COMPLIANCE MECHANISMS FOR HIGHER PRODUCTIVITY VEHICLES

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Abstract

Higher productivity vehicles (HPVs), which have a gross combination mass of at least 50 t and a length of 22 m or more, are becoming prominent in many countries because of their higher payload and volumetric capacity. These vehicles may be subject to differential regulations and in some countries face differential compliance mechanisms. This paper outlines seven categories of differential regulations and five types of compliance mechanisms that may be applied differentially to HPVs. Interviews with international trucking experts are synthesized to provide information about how compliance mechanisms for HPVs are being applied worldwide, the reasons for their application, and implementation considerations. In general, the application of differential regulations for HPVs is routine, while differential compliance mechanisms, other than permitting, remain somewhat uncommon. Differential compliance mechanisms for HPVs should be assessed contextually, and if applied, should be low-cost and directed at the behavior sought to be modified.

Keywords: Compliance, Higher Productivity Vehicles, Regulations, Mass, Length, Permitting

1. Introduction

Trucks operate within a complex and dynamic regulatory environment, which differs between countries and between jurisdictions within countries. Despite these complexities and differences, the common intent of the regulations is to set out requirements that, when complied with, contribute to the overall goals of infrastructure preservation, safety, environmental stewardship, and fairness within the road transport industry. To this end, regulatory control pertains to, *inter alia*, vehicle mass and dimensions, routing, vehicle specifications, operations, and driver qualifications and training. Certain regulations, such as mass and dimensions limits, by their nature vary by truck configuration; others have traditionally been applied equally to all configurations. In some jurisdictions, however, some of these regulations (beyond the mass and dimensions limits) have been applied differentially to vehicles that provide productivity advantages.

Compliance mechanisms encompass the various approaches for achieving regulatory compliance. Like the regulations themselves, compliance mechanisms have evolved over time, vary considerably between countries and jurisdictions, and in some cases are applied differentially to certain truck configurations. Traditionally, most countries have employed on-road enforcement methods (and still do), though technologies are playing an increasingly prominent role in delivering enforcement programs. More recently, alternative approaches to achieving compliance, such as accreditation programs, have been implemented and directed towards certain vehicles in the fleet.

The purpose of this paper is:

- to outline the types of compliance mechanisms that may be applied differentially to higher productivity vehicles (HPVs);
- to document international experiences in applying compliance mechanisms to HPVs; and
- to examine reasons for the differential application of compliance mechanisms to HPVs and outline implementation considerations.

HPVs are used to increase truck productivity in terms of both payload and volumetric capacity. In countries with a history of HPV use (e.g., Australia, Canada), available evidence shows a general increase in their scope of operation. In other countries, consideration is being given to expand their use. A precise definition of HPVs is not needed for this analysis and the category and nomenclature may vary between countries. In general, for this paper, a HPV is classed as one which has a gross combination mass (GCM) of at least 50 t and a length of 22 m or more (Organisation for Economic Co-operation and Development, 2011). These vehicles are heavier and/or longer than ‘workhorse’ heavy vehicles.

It is instructive to briefly examine the practical implications of the HPV definition in the two countries in which they are most commonly used: Australia and Canada. In both countries, this definition excludes the two workhorse heavy vehicles—namely the five- and six-axle tractor semitrailers (3-S2 and 3-S3)—but includes the eight- and (in Australia) nine-axle B-train configurations (3-S3-S2, 3-S3-S3) and longer combination vehicles (LCVs). Thus, in the context of Australia and Canada, the HPV definition applied in this paper encompasses both vehicles that operate under basic regulations (i.e., the eight- and nine-axle B-trains) as well as

LCVs which operate subject to the conditions of permits issued by provincial or state agencies[1].

The research approach relies primarily on the authors' experience concerning HPV compliance mechanisms, supplemented by the experiences of trucking experts consulted as part of this research effort. Thus, the content of the paper emphasizes the state-of-the-practice in Australia and Canada, but also synthesizes notable experiences elsewhere to provide relevant insights.

2. Description of Differential Regulations and Compliance Mechanisms for HPVs

This section outlines and describes the types of regulations (referred to as 'standards' in some countries) that may be applied to HPVs and the differential compliance mechanisms they may face. Differential regulations are examined first, followed by approaches to achieving compliance.

2.1. Differential Regulations for HPVs

Regulations of heavy vehicles and their operations control a broad and complex range of factors. Regulations limiting vehicle mass and dimensions arguably push the operation of some of these vehicles closer to the limits of infrastructure and amenity and cause the road regulators to consider differential compliance mechanisms. Table 1 outlines other types of regulations that may be applied differentially to HPVs and describes examples of criteria that may be relevant for each type. Notably, some countries take a prescriptive approach to specifying regulations; others do so within a performance-based framework.

