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Regulating Heavy Vehicles in Australasia Using A Performance Based Standards Approach

Bob Peters

AUSTROADS

Jim Stevenson

National Road Transport Commission

Abstract

Productivity and safety gains in the heavy vehicle area over the last quarter of a century have been associated with periodic reviews of prescriptive regulations applying to general access. In Australia and New Zealand, most heavy vehicles have been regulated on the basis of length, height, width and axle mass. But in recent years, flexibility has been extended to some vehicles that don't fit within the standard 'envelope' to operate on specific parts of the road network, provided they perform satisfactorily.

There is increasing evidence that to achieve productivity and safety targets in the future, increasing attention will have to be given to regulation on the basis of explicit measures of 'system' performance. The challenge involves relating performance-based standards and alternative compliance and enforcement practices covering the performance of the vehicle, the road system, the transport operator and the driver, and to incorporate this within alternative forms of regulation.

This paper looks at how Australia and New Zealand are building a new regulatory framework for heavy vehicles based on this fresh approach. The successful development and implementation of the approach is expected to lead to safer and more productive vehicles and roads.

1. INTRODUCTION

The National Road Transport Commission (NRTC) and Austroads (the association of Australian and New Zealand road transport and traffic authorities) have commenced a joint project to develop a performance-based standards (PBS) approach to the regulation of heavy vehicles in Australia. Traditionally, heavy vehicle regulation in Australia has been based on tightly defined mass and dimension limits. These have been developed largely through empirical approaches. PBS will be an alternative to the current prescriptive approach to regulation and involves the regulation of heavy vehicles according to how they perform, how they are operated and driven and the characteristics of the transport network.

PBS will be successful if it results in enhanced productivity, improved road safety and reduced environmental impacts. It will do this by:

- Permitting the operation of safer higher productivity vehicles by controlling critical performance measures such as overturning stability;
- More closely matching heavy vehicles and the roads on which they travel;
- Encouraging the heavy vehicle industry to innovate to meet the diverse customer needs by delivering a significant "reward for effort";
- Accelerating new vehicle technology and Intelligent Transport Systems technology; and
- Improving compliance with transport regulations.

From an environmental perspective some improvements will come through more efficient vehicles – less emissions from quieter vehicles. Others will come from reductions in emissions due to more efficient use of vehicles – fewer vehicle kilometres required to undertake the freight and passenger task.

Individual members of Austroads have for many years been permitting some vehicles that fall outside the prescriptive standards to use parts of the road system, where the operators have been able to demonstrate that the vehicles can operate satisfactorily. However, this activity has reached a stage where there is a need for a nationally uniform approach.

The project is in its early days but much has already been achieved, including the assembling of the material describing current practices and the development of the performance measures for which standards will be set.

2. HISTORY OF NATIONAL HEAVY VEHICLE REFORM

It has been estimated that there has been a 50% reduction in heavy vehicle accidents and a 25% improvement in productivity over the last decade. At the same time, heavy vehicle road use in Australia has grown by 53% and it is expected that road freight will grow a further 100% by 2015.

It is unlikely that these trends can be maintained without the adoption of mechanisms that promote innovation, including a more sophisticated approach to heavy vehicle regulation.

Australia has undertaken national reviews of heavy vehicle mass and dimension at intervals of approximately 10 years since the 1970s. The key changes as a result are best illustrated for the case of the six axle articulated vehicle (Figure 1 - 12S3), the 'workhorse' of the Australian freight fleet. See below:

Study	**Gross mass and length of six axle articulated vehicle**
Economics of Road Vehicle Limits study of 1976 (ERVL)	Increased to 38 tonnes and 17 metres
Review of Road Vehicle Limits study of 1985 (RORVL)	Increased to 42.5 tonnes[1] and 17.5 metres
National Mass and Loading Regulations 1993	Length increased to 19.0 metres and gross mass of 42.5 tonnes adopted in all States and Territories
Mass Limits Review of 1999 (MLR)	Increased to 45.5 tonnes where vehicles have road friendly suspensions and the operator is a member of an accredited mass management scheme

[1] *Note: adopted as a general access limit in some States and Territories immediately, but not adopted nationally until later.*

Figure 1 shows a range of heavy vehicles presently using the Australian road system.

The general limit for vehicle width is currently 2.5m and for height 4.3m. These standards have not been subject to such intensive and regular reviews as mass and length limits. However, some vehicles are allowed to operate at greater heights or wider on restricted routes or under permit/exemption arrangements.

