TRUCKS MATTER! SUPPORTIVE REGULATORY AND COMPLIANCE FRAMEWORKS TO EXTEND THE LIFE OF ROAD ASSETS

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Abstract

Transport agencies in both developed and developing economies face problems with ageing infrastructure and budgetary constraints. Furthermore, competition for scarce public resources often inhibits or delays maintenance activities. Simultaneously, the demand for road freight transport continues to rise and become more complex. These trends are likely to continue, making proactive asset management ever more urgent. In this context, digitalization offers new opportunities.

The OECD-ITF working group *Policies to Extend the Life of Road Assets* (2017-2018) brought together policy options for extending the life of road assets by mitigating deterioration caused by trucks. Beyond traditional engineering responses, they considered the role of trucks in road asset deterioration from a broader, demand-oriented perspective. This resulted in a new policy framework for maintaining and managing road assets in a cost-effective way and to meet road freight transport demand on a sustainable basis. The new policy framework contains three groups of policy measures: demand-responsive policies; policies that regulate demand; and policies that influence demand.

The report from the working group on *Policies to Extend the Life of Road Assets* incorporates eight chapters (including a summary chapter).

This paper focuses on the following chapters from the report:

- Chapter 4 – Supportive Regulatory Frameworks for trucks.
- Chapter 5 – Achieving Compliance with Regulations.

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1. What is the issue the paper addresses

Policies to extend the life of road assets are often viewed as being in competition with truck access policies, and more broadly, in competition with regulatory frameworks for the management of trucks on road networks. Trucks are widely recognised as contributing to the 'consumption' of road assets at a much greater level than most other vehicle types.

The projected growth in freight volumes means that there will be sustained increases in the tonne kilometres (t-kms) of freight moved by trucks. This forecast, coupled with fiscal constraints that impact on road asset maintenance and capital investment programmes, means alternative approaches need to be included to complement conventional options considered by policymakers and road asset managers. The 'do nothing' approach is not sustainable. The result will be an ongoing increase in the volume of truck traffic, and the potential for increased wear of road infrastructure.

Although every jurisdiction has a regulatory framework for controlling the size, weight and configuration of trucks, not all frameworks are capable of enabling innovative truck configurations or an appropriate relationship between truck configurations and infrastructure capacity limitations. In addition, not all road infrastructure is suitable for all vehicle configurations. So there is a need to optimise the match between vehicle configuration, size and weight and access provisions to the road network.

Achieving compliance with regulations is directly related to regulatory frameworks for trucks. It is important to assess the potential impact of improved enforcement policies and methods, and the consequences of these on the reduction of overloading occurrences and intensities, and from this the potential benefits for road assets.

One of the most efficient mitigation measures to limit the impact of trucks on existing infrastructure is to improve compliance of axle loads and gross vehicle weights in accordance with regulations. Overloading does induce additional wear and may cause damage to infrastructure. Current policies and methods of overload enforcement in most of the world, mainly by static or low-speed weighing, are generally inefficient. They require intensive use of human resources which is costly and not always available.

The extent to which non-compliance with regulatory requirements – in particular, axle group weight limits and gross weight limits – affects infrastructure damage should not be underestimated. The relationship between load and wear is not linear and higher loads have a disproportionately large impact on the life of road assets.

The level of overloading that occurs also influences the willingness of policy makers to introduce reforms to improve vehicle productivity. Although such reforms could enable increased weights to reduce the total number of vehicle movements for a given tonne-kilometres of freight, infrastructure managers need to have greater confidence that these higher weight limits will not be exceeded.

2. What did we do? (Method)

The OECD-ITF working group *Policies to Extend the Life of Road Assets* (2017-18) brought together policy options for extending the life of road assets by mitigating deterioration caused by trucks. Beyond traditional engineering responses, it considers the role of trucks in road asset deterioration from a broader, demand-oriented perspective. The work contributes to developing a new policy framework for maintaining and managing road assets in a cost-effective way and meeting road freight transport demand on a sustainable basis.

The insights and policy options presented build on the collective knowledge of the Working Group on *Policies to Extend the Life of Road Assets* convened by the International Transport Forum. The group included 27 renowned practitioners and academics from 17 countries with expertise in asset management, traffic management, vehicle dynamics, logistics and economics, truck operations, and transport regulation and compliance.

The report from the working group on *Policies to Extend the Life of Road Assets* incorporates eight chapters (including a summary chapter). The report approaches the development of policy options from a systems perspective—a perspective that acknowledges the complex and interactive nature of various influencing factors, identifies possible trade-offs between alternative courses of action, and highlights issues that policy and decision makers should consider.