Table 1 – Types of Regulations that may be Applied Differentially to HPVs

Type of regulations	Description of regulations
Permissible routes and times	HPVs may be permitted on routes which meet geometric, structural, or traffic-related criteria. Example criteria include divided/undivided status, number of lanes, paved shoulder width, pavement strength, and bridge ratings. HPV operations may also be limited temporally. For example, HPVs may only be allowed on certain routes during off-peak travel times (e.g., specific hours of the day, days of the week, days of the year, or months of the year).
Operator requirements	HPV operators (carriers) may be required to meet minimum standards in terms of safety ratings, financial security and insurance, accreditation, and compliance history.
Vehicle performance and equipment	HPVs may be required to meet minimum vehicle performance standards such as: off-tracking, rollover, trailer sway, rearward amplification, power-to-weight ratio (to ensure adequate performance in hilly terrain), and braking. Equipment standards may also be specified (e.g., dolly types, vehicle lighting, placards). An emerging area of potential vehicle-related regulatory control involves technologies and systems designed to mitigate fuel consumption and emissions.

[1] In Australia the permit process now involves the National Heavy Vehicles Regulator.

Type of regulations	Description of regulations
Driver qualifications and training	HPV drivers may be required to have a minimum level of commercial vehicle driving experience and a satisfactory driving record. Drivers may also be required to certify (and maintain certification) beyond minimum licensing requirements for commercial vehicle drivers.
Fatigue	HPV drivers could be restricted to reductions in hours of service or enhanced fatigue monitoring requirements.
Operational conditions	HPVs may be subject to differential restrictions concerning speed (possibly as controlled by a speed limiter), commodities hauled (e.g., hazardous materials may be restricted), overtaking, minimum following distance, lane adherence, and parking.
Road and weather conditions	HPV operations may be restricted if road and weather conditions impede the ability to drive in a safe manner. Conditions may be defined in terms of traction, visibility (if impaired by rain, snow, fog, smoke), or crosswind.

2.2. Differential Approaches to Achieve HPV Compliance

The regulations described in the foregoing section are meaningless unless operators and drivers are somehow motivated to comply with them. The following points briefly outline the range of approaches applied to achieve regulatory compliance; any of these may be applied differentially to HPVs.

- *On-road enforcement*: On-road enforcement has been the traditional approach to achieving regulatory compliance for all truck configurations including HPVs. Essentially, this involves direct observation of on-road trucking operations, typically at fixed sites or using mobile patrols. More recently, significant effort and investment has been directed at enhancing on-road enforcement with a range of automated equipment and communications technologies to enable officers to observe infractions and take enforcement actions virtually.

- *Permitting*: Jurisdictions routinely issue permits (for a fee) to operators wishing to haul loads that exceed basic mass and dimensions limits. In many cases, these permits specify a set of regulations that govern various additional aspects of the permitted trucking operation. Thus, permits are a common compliance mechanism applied differentially to HPVs. If permit holders are observed to be in violation of one or more of the permit requirements, the permit can be revoked or other severe penalties can be applied.

- *Chain-of-responsibility*: The chain-of-responsibility principle holds that all those with responsibility for transport operations bear some degree of legal liability. Depending on the data requirements to demonstrate compliance, industry stakeholders other than operators (e.g., consignors, consignees) could be exposed to legal liability. This principle has been applied in Australia to all heavy vehicles, but it could be applied uniquely to HPVs, perhaps through permit systems. In North America, this principle has been implemented to a certain degree in some jurisdictions through relevant evidence laws, which enable the issuance of a citation (e.g., for operating overweight) based on an auditing of records held by the cargo consignor or consignee.

- *Accreditation programs/alternative compliance*: Accreditation programs (sometimes termed alternative compliance because of the shift of emphasis away from deterrence and toward a more collaborative approach) are mechanisms by which transport operators can achieve commercial benefits and/or regulatory concessions (e.g., increased road access, higher mass, reduced incidence of vehicle inspections) in return for demonstrating high levels of compliance through auditable systems. Australia and South Africa have pioneered these approaches, which have been used as compliance mechanisms for the operation of HPVs.

- *Operator accreditation/safety ratings:* Operator licensing or safety ratings systems are in place in all countries of the European Union (EU), many other European countries, Canada, United States, Japan and New Zealand. Under these systems, truck operators must register with regulatory agencies and meet various safety-related requirements in order to operate road freight services. It would be possible to use these schemes to place additional requirements on HPVs.