3. THE APPROACH TO THE PROJECT

The project is being undertaken in four phases:

Phase A	Identification of performance measures and standards; survey of the existing fleet; and demonstration case study
Phase B	Preparation of guidelines for the consistent application of PBS
Phase C	Regulations, compliance and Enforcement – the alternative arrangements for PBS
Phase D	Case studies – assembly of work previously conducted and the practical application of PBS to nationally agreed priorities

The project is being managed by the National Road Transport Commission with the assistance of a broadly-based expert advisory group, with membership drawn from road and traffic agencies, industry, transport operators, remote areas, vehicle suppliers, road authorities and local government.

3.1 Phase A: Performance measures and standards; survey of the existing fleet; and demonstration case study

Prior to the adoption of performance standards, there is a need to establish the Performance Measures. The potential field of performance measures assembled was very large (97) and was structured into the six groups shown below:

Outcome	Group	Number identified
Safety	Broken down into directional performance, longitudinal performance, mechanical integrity, traffic compatibility, geometric compatibility, human factors and crash indices	48
Infrastructure	Pavement wear and bridge stresses	8
Productivity	Vehicle and freight/passenger task	13
Amenity	Access	2
Road-vehicle-interaction	Alignment, pavement characteristics and traffic characteristics	21
Environmental	Vehicle	5

However, the number of core measures is likely to be about 30, as indicated in Table 1. The standards for each of the measures have yet to be determined, but will in many cases vary depending on the circumstance. A standard that is acceptable in a remote area with negligible traffic and a forgiving environment will often not be acceptable in a heavily trafficked or mountainous environment.

The next stage is to agree to the set of performance measures and the standards that will be used. Most of this will come from the experience gained in recent years by members of Austroads. It will also rely on evaluations of the impacts of different levels of performance, particularly in terms of the risks (for safety, traffic interaction and infrastructure performance) that they might represent. The project has assembled and reported what has taken place in recent years, both in terms of the performance measures used and the studies that have been undertaken.

3.2 Phase B: Preparation of Guidelines for the consistent application of PBS

This is largely breaking new ground for heavy vehicle regulation. As previously indicated, various forms of PBS regulation have been in use in parts of Australia for some years, but they have been on a state-by-state and case by case basis. In addition, the vehicles permitted to operate following a PBS assessment (usually by way of extensive simulation work) have been for a specific task on a specific route. Consistency in simulation and assessment between cases has been limited, as has it been between states. It would be fair to say that very little in the way of guidelines have been produced, let alone all-encompassing national guidelines that can be used by all parties. Bringing the learning from this background into one set of guidelines is pressing.

A consultancy has been let to specify the format of the guidelines. These will spell out the requirements on the operator, the methods of technical evaluation, economic evaluation and risk assessment requirements. It will also examine what will be required of governments.

3.3 Phase C: Regulation, Compliance and Enforcement – the alternative arrangement for PBS

The guidelines discussed above will outline the processes to be followed, but ultimately the requirements that they embody will need to be set out in legislation. It would be very brave to move to a purely PBS approach without some form of regulation. The best of intentions will be used in setting the performance measures and standards, but this will not cover all eventualities – at least for some time. That means there will still need to be a prescriptive 'shield' surrounding PBS. Many parts of the industry will not be interested in exploring the PBS approach and will as a consequence, require a set of 'black and white' regulations in which they can work.

Compliance and enforcement in a PBS environment is a different 'game'. In Western Australia many different forms of permit are issued each year, making traditional on-road enforcement very complicated. How does an on-road enforcement officer determine that 95% of an operator's loads have been at or less than a certain weight? How is an enforcement officer to know whether a vehicle's centre of gravity is below a certain height? Greater use is being made of various 'Quality' approaches to concessional loading, mass management, company accreditation and fatigue management. But to date, this has often only been with the larger companies and some of the results have not been entirely satisfactory.

The use of Intelligent Transport System approaches to assist are being investigated in another Australasian project, the Intelligent Access Project, which is looking at using Global Positioning System and wireless telephony to monitor vehicles for compliance. In time this will undoubtedly help in the management of the heavy vehicle industry, leading to further improvements in safety and efficiency. It also provides the opportunity for greater variety in what vehicles are allowed to operate under what circumstances. For example,

regulators can be sure that vehicles only operate on approved routes or at a given maximum speed. This means that greater flexibility might be possible in other aspects of the vehicle's operation, delivering the same level of overall performance.

A consultancy has been let to provide advice on how best to accommodate the issues of regulation, compliance and enforcement in a PBS environment. A specialist advisory group is being established to assist in this process.