This paper focuses on the following chapters from the report:

- Chapter 4 – Supportive Regulatory Frameworks for trucks.
- Chapter 5 – Achieving Compliance with Regulations.

3. What did we find? (Results – New best practices)

3.1 Overview of current approaches to managing regulatory frameworks and compliance

In most jurisdictions, size and weight regulations have historically focussed on protecting road infrastructure from damage, rather than optimising the use and consumption of the infrastructure. These regulations have typically been prescriptive and have evolved over time, with a series of incremental changes, rather than having an overall, strategic focus.
There are examples in many regions where changes within these traditional regulatory frameworks have been introduced that are intended to reduce infrastructure wear per tonne of freight moved, while providing transport operators with economic gains.

Many regions have introduced higher productivity vehicles (under various names) to meet the growing freight task. By catering for increases in weight or cubic capacity, higher productivity vehicles have the potential to improve the productivity of freight movements and reduce fuel consumption, unit labour costs and the number of truck trips.

It should be noted that in some cases, changes have been detrimental to pavement wear. An example is the use of wide-based single tyres, which although provide gains in transport efficiency through lower weight and reduced rolling resistance, have also been shown to generate increased pavement wear.

Not all jurisdictions have taken advantage of the opportunities to improve pavement wear performance of existing vehicle combinations. However, the extent to which traditional regulatory frameworks can respond to the growing demand for road freight transport is limited.

The additional capacity that flexible regulation can achieve through authorising higher productivity vehicles for use in the appropriate circumstances needs to be exploited. An effective regulatory framework for trucks should set out to balance what are often competing objectives between productivity, safety and road asset preservation by reducing the growth in individual vehicle movements while at the same time accommodating an increase in t-km transported.

State-of-the-art regulatory frameworks consider five inter-related dimensions:

- Truck design.
- Infrastructure capacity.
- Regulations to manage truck access and safety risks.
- Management of the interaction of trucks and infrastructure.
- Regulations to manage truck safety and risks.
- Regulations to recover costs of road infrastructure consumption.

Individually or collectively, each of these approaches represents an ability to 're-engineer' the use of road assets – and an ability to deliver significant productivity gains through truck access policy – without defaulting to traditional engineering options/investments in road assets.

The effectiveness of such a state-of-the-art regulatory framework depends on effective compliance management. Monitoring of trucks by road authorities typically makes use of road-based systems and on-road enforcement personnel for compliance management and law enforcement purposes. Examples include:

- Static weighbridges and road-side safety stations
- Weigh-in-Motion (WIM) sensors linked to Automatic Number Plate Recognition (ANPR) cameras (for monitoring both speed and overloading)
- Intelligent access monitoring.

Traditional approaches focus on the detection of violations and triggering enforcement based on observed breaches of regulations. Such approaches are inherently reactive. That is, they generally apply after the offence has been committed. This means that, in addition to the reactive nature of traditional approaches, they are limited by:

- A need for authorities to have personnel and systems in place to observe breaches
- A heavy reliance on enforcing the law rather than helping people to improve compliance
- Processing failures one by one, so that there is no mechanism for developing systemic solutions

- Focussing on the enforcement process, so that they sometimes fail to recognise that it is behavioural change that is being sought rather than increased prosecution or conviction rates (Sparrow 2000: p. 183).

An effective compliance framework for trucks should recognise the diversity of reasons why non-compliance occurs, employ multiple approaches to influence positive behaviour and compliance with regulations, and mitigate risks to infrastructure and safety.

A brief overview of each of these inter-related dimensions is presented as follows.

3.2 Truck design

Truck design encompasses the dimensions, weights and configuration of vehicles, and may also encompass axle layout, tyre configuration (dual or single) and widths and suspension design.

Of all the design parameters, truck axle and axle group mass weights as well as overall weight have the most significant impact on the life of road assets. Pavement wear is primarily related to axle and axle group mass. The specifics of this relationship depend on both the pavement structure (design) and the nature of vehicle loading. Jurisdictions should consider what the applicable relationship is for their circumstances. For bridges and related structures, the loading applied depends on the span lengths. It will often involve the loading from more than one axle group being applied simultaneously and for longer spans may involve the axle loads from multiple vehicles.

There are opportunities to reduce pavement wear through alternative vehicle configurations (as distinct from comparatively simple modifications to existing truck designs). This can be achieved through changes in prescriptive vehicle design requirements, or through Performance-Based Standards (PBS) approaches to truck design.

