a serious problem with negative impacts on infrastructure, safety and environment and distorts competition between hauliers and transport modes. Currently weight enforcement is not an effective deterrent as many vehicles are still overloaded. Today's enforcement methods are expensive and cumbersome for public authorities and burdensome for the majority of law-abiding hauliers.

Technology is readily available to dramatically improve weight enforcement whilst also saving time and costs for both public authorities and hauliers. The study shows that voluntary use would not bring widespread benefits. On-board weight sensors must be mandated to enable authorities to pre-screen lorries for overloading and carry out more targeted checks. This will focus the actual enforcement effort on vehicles that are likely to be overloaded and act as a more powerful deterrent.

Accurate and affordable weight sensors should be mandated for new HGV (N2, N3 >3,5t) because of their higher axle loads and mileages. Costs are expected to be around €500 per vehicle. Because of the synergies with the digital tachograph, mandatory fitment of weight sensors on all new lorries from 2017 is appropriate.

All the conditions for radically improved weight enforcement through the use of weight sensor technology are fulfilled. The technology is already available; it's accurate, inexpensive and its use would decrease the administrative burden for hauliers or public authorities. Because of the limited cost and great potential gains (lower road maintenance bills, fairer competition) this is also highly cost-effective.

For further information:

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[i] COM(2013)195 Proposal for a Directive of the European Parliament and Council amending 96/53/EC of 25 July 1996.
[ii] RappTrans (2013) Study on heavy vehicle on-board weighing, Final report, Basel, December 2013. http://www.transportenvironment.org/publications/weight-sensors-lorries-effective-affordable-reliable
[iii] HVParis2008 – ICWIM 5 – Proceedings of the International Conference on Heavy Vehicles
[iv] Including DAF, Scania, Iveco, MAN, Daimler, Volvo.
[v] COST 323 accuracy classes : Class A, direct enforcement : 1-2%; Class B, pre-selection: ca 10%.
[vi] Commission impact assessment, COM (2013) 195, p.xlviii
[vii] "Assuming the average price of the range provided in chapter 5.2.1 *(€3000-€12000)* and an average life time corresponding to that of HGVs being 7 years" COM (2013) 195, p.xlviii, footnote 92.