3.4 Phase D: Case Studies – Assembly of work previously conducted and the practical application of PBS to nationally agreed priorities

A key part of the project is the progressive completion of case studies and the early implementation of this work. The case studies draw together the innovation, technology, productivity, safety and compliance and enforcement implications of PBS. The following case studies will be completed this year:

- B-double length. There is constant pressure for more length. One State has moved to 27.5m. Is there room to move and how should the length issue be managed?;
- Review of the national Load Restraint Guide. Safety is paramount and load restraint is crucial to this. The community will not accept further heavy vehicle deregulation unless they can be assured that the vehicles and their loads are safe;
- Truck-trailer mass limits. In most States and Territories, the gross mass of rigid trucks towing trailers is limited to a total of 42.5t and the trailer may not be heavier than the truck. In one State the gross mass limit is the sum of that allowed for each axle group, in others smaller gross limits are applied and additional requirements are imposed on vehicles for the type of suspension and wheelbase allowed. How should the gross mass limit be set?;
- Bus mass and dimensions. Many buses only operate on major roads. With public transport fighting to be competitive, more efficient buses would help. What can be done?;
- Mass and dimensions for rigid trucks. These are basically 'one size fits all' at the moment. Is there a need for flexibility?;
- Vehicle width – particularly in relation to the movement of refrigerated vehicles in remote areas. Can movement be made on the 2.5m width issue?;
- Heavy vehicle access to local roads. Most local roads were built for limited light traffic and there are time, size and mass restrictions on access by heavy vehicles. What does this mean for PBS?; and
- Specific application of mass limits (eg. For twin-steer axles and wide single tyres);

4. CRITICAL ISSUES

Much of this project is concerned with managing the many complex issues that will arise. There is probably no complete answer to many of the concerns but they must be considered. Some of those that will be addressed are as follows.

Fleet Diversity. Heavy vehicles operating on public roads in Australia and New Zealand range in size from 4.5 tonnes to 215 tonnes. The 4.5 tonne vehicles can generally operate anywhere, but as the vehicle steadily gets larger, its performance declines to the stage where there are very few roads on which they can operate satisfactorily. PBS needs to be able to accommodate this diversity.

Evaluation – is PBS worthwhile? A Regulatory Impact Statement (RIS) will be prepared to quantify the costs and benefits of the approach. This is an Australian Government requirement of any proposal of a regulatory nature.

Uniformity of Outcome versus Consistency of Approach. This is always a vexed issue where the regulators in each State and Territory are largely independent of each other. A 'one size fits all' approach to regulation will not be accepted as the 'remote' areas have far softer standards than the areas with high traffic densities or topographically difficult areas.

Setting performance standards. In establishing the level of performance that will be required of heavy vehicles, a choice can be made between whether improved performance is to be required or whether existing performance is to be maintained. Should performance standards be set at levels that will provide for improved safety or increased productivity, or should they be set at the lowest level achieved by vehicles currently able to operate under prescriptive regulations?

Relating vehicle performance and operator/driver accreditation. A **good** driver may be able to drive a bad vehicle safely, but **a bad driver** cannot. How can this reality be satisfactorily accommodated in PBS?

Complexity and cost versus regional economic benefits. The present use of PBS is very costly as each assessment often means much computer simulation and field trials, costing many thousands of dollars. How can PBS be made available to more operators at a reasonable cost?

Access by small operators. Some 93% of operators operate only 1 or 2 heavy vehicles. Is PBS truly open to all? Is it going to restrict competition?

Intellectual Property. Some operators have invested heavily into research and development, making considerable use of simulation and field trials in order to gain regulator acceptance of innovation. The issue of intellectual property has been raised. How will this issue be managed?

Managing existing non-complying vehicles. Some existing vehicles will not comply with the new standards. How should they be treated?

Building ownership and support. It could be argued that this is the biggest issue. The 'boffins' understand PBS, but that is not the case with the bulk of the industry and other stakeholders that influence road transport. People will not vote for something they do not understand.

Maintaining the focus on outputs during the project. The need to bring the industry along with the project is of paramount importance. Having real outputs during the project along with seminars and briefings is crucial. However, there is still likely to be a major hiatus before the project gets to the stage of being nearly 'real'. It is nearly impossible to fully engage people in an issue until it is close to implementation or they can see it having a significant impact on something that is important to them.

5. LEARNING FROM EXPERIENCE AND OTHERS

5.1 Experience – Load Restraint Guidelines

The Load Restraint Guide was released in 1994, and incorporated performance standards alongside more prescriptive guidelines on ensuring loads are safely secured. A review of their impact showed that their comprehension required improvement and this is in-train, to:-

- Provide the innovation/benefits
- Illustrate what is too technical
- Marry the enforcement with the performance criteria
- See that these are accessible by the smallest operators.