The basic principle of PBS is matching the right vehicles to the right roads. PBS has been implemented in Australia, Canada, and New Zealand, and is under trial in South Africa and Sweden. PBS focusses on the performance outcomes of vehicle operations. Innovative truck designs can be developed to meet requirements of specific transport tasks while still complying with a defined set of infrastructure and safety performance standards. These vehicles do not usually generate additional road wear compared to conventional trucks, as they typically operate with the same maximum axle loads as conventional trucks but have more axles to carry a higher payload. In most cases, the payload makes up a higher proportion of their total weight (payload efficiency) and thus they generate less pavement wear per tonne of payload moved. The key measure is pavement wear per tonne of payload moved.

3.3 Infrastructure capacity

Infrastructure capacity relates to structural capacity and geometric capacity. The structural and geometric capacities of road infrastructure can vary significantly, and all infrastructure may not be suitable for all truck designs. Both the structural capacity and the geometric capacity of the infrastructure directly influence the extent to which new truck designs can be introduced. Infrastructure capacity, particularly of road structures, may influence the maximum weights of combinations of axles based on their spacing and the maximum overall

weights of trucks. For longer span bridges, multiple vehicles may load the bridge simultaneously and there may be a need for measures to control inter-vehicle spacing or other traffic management strategies. However, in the case of longer span structures, the dead load (self-weight of the structure) represents a much greater proportion of the total load, so the live load (traffic loading) is generally less critical.

It is also important to note that different parts of the road network may be managed by different entities, which means that assessments and approvals may need to involve multiple stakeholders. This is particularly the case with local municipalities. There should be structured policies and procedures to assess and evaluate the suitability of infrastructure to accommodate different truck designs, which involve all relevant infrastructure managers.

There are opportunities to assess infrastructure based on broad categories, which would enable the establishment of effective networks. This avoids the challenge of performing bespoke assessments for individual truck design and/or access entitlements to the road network. For example, the Australian PBS scheme defines four levels of access with different pass or fail criteria for each level. If a route is assessed as being suitable for a given level, then all vehicles that achieve the performance standards for that level can be granted access.

3.4 Managing the interaction between truck design and infrastructure

A key factor with regard to the interaction between truck design and infrastructure relates to structural capacity and life. Each jurisdiction holds a pavement design guide, assumptions about the relationship between axle loads, weights and the pavement wear which results from these interactions. Infrastructure has a design life that is based on an expected level of traffic loading (including the number of axle passes and axle load distributions). Underpinning this design process is a model of the relationship between axle loads and the consumption of pavement life/amount of pavement wear. These models can differ based on the type of pavement structure (design) and the nature of heavy vehicle loading.

Regulatory frameworks need to be cognisant of the load versus pavement wear model(s) that is applicable to each jurisdiction. The models for pavements differ significantly from the models for road structures. Underpinning bridge design is the need to consider vehicle axle spacings and weights, and the length of bridge spans. Each jurisdiction utilizes a bridge design code which specifies the level of loading that bridges are required to be able to withstand. These parameters need to be considered within any regulatory framework, and directly influence the life of the infrastructure.

Different truck designs have different on-road performance characteristics, which need to be assessed with reference to the infrastructure's capacity. This means that certain truck designs are only suitable to operate on designated parts of the road network. The performance of individual truck designs should be matched with the structural and geometric capacity of the road infrastructure.

3.5 Regulations to manage truck access and safety risks

The management of infrastructure and risks is crucial to the management of trucks and their interaction with infrastructure. In many regions, there is a tiered approach to the management of infrastructure and safety risks:

- General access – where trucks can operate on all parts of the road network.
- Restricted access – where trucks are approved to operate on specific parts of the road network.
- Intelligent access – where trucks are remotely monitored to provide assurance that infrastructure capacity and safety risks are being adequately managed.

In simple terms, the intelligent access approach ensures that 'the right vehicle is on the right road'. Intelligent access involves the use of remote monitoring of vehicles using telematics, to ensure that conditions of access are adhered to by drivers and operators, thereby ensuring route (and speed) compliance. Policymakers may elect to use intelligent access for trucks that could pose significant risks to infrastructure and safety if not operated in accordance with the conditions of their approvals. Telematics devices collect and generate data that can be used to improve compliance management outcomes.