3. International Experiences in Differentially Applying Regulations and Compliance Mechanisms to HPVs

Experts from selected countries were contacted during the spring of 2014 in an effort to compile international experiences in the differential application of regulations and compliance mechanisms to HPVs. A complete survey and detailed comparative analyses were not possible for this paper. This section summarizes findings from our correspondence with these experts, beginning with experiences in Australia and Canada and followed by those in other countries.

3.1. Australia

The most common HPV in Australia is the B-double (eight or nine axles). These are the long-haul workhorse vehicles and access most major roads. They have a length limit of 26 m and a mass limit of 68.5 t. Double road trains (36.5 m, 85.7 t), triple road trains (53.5 m, 125.2 t), and B-triples (36.5 m, 91.2 t) are operated in most states. In 2013, Australia had 51,000 5- and 6-axle tractor semi-trailers, 14,500 B-doubles, 5,500 double road trains and 2,500 triple road trains. Among these classifications, there is a growing number of performance-based standards (PBS) vehicles.

B-doubles are subject to gazette notices and most larger vehicles are subject to permits. These vehicles may be route-restricted and, if operating at Higher Mass Limits (axle mass linked to an accredited road-friendly suspension) must be accredited under the Mass Management module of the National Heavy Vehicle Accreditation Scheme.

In some states, HPVs are required to be members of the Intelligent Access Program, which is a government satellite-based (i.e., vehicle tracking using on-board global positioning systems) route compliance program.

3.2. Canada

In Canada, there are several truck configurations in the basic (i.e., non-permitted) truck fleet that qualify as HPVs. Most prominent of these is the eight-axle B-train configuration, which consists of two trailers and is limited to 25 m in length and between 62.5 t and 63.5 t in GCM when operating inter-provincially. These vehicles operate similarly to workhorse vehicles and

are not subject to differential compliance mechanisms (other than some route-related restrictions associated with load bearing capacity).

In contrast, LCVs are now routinely permitted in nine of 13 Canadian provinces and territories and in all cases operate subject to numerous conditions and requirements set out in the permit. Three LCV configurations predominate, namely Turnpike doubles (two 16.2-m trailers), Rocky Mountain doubles (one 16.2-m trailer and one 8.5-m trailer), and triple trailer combinations (three 8.5-m trailers). Operators wishing to utilize these configurations purchase an annual provincial permit. This distinguishes them from single-trip oversize/overweight permits that are also issued for special hauls.

The routine permitting environment for LCVs provides a mechanism by which differential regulations may be applied. Referring to Table 1, all of the regulatory categories (except for fatigue monitoring) are applied to LCV operations through specifications in the permit. Recent efforts have largely harmonized the permit conditions for Turnpike double operations across the four western Canadian provinces (British Columbia, Alberta, Saskatchewan, and Manitoba), exemplifying the routine nature of these vehicles and their importance for accomplishing the road freight transport task in these jurisdictions. Similar efforts may be forthcoming for Rocky Mountain doubles and triple trailer combinations, although their utilization is somewhat more limited.

Regarding approaches to ensure compliance, LCV operations are generally subject to the same types of on-road enforcement as workhorse vehicles. The key differential compliance mechanism is the permit structure itself. Thus, while no differential measures are taken to enforce HPV regulations, should a violation of a permit condition be observed, operators that utilize HPVs could have their permit revoked—essentially a form of sanction that would not be relevant to workhorse vehicles.

3.3. Experiences from Selected Countries[2]

Netherlands
The Netherlands has had HPVs (Large Goods Vehicles) under trials since 2001. Since January 2013 they have been permitted under a permanent regulation. There are now over 1000 operating (25.25 m and 60 t) under restricted routes which service all logistics hubs. These vehicles obtain exemptions but are not subject to any differential compliance mechanisms, except that an in-vehicle axle load measure is obligatory. This data is collected from the anti-lock braking system already in the vehicle that can be read out from on-road inspection.

Finland
In 1997, Finland (along with Sweden) was permitted by the EU to run vehicles to a maximum GCW of 60 t and a length of 25.25 m. Since October 2013, Finland has permitted vehicles of up to nine axles at masses of up to 76 t, with a trial of larger vehicles. These HPVs (Longer Heavier Vehicles) carried 73% of road freight (in t-km) in 2010. With the exception of the trial vehicles, they are not subject to any differential compliance mechanisms.

Sweden
Sweden operates vehicles to a maximum GCW of 60 t and a length of 25.25 m. These vehicles carry approximately 90% of freight goods (in t-km). In 1990, Sweden commenced trials of larger vehicles of up to 30 m in length and 90 t in weight. In 2012 close collaboration

[2] Some of the European data is from European Parliament, 2013.

with Australia was initiated leading to the establishment of a pilot of the Intelligent Access Program (IAP). With the exception of the trial vehicles, Sweden does not apply to any differential compliance mechanisms. There is the consideration of the application of route compliance, via the IAP, to High Capacity Transports (HCTs – greater than 60 t and 25.25 m).

Germany

The Long Truck Trial came into force in Germany in January 2012. Five truck types were given a permitted length of up to 25.25 m, but were restricted in GCW to the EU limit of 40 t or 44 t (the latter in the case of intermodal transports). The trial is route restricted and limited to some Federal States. The drivers of the longer trucks are required to have at least five years of truck driving experience and undertake at least two hours of driving the longer truck combination. Additional safety standards are required of these vehicles. About 30 operators are utilizing a total of approximately 60 longer trucks under the scheme. The main additional compliance requirement for these vehicles is on-board axle load measurements.

United States

In the United States, the majority of the road freight transport task is accomplished by workhorse vehicles (i.e., not HPVs). However, certain states (particularly in the western US) issue permits for the operation of HPVs similar to the eight-axle B-train and LCV configurations used in Canada. The permitting conditions relevant to LCV operations principally include route compliance and temporal restrictions. In addition, other than the permitting mechanism (and in certain states, relevant evidence laws), no differential approaches to achieving compliance are applied to HPVs in the US.

Mexico and Central America

Mexico has a relatively long history with HPV use, and there is potential for this experience to influence trucking operations in the Central American region. Of current interest is the operation of a permitted truck-trailer combination limited to 23 m in length and a mass of 57 t. HPVs in Mexico operate subject to permits, which specify weights and dimensions limits, routes, driver qualifications, operating requirements (speed, lane selection, following distance). Shippers, carriers, and drivers may be held responsible for regulatory compliance (National Cooperative Highway Research Program, 2011). No information was obtained about differential compliance mechanisms used in Central American nations.

Argentina

Argentina has recently legalized B-train configurations that operate under a permit. Conditions governing the operation of these trucks may include route compliance monitoring using GPS, mandating that visible axle load scales be mounted to the truck, requiring the lowering of a liftable axle when the vehicle is loaded, and specifying minimum power-to-weight ratios.

New Zealand

In May 2010, New Zealand introduced High Productivity Motor Vehicles, which are in excess of the standard mass and dimensions of 20 m and 44 t. At least 2000 of these vehicles are in operation, of a total fleet of 20,000 heavy vehicles. These vehicles are not subject to any differential compliance mechanisms except that a breach of permit leads to potentially very high fines.

South Africa
The permissible maximum length for South African combination vehicles (and for many other African countries) is 22 m and the permissible maximum combination mass is 56 t, so that many South African vehicle combinations meet the definition of a HPV. These vehicles all operate as-of-right and are not subject to any differential compliance mechanisms.

South Africa also has a number of performance-based standards vehicles, operating outside these mass and dimension standards under permits. These vehicles are part of the Road Transport Management System (RTMS), a self-regulation scheme and operate on restricted routes. The RTMS involves accreditation for mass compliance.

3.4. Summary

Overall, the specification of differential regulations for HPVs—beyond the mass and dimensions limits—is somewhat common. In contrast, other than the use of permitting mechanisms, there is limited experience with the application of differential compliance mechanisms for HPVs, with many countries opting so far to enforce HPVs in the same way as all other heavy vehicles. Notable findings follow:

- Certain countries (particularly Canada and Germany) appear to emphasize incremental driver qualifications and training requirements.

- Satellite-based route compliance is imposed on many HPVs in Australia and is also applied in Sweden.

- Many HPVs are operated under permits (of some kind), rather than 'as of right'. For this reason offences for any penalties may be severe should a violation of a permit condition be observed. In this regard, the differential mechanism is based on the ability to impose sanctions that would not be applicable to normal operations.

- In South Africa and Australia, specific accreditation systems are used for many HPVs.

4. Options for Applying Differential Compliance Mechanisms for HPVs

Based on these findings, the question to be asked is: Should HPVs be subject to additional compliance mechanisms and, if so, what types? The answers to these questions depend, somewhat philosophically, on whether one tends to view the longer and/or heavier nature of these vehicles as potential threats to infrastructure and society generally, or whether one emphasizes the private (and potential societal) benefits of higher productivity, and to what extent the operators of these vehicles have an incentive to self-regulate.