Further work is taking place to bring out an improved second edition of the guidelines.

5.2 Other Industries

PBS regulation may be new to the road transport industry in Australia and New Zealand but it already applies to varying extents in other industries. The project team has had briefings from the National Food Authority, Occupational Health and Safety authorities and the people managing the Transport Services Contract in the Australian State of Victoria. In addition members of the Specialist Advisory Group have experience in performance based road maintenance contracts.

Much of the experience in these areas is still very limited, as the policies have only been in place for a short time. In the case of the road maintenance contracts, the early experience

has been positive, but it must be remembered that these are large 10-year contracts. Both the contractor and the client have invested considerably in their preparations and are very knowledgable.

The project will continue to engage others with experience in performance-based management to ensure the PBS project takes the best from them all.

6. WHAT MIGHT PERFORMANCE BASED STANDARDS LOOK LIKE?

It is likely that performance standards will vary depending on the extent of adoption of a particular standard. It is also likely that demonstrating compliance with a fully performance based standard will often be complex and difficult. Taking advantage of it will often require considerable investment by manufacturers and the industry. This can be seen below.

		Examples		
	Standard Type	**1. Pavement wear**	**2. Bumper bar properties**	**Measurement**
Increasing complexity or difficulty	Fully performance based	Optimise infrastructure wear and tear for given freight or passenger task	Reduce accident severity related to bumper bar accidents by 50%	Outcomes
Increasing relevance to the desired outcomes	Partially performance based	Specify pavement wear per unit of payload (ESAs/tonne)	Specify bumper bar properties (eg collapsibility of material), or specify intended effect of bumper bar (eg no damage to vehicle in a collision with a wall at 10 km/h; no serious injury to a pedestrian at 10 km/h)	Factors directly related to outcomes
	Fully prescriptive	Specify vehicle and axle load limits and tolerances	Specify the height, material and method of construction of a bumper bar	Factors indirectly related to outcomes (but easier to obtain)

7. CONCLUSION

The project is in its early days but good progress is being made. The field of measures is being honed down to a manageable set and the standards are being considered. Considerable documentation has taken place on work done in the recent past and from this 'defacto' standards are emerging. The case studies are being used to help build the PBS regulations. Other industries using PBS have been engaged for ideas on how best to implement PBS in the heavy vehicle sector. Communication is an issue and this is taking

place by way of a detailed communication plan. It includes presentations in as many relevant fora as possible, widely circulated brochures, a detailed policy framework document and seminars. However, it is likely that the communication will be most effective when decisions are being made on standards and forms of regulation to which the industry can readily relate.

8. REFERENCES

The NRTC/Austroads Terms of Reference for the PBS Project.

A1 – Report on the Field of Performance Measures prepared by Roaduser International and ARRB-TR.

A2 – Draft Report on a Demonstration Case Study (Truck-Trailer) prepared by Roaduser International.

B1 – Terms of Reference for a Project on the preparation of the format of Guidelines for PBS.

C1 – Terms of Reference for a Project on the Legislative, Regulatory, Compliance and Enforcement implications of PBS.

D2 – Report Assembling work previously conducted using PBS – prepared by ARRB-TR.

A3/A4 – Terms of Reference for the specification of Standards and the measurement of the current fleet of Heavy Vehicles.