3.6 Achieving regulatory compliance

Improved truck compliance with respect to weight limits has the potential to extend the life of road assets. There are four broad categories of devices that are used for weighing vehicles and achieving improved compliance outcomes:

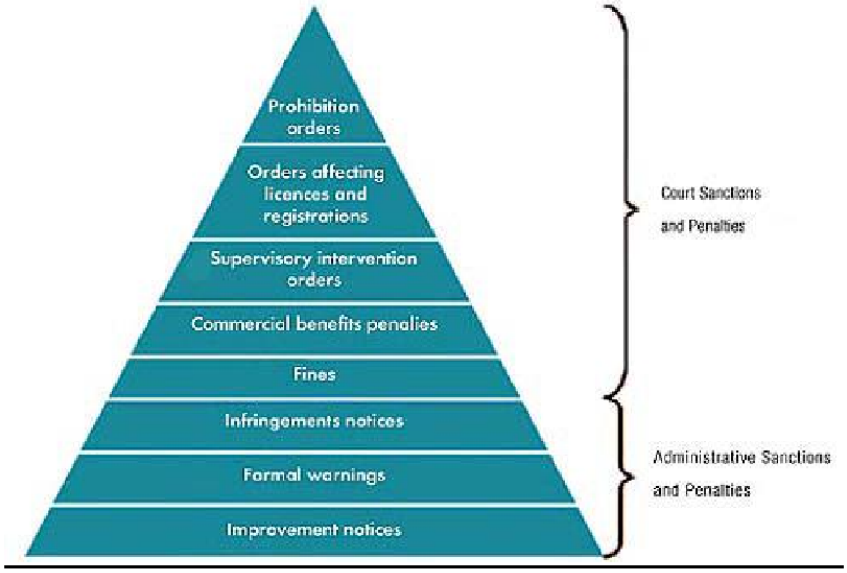
- Weighbridges
- Portable weigh scales
- Weigh-in-Motion
- On-board Weighing.

Beyond these traditional approaches, there are diverse approaches available to achieve compliance with regulations.

A more educative or persuasive strategy should be directed towards those who are inclined to comply but have made an inadvertent mistake or misinterpreted the rules and their implications. If the intervention fails to induce compliance, then the regulator should invoke an escalated penalty and so on until the offender complies. If compliance is still not achieved, the offender should be removed from the system.

In contrast, the full, punitive force of the law should be directed towards those who have actively elected not to comply. This group is characterised by a pattern of recidivism and a systemic ‘culture of non-compliance’.

The ‘enforcement pyramid’ in Figure 1 shows how different approaches can be adopted.



Source: (Leyden, P, McIntyre, K, Moore, B., 2004)

Figure 1: The "Enforcement Pyramid"

The pyramid allows for a holistic approach to compliance and its strategic enforcement by considering the many influences that can contribute to non-compliance. This approach also encourages industry to engage in a partnership approach with regards compliance. It emphasises the low-cost options for compliance – persuasion, partnership, education – and only when these less interventionist approaches fail are sanctions and penalties required.

Alternative compliance management

The ability to influence positive behavioural outcomes can be achieved through alternative compliance approaches, which have been adopted in some regions. Transport operators may be certified through some form of accreditation scheme i.e. promotion of self-regulation/voluntary compliance. This is particularly relevant in many developing countries where non-compliance, not only in terms of overloading and speeding, but also driver and vehicle fitness, is widespread.

Examples of such accreditation schemes are ISO 39001:2012 Road Traffic Safety Management Systems (the primary focus is Road Traffic Safety – RTS), SANS 1395:2014 Road Transport Management Systems (RTMS) in South Africa and the National Heavy Vehicle Accreditation Scheme (NHVAS) in Australia. Certification in terms of such accreditation schemes can be made a prerequisite for transport operators to own and operate high capacity vehicles.

Such accreditation schemes require periodic external audits to be conducted, during which the external auditor will check the company's policies and processes and verify whether such policies and processes are being implemented. Furthermore, where non-compliances have been detected, there must be evidence of corrective actions.

How weight assurance can drive productivity reforms

Vehicle and axle weight data can be obtained from Weigh-in-Motion (WIM) or On-Board Weighing (OBW) systems and provide the ability to link this data to other key pieces of information, including the vehicle configuration, its location and time of collection, and, if required, its speed. This means that weight information is not only more reliable and available, but contextually aligned with other key pieces of information, allowing for richer use.

The ability to access and use weight information is important in design, management and compliance for both pavements and bridges. Obtaining assurance through the accuracy and integrity of weight measurements presents new opportunities for all stakeholders. An example of new opportunities can be seen in the updated Australian Standard for bridge assessments (Standards Australia, 2017). The updated standard incorporates reduced traffic load factors for vehicles monitored through the Intelligent Access Program (IAP) and OBW for the Ultimate Limit State (ULS). By obtaining assurance in the weights of vehicles, the resultant reduced traffic load factors for bridge assessments achieve an increase in vehicle mass limits while at the same time improving compliance.