Considering the former perspective, the main reasons that could be proposed for differential compliance mechanisms for HPVs are: threats to infrastructure and amenity; public perception; and enhanced social responsibility. First, as HPVs are (usually) beyond the basic mass and dimensions limits, certain HPV configurations place incremental strain on the infrastructure (pavements, bridges, and road geometry) and may disrupt other users in the traffic stream. These incremental strains and disruptions may warrant differential compliance mechanisms. Second, there may be public (and political) pressure to apply differential mechanisms to HPVs, motivated by public perceptions concerning their safety, infrastructure, operational, and environmental consequences. Third, there could be a view that the operators

of these vehicles have been given an enhanced license to operate and thus could reasonably face an enhanced social responsibility.

If, for these or other reasons, differential compliance mechanisms for HPVs are pursued, the following implementation considerations may be relevant:

- As mentioned earlier, traditional on-road enforcement programs are increasingly applying a range of technologies and systems aimed at reducing costs and improving effectiveness. There would be no reason to exclude HPVs from this, and possible opportunities to pilot test certain technologies on HPV operations. In fact, it is likely that enhanced compliance mechanisms for HPVs—in whatever form—will rely on application of sophisticated technologies and systems.

- To allay infrastructure concerns, differential regulations for HPVs pertaining to route compliance (for mitigating pavement, bridge, and geometric concerns) and temporal restrictions (for amenity concerns) appear most relevant. The mechanisms to ensure compliance with these regulations include traditional on-road enforcement, but they may be more effectively administered via permit programs, application of the chain-of-responsibility principle (especially for weight compliance), and accreditation programs. Again, technologies such as GPS tracking, on-board scales, and virtual weigh-in-motion play a role in enhancing HPV compliance.

- Accreditation or alternative compliance approaches have the potential to improve compliance rates for HPVs compared to traditional methods of enforcement. In so doing, these approaches may help alleviate public concern (provided they are appropriately directed at the specific areas of concern) and demonstrate an operator's commitment to an enhanced social responsibility. Due to the novelty of these approaches, however, jurisdictions may be hesitant to explore them or may experience opposition from operators and/or other freight transportation stakeholders. Including accreditation as part of HPV permits provides an opportunity to pilot test them since operators are familiar with this approach and are more likely to cooperate with various permitting conditions in exchange for higher weights or longer vehicles.

- Public concern may also be relieved through programs that accredit or rate operators based on their performance. While these programs are generally applied to all operators of heavy vehicles, there is no particular reason that they could not be applied differentially to HPV operators (e.g., applying more stringent safety requirements for HPV operators). However, the cost, organizational, and data capture requirements imply a scale that may be better-suited to all heavy vehicles rather than specifically to HPVs.

- There may be a need to consider any differential regulation or compliance mechanism for HPVs in light of the potential for incremental requirements to increase HPV operating costs, limit their uptake, and diminish potential productivity benefits. Moreover, depending on the context of the jurisdiction in question, if systematic enforcement is not possible for heavy vehicles generally, implementing differential requirements for HPVs may be a misallocation of available regulatory resources.

Alternatively, if one emphasizes the potential benefits of operating HPVs, the conclusion could be that no differential compliance mechanisms should be applied to their operation. HPV operations typically feature well-maintained vehicles, highly qualified and/or

experienced drivers, and operators that have a proven record of competence and safety. Moreover, given the potential productivity gains for the operators, there is an incentive for self-enforcement. Interestingly, it is this incentive that enables some of the compliance mechanisms discussed in this paper. This conclusion does not necessarily mean that alternatives to differential regulations and compliance mechanisms—such as more rigorous conventional approaches and/or application of more severe sanctions—could not be pursued for the vehicle fleet as a whole.

5. Conclusions

Whether or not one supports differential regulations and compliance mechanisms for HPVs, if the intent of the regulations is to achieve the goals of infrastructure preservation, safety, environmental stewardship, and fairness within the road transport industry, then two final questions should be considered. First, if HPVs are treated differentially and this treatment is evaluated as successful, which mechanisms should be 'downloaded' onto the basic heavy vehicle fleet? (We recognize that by asking this question, the context of differential application becomes moot.) Second, if differential treatments have not been pursued, how has this determination been evaluated and have the full spectrum of possible options to achieve the goals of the regulations been sufficiently explored?

Ultimately, the need for differential regulations and compliance mechanisms for HPVs is highly contextual. Implementation will depend on:

- whether regulatory resources will be drawn off from other heavy vehicles;
- whether differential compliance mechanisms (in conjunction with enhanced safety standards) will significantly impede the operation of HPVs;
- the desire to demonstrate to other heavy vehicle operators the success of enhanced compliance mechanisms for HPVs; and
- the social/political situation and the need to be seen to meet community concerns.

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