Figure 1: Range of Typical Heavy Vehicles Using the Australian Road System

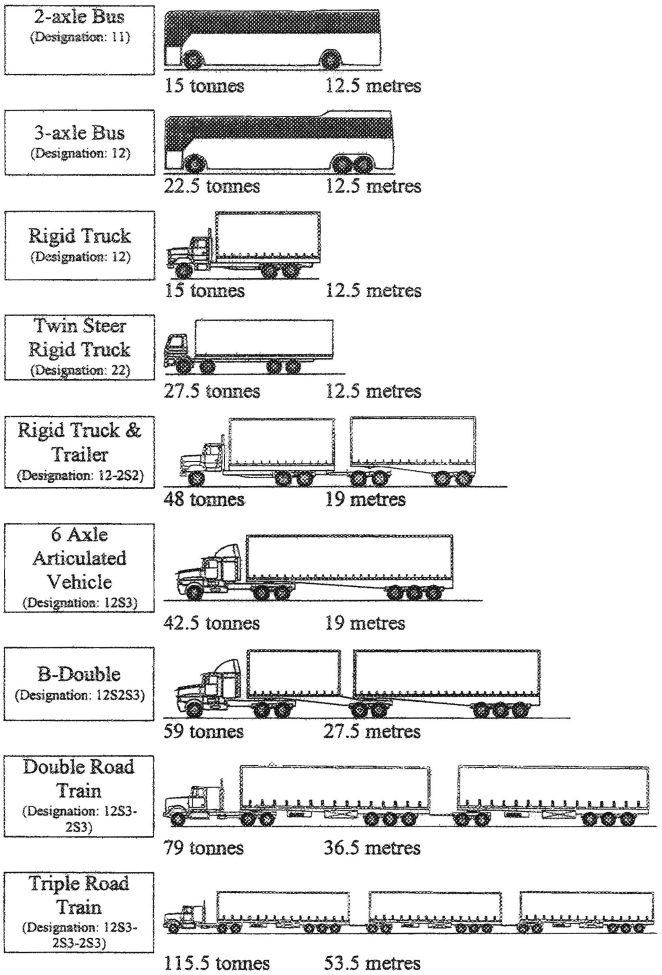

Table 1: Potential Core Performance Measures

Performance Measure	Description
Load Transfer Ratio (LTR)	Tendency to rollover in sudden manoeuvre: measures load transferred from one side of the vehicle to the other
Rearward amplification	"Crack the whip" response of rear trailer
High-speed transient offtracking	Tendency of rear trailer to track outboard in sudden manoeuvre
Static roll stability (SRS)	Tendency to rollover in a steady turn; measures lateral acceleration at rollover
Low-speed offtracking	Tendency of rear trailer to track inboard in low speed turns; ability to fit within Austroads specifications
Braking stability (in a turn)	Tendency for rollover or jackknife when braking in a turn
Gradeability (incl. Startability)	Sustainable speed travelling up a defined grade
Intersection clearance time	The time taken for the rear of the vehicle to clear an intersection (either straight through or turning) with the vehicle starting from rest
Tail swing	Tendency of the rear to swing outboard while initiating a low speed turn
Dynamic width	The total width occupied by a vehicle in motion including its width, plus the effects of steady state and dynamic off tracking, tracking variations under disturbances, and roll measured at the top of the vehicle.
Ride quality & Fatigue	Degree to which multi axis vibrations in certain frequencies are minimised at the driver position by vehicle, cab and seat design
ESAs per tonne	Degree to which the passage of the loaded vehicle affects remaining pavement life, taking into account the payload carried
Dynamic wheel loads	Degree to which vehicle suspension is road-friendly in terms of dynamic loading
Tyre contact pressure distribution	Degree to which high pressures occur within the tyre contact patch with the pavement
Shear forces	Degree to which horizontal forces are applied to the pavement by the vehicle tyres
Critical design vehicles (Bridges)	Comparison of the load distribution effects of a subject vehicle with the effects imposed by a design vehicle
Payload - weight	Difference between the GCM and the vehicle tare weight, for vehicles that are weight limited
Payload - passengers and luggage	Passenger and luggage weight accommodated by the GCM and the vehicle tare weight
Operating cost per tonne-km	Average cost to operate a vehicle taking into account the load carried and the distance travelled
Payload - cube	Volume of freight that can be accommodated by the design of the vehicle and load space, and the maximum allowable dimensions
Tonne-km per vehicle-hr	Average freight task per vehicle achieved taking into account the total hours of operation
Total deck length per unit OAL	Ratio of the total deck length to the overall vehicle length
Superelevation	Additional crossfall designed into a curved road segment to counter the outward force experienced by a vehicle as it travels at speed around the curve
Overtaking opportunities	Number of opportunities that other vehicles are given to overtake a slower vehicle on a given route, due to provision of overtaking or climbing lanes or sufficient clear sight distance
Roundabouts	Geometric features of roundabouts, affecting the tendency of vehicles to roll over and the ability of vehicles to track through the roundabout
Unevenness	Deviations of a pavement surface from a true planar surface with characteristic dimensions that affect vehicle dynamics, ride quality, dynamic loads and drainage; usually expressed as (i) longitudinal profile (or roughness), (ii) transverse profile and (iii) cross slope
Seal width	Width of the sealed section of the road carriageway, including all lanes in both directions
Signal phases	Amount of cycle time allocated to particular vehicle movements at a signalised intersection
AADT	Annual Average Daily Traffic (AADT) carried by a road; total for all vehicle classes
Percent heavy vehicles	Percentage of vehicles in the traffic stream that are heavy vehicles
Speed differential	Speed difference between impeding vehicles (trucks) and other road users
Medians and driveways (access)	The extent to which access of all road users to the route is limited or moderated