4. What do we recommend? (Conclusions)

Significant benefits can be derived from regulatory frameworks that facilitate the interaction of vehicle design and infrastructure capability. Collaboration between vehicle designers, infrastructure managers, regulators, legislators and transport operators is critical to the success of any regulatory framework that will extend the life of road assets.

Adopting a cross-disciplinary approach contributes to balanced outcomes that can take into account all costs and benefits and optimise the use of road infrastructure as an economic utility for the efficient and productive transport of goods. Innovative approaches such as performance-based approaches to vehicle design, and the remote monitoring of vehicles with suitable capacity, can increase the productivity of road freight transport while managing and even reducing road infrastructure risks.

The key challenge faced by policymakers (and legislators) to create supportive regulatory frameworks for trucks is to avoid regulatory prescription and the imposition of barriers to innovation. Instead they should look to promote opportunities for road managers, regulators and the transport sector to collaboratively achieve outcomes that can advance policies to extend the life of road assets, while accommodating the forecast growth in road freight transport.

Achieving compliance to loading regulations has a significant impact on the life of road assets. The inherent level of compliance observed in any regulated environment results from several interrelated factors and influences, which need to be considered in the context of a region's social and cultural norms.

Like any other regulated sector, achieving adherence to road transport regulations requires a strategic, cross-disciplinary, risk-based approach to deliver improved compliance outcomes. There is no single approach that guarantees results. However, all too often, the terms 'compliance management' and 'enforcement' are used interchangeably – despite enforcement being but one of several potential instruments available to improve compliance outcomes.

The use of these instruments will be guided by the inherent level of compliance, and the responsiveness of transport operators, drivers (and other parties along the supply chain) to comply with regulations. To this end, an understanding of the motivations for non-compliance is crucial, as are the appropriate responses to influence behavioural change.

The focus on changing behaviour needs to include a combination of carrot and stick approaches with the emphasis on former. An enforcement focussed regime (stick approach) will usually only impact a small proportion of the noncompliant vehicles because of resource limitations. Much of the negative impact on infrastructure from non-compliance will continue. Well-designed carrot approaches are likely to achieve higher rates of compliance, so long as they are complemented with the ongoing use of various stick approaches.

The following recommendations were made:

4.1 Adopt regulatory frameworks that treat the use of road assets as an economic input and measure the use of road assets in terms of economic utility in order to increase the productivity of road freight transport.

This could include:

a. Assess the full breadth of economic costs and benefits that can be derived.
b. Identify opportunities to reduce pavement and bridge wear through regulatory frameworks.
c. Adopt a performance-based standards approach to vehicle design to facilitate innovation with regards productivity and safety and
d. Adopt intelligent access policies (including the use of telematics and related intelligent technologies), which enable specific vehicle types and/or loads to travel on restricted parts of the network with suitable infrastructure capacity.

4.2 Implement infrastructure pricing for trucks to improve cost recovery

This could include:

a. Adopting distance-based charging to improve the recovery of costs from users of road infrastructure.
b. Adopting incremental charging arrangements based on distance travelled and/or mass carried from operators of higher productivity vehicles where these vehicles are deemed to increase road asset wear.
c. Making use of regulatory and financial incentives (in a voluntary policy environment) to encourage transport operators to:
    - Use vehicle designs and configurations with lower road asset wear characteristics
    - Adopt higher productivity vehicles on infrastructure with suitable capacity (i.e. restricted or intelligent access)
    - Adopt the use of telematics and related intelligent technologies
    - Share data with asset managers.

4.3 Understand the reasons why non-compliance occurs so that appropriate approaches can be selected for an effective compliance framework.

a. Establish an evidence-base of the current levels of compliance and non-compliance.

b. Ensure that compliance management frameworks are outcome focussed, with the availability of different interventions and techniques to influence positive behavioural outcomes.
c. Ensure that compliance strategies are supported by the design of regulatory frameworks.

4.4 Move towards innovative approaches to regulatory design and compliance that include a combination of 'carrot and stick' approaches with an emphasis on positive incentives for efficiency.

a. Introduce mechanisms for accreditation and self-regulation.
b. Introduce contemporary approaches to manage the weight of vehicles (including in-road and on-vehicle technologies).
c. Use telematics and related intelligent technologies to manage compliance with regulations.
d. Provide incentives for transport operators (and other parties in the supply chain) to comply with regulations (i.e. mechanisms to reward good behaviour).

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