APPLYING A RISK-BASED APPROACH TO ROAD ACCESS USING TELEMATICS

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Abstract

The safe and efficient movement of freight on public road networks is critical to the productive movement of goods and produce and the functioning of an economy. The management of vehicles operating under restricted access arrangements, which include special purpose vehicles, multi-combination configurations and higher productivity vehicles, has relied on traditional methods of managing (and monitoring) access to the road network.

These traditional methods include conformance with mass, loading and dimension requirements by transport operators and drivers, and adherence to restricted access networks and routes through roadside enforcement. Road infrastructure managers and regulators have had limited ability to derive insights into the movement of Restricted Access Vehicles (RAVs) across the network and identify safety risks and infrastructure limitations.

In the Australian State of New South Wales, new risk-based approaches to manage RAVs are using new variants of Intelligent Access.

The paper explains how road infrastructure managers use new Intelligent Access variants to further advance heavy vehicle productivity and safety.

Keywords: Telematics; Intelligent Access; Digitalisation; Regulation; Asset management; Infrastructure planning, Risk management.

1. Introduction

The Australian State of New South Wales (NSW) is Australia's largest state economy. At more than half-a-trillion dollars, New South Wales is Australia's largest state economy, accounting for around a third of the nation's economic output and home to nearly a third of Australians. The NSW population, which currently stands at 8.1 million people, has grown at an average of 1.1 per cent over the last 30-years (NSW Treasury 2021).

The economic growth and prosperity of NSW depends on the safe, efficient and reliable movement of goods. With the freight sector contributing nearly $AU 66 billion a year to the NSW economy, the NSW 2040 Economic Blueprint identifies the need to 'Improve freight networks from regional New South Wales to global gateways to increase exports' (NSW Treasury 2021)

The New South Wales Freight and Ports Plan 2018-2023 is a call to action for government and industry to collaborate on clear initiatives and targets to make the NSW freight task more efficient and safe so NSW can continue to move and grow (TfNSW 2019).

The Plan aims to increase efficiency and connectivity by improving road freight access through the following actions:

- Achieve safe and efficient freight movements which also address local amenity issues, network impacts and infrastructure constraints
- Create Performance Based Standards (PBS) networks to improve connectivity across the NSW road network
- Foster the take-up of modern and safer PBS vehicles which can carry more freight leading to fewer trucks on the road than would otherwise be the case
- Increase access for vehicles operating at Higher Mass Limits (HML).

Transport for New South Wales (Transport for NSW) is the lead agency responsible for the development of a safe, efficient, integrated transport system that keeps people and goods moving, connects communities and shapes the future of NSW's cities, centres and regions.

Transport for NSW is responsible for a state road network which is almost 185,000 kilometres in length and carries more than 60 per cent of the freight moved in the State (TfNSW 2021).

A key challenge for meeting the growing freight task in NSW is improving access for the use of High Productivity Vehicles (HPVs). The main issue with accommodating HPVs on the road network is that they require more space when cornering and negotiating intersections. They also require bigger rest and break down areas. As the road network has not been designed for vehicles of these dimensions, key roads need to be upgraded to accommodate them.

Transport for NSW has introduced a Heavy Vehicle Access Policy Framework, which is an important reform delivering greater national harmonisation, with better safety and efficiency outcomes for industry and the community as freight demand grows.

2. Background and context

The Heavy Vehicle Access Policy Framework outlines a strategic approach to heavy vehicle access in New South Wales for Regional and Local roads as well as State Roads. The objective is to achieve the safe, productive and efficient movement of road freight in New South Wales now and into the future. The implementation of the Framework is a key initiative of the New South Wales Freight and Ports Plan 2018-2023 (TfNSW 2018).

Innovative telematics applications provide road infrastructure managers insights to make better network decisions and support investment decisions regarding road infrastructure. The widespread adoption of telematics in the heavy vehicle fleet over the last decade presents an opportunity for road infrastructure managers to introduce new ways of managing RAVs across road networks. The Heavy Vehicle Access Policy Framework leverages the widespread use of telematics with new variants of Intelligent Access, with the aim of minimising the regulatory burden and cost to transport operators.

This Framework will significantly increase the number of vehicles participating in, and the volume of data derived from, Intelligent Access arrangements in Australia. This overcomes the challenges inherent in collecting reliable road use data from heavy vehicles for reporting, analysis and visualisation.

The evolution of Intelligent Access concepts in Australia is discussed in a separate HVTT paper presented by Hill and Gordon titled *Evolution of Intelligent Access in Australia – A case study in stakeholder engagement*, which will assist in understanding the different Intelligent Access variants referred to throughout this paper.

3. Managing risks associated with heavy vehicle use

Traditional methods of managing risks associated with RAVs have typically focused on *vehicle conditions* and *access conditions*. In this context, *vehicle conditions* relate broadly to a vehicle's design parameters and may include prescriptive or performance-based standards (PBS) for vehicle design, configuration, components and/or safety features. On the other hand, access conditions relate broadly to the operating parameters of a vehicle and may include access restrictions where a vehicle can is legally permitted to operate on the road network, the maximum permissible mass, time-based restrictions, and/or vehicle speed limits.

These traditional methods rely on ex ante approaches to managing risk, which are often based on assumptions or bounded by history, facts and interpretations (Simon 1957). Samset and Chistensen (2015) provide a diagrammatic representation of ex ante and ex post evaluations. This is presented in Figure 1.

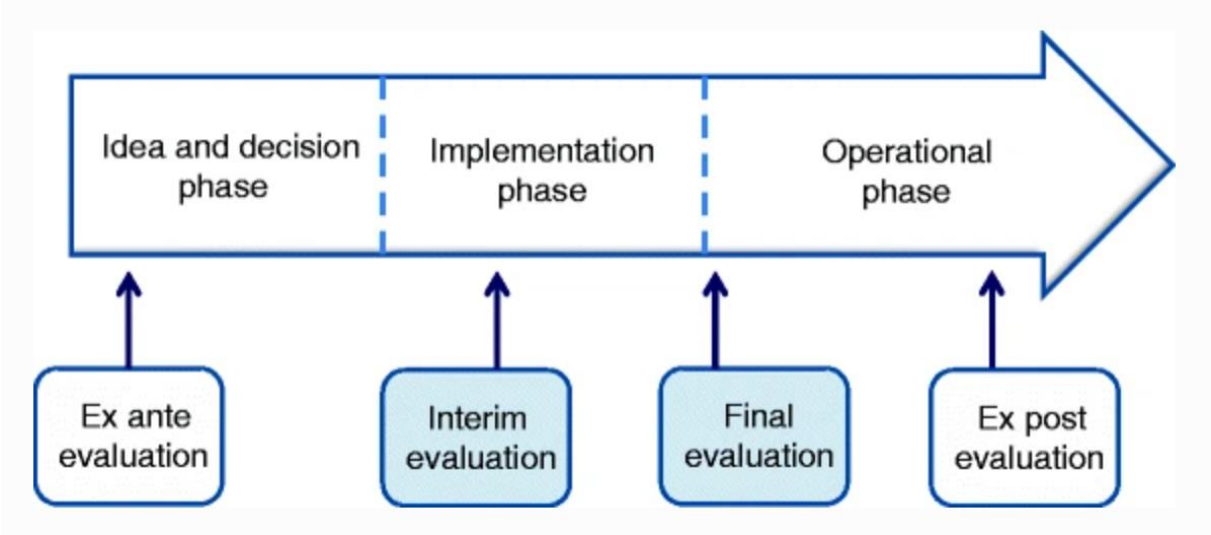

Figure 1 – Ex ante and Ex post evaluations (Samset and Christensen 2015)

Ex post assessments should have symmetry with *ex ante* assessments: through verifying that stated objectives have actually been met, determining whether there have been any unforeseen or unintended consequences, and considering whether alternative approaches could have done better (Samset and Christensen 2015).

However, according to Samset and Christensen, experience indicates that most evaluation activities occur in the implementation phase or just after its conclusion, options designated interim evaluation and final evaluation, respectively.

This is despite the importance of ex post evaluation, which should incorporate monitoring of performance measures, data aggregation and comparisons or trends over time. It can be used in advocacy by providing performance measures that enable the programme administrator to 'tell the story' and in allocation by ensuring standardised data is collected, allowing for comparisons of relative merit. It can be used in analysis by providing a relatively simple means of tracking inputs, outputs and to an extent, outcomes, over time (Australian Department of Industry, Innovation and Science 2015).

Traditional methods of managing conformance with mass, loading and dimension requirements by transport operators and drivers, and adherence to restricted access networks and routes through roadside enforcement, has not provided road infrastructure managers, regulators or community stakeholders with the ability to derive insights from data from the operation of RAVs across the network.

In terms of the dynamic interactions between vehicle utilisation, infrastructure management and safety – and deriving ex post understandings of conventional risk managements there remain challenges in performing ex post evaluations – the International Transport Forum (ITF) research report on Policies to Extend the Life of Road Assets, it is recognised that:

> 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 policy makers 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 different truck configurations, nor enabling the appropriate relationship with infrastructure capacity limitations. In addition, not all road infrastructure is suitable for all vehicle configurations. So there needs to be a match between vehicle configuration and access provisions to the road network (ITF 2018).

Although heavy vehicles are widely recognised as contributing to the 'consumption' of road assets at a greater level than other vehicle types, there have not been consistently reliable methods of gaining insights into the utilisation and loading of heavy vehicles operating on the road network. Where data are available for heavy vehicle road use and loading, conventional methods of collecting data typically only provide 'point-based' data samples (i.e. road-based systems which count vehicle passes, axle groups and or loads). Compared with other economic utilities (such as electricity, water or communications infrastructure), there is a comparative shortfall in data collected from road assets to inform the level of asset utilisation and consumption.

Shortfalls in ex post data can lead to assumptions that over-compensate for infrastructure and safety risks that cannot be adequately quantified. Over time, this can lead to sub-optimal outcomes for heavy vehicle access policies, and limit the potential for innovative, higher productivity vehicles to be introduced on the road network.

With the forecast growth in road freight transport over the coming decades, coupled with fiscal constraints which impact on road asset maintenance and capital investment programs, alternative approaches need to be included to complement conventional options considered by policy makers and road asset managers (Koniditsiotis and Hill 2018). The challenge remains for infrastructure managers and regulators to ensure appropriate tools are available to use data to inform evidence-based decisions to identify, quantify, and manage risks. The Heavy Vehicle Access Policy Framework responds by providing the tools necessary to deliver improved infrastructure, productivity, and safety outcomes through a data-driven approach through new variants of Intelligent Access.

4. Overview of the NSW Heavy Vehicle Access Policy Framework

The NSW Heavy Vehicle Access Policy Framework incorporates telematics and data to provide vital insights into the use of RAVs, and their interaction with road and bridge infrastructure, and other road users. Based on risk, the appropriate variant of Intelligent Access is applied as an access condition.

The objectives of the Framework are as follows:

- Improve the safe, productive and sustainable use of heavy vehicles in NSW
- Minimising regulatory burden and cost on transport operators

- Maximise the effectiveness of road infrastructure maintenance and investment expenditure through trend analysis of network usage
- Improve the safe operation of heavy vehicles through data-driven decisions to inform risk-based assurance activities
- Take advantage of new and existing technologies to deliver efficiencies and productivity for industry and greater visibility and assurance for road agencies and communities.

The Framework recognises that there is a balance between risk and compliance management. Therefore, lower-risk vehicles attract a lower-level variant of Intelligent Access with less emphasis on data integrity (such as the Road Infrastructure Management (RIM) application. In comparison, higher-risk vehicles attract a higher-level variant of Intelligent Access, which can be used for enforcement purposes (such as the Intelligent Access Program). In determining the appropriate variant of Intelligent Access for different kinds of RAVs, the following process is applied:

1. Assess the level of risk to other road users from RAV compared to general access heavy vehicles
2. Assess the level of risk to road infrastructure from RAV compared to general access heavy vehicles
3. Assess the comparative costs of different Intelligent Access variants versus the ability of data collected to improve safety, productivity and sustainability of the NSW road freight task
4. Assess the current access conditions for the RAV.

Using this process, RAVs are classified as lower, medium or higher risk vehicles. The general attributes of vehicles in each classification are as follows:

4.1 Higher Risk vehicles

Higher risk vehicles generally include those which meet the following criteria:

- Axle masses exceeding Higher Mass Limits (HML); and
- Total mass (generally fixed); and
- Comparably short extreme axle spacing to total mass; and
- Non-load carrying vehicle; and
- Permitted to travel at speeds above 50km/h.

Due to the high risk to road infrastructure, these RAVs will require enrolment into the IAP and may require Smart On-Board Mass (OBM) systems to operate on sensitive road assets.

4.2 Medium Risk vehicles

Medium risk vehicles generally include those which meet the following criteria:

- Operating at Higher Mass Limits (HML) for non-PBS approved vehicles; or

- PBS approved vehicles operating at Tier 2 or Tier 3 masses in accordance with their PBS Vehicle Approval; or
- Class 1 Load Carrying Vehicles that exceed the mass or dimensions under the Multi-State Class 1 Load Carrying Vehicles Dimension Exemption Notice; or
- PBS approved vehicles that exceed PBS Network Classification Guideline lengths, i.e. a PBS approved vehicle that meets all PBS Level 2 standards but exceeds 30 metres in length.

Due to the risks associated with mass and or length, these RAVs will require the Telematics Monitoring Application (TMA) variant of Intelligent Access, and may require Smart OBM to operate on sensitive road assets.

4.3 Lower Risk vehicles

Lower risk vehicles generally include those which meet the following criteria:

- Operating at General Mass Limits (GML); or
- Operating at Concessional Mass Limits (CML); or
- PBS vehicles operating at Tier 1 masses in accordance with their PBS Vehicle approval; or
- Operate under special schemes approved by Transport for NSW.

These vehicles currently have broad access and pose a comparatively lesser risk than other RAVs. Accordingly, these RAVs only require the Road Infrastructure Management (RIM) variant of Intelligent Access.

Under the Framework, all RAVs operating in NSW will be monitored through a variant of Intelligent Access by mid-2025.

5. How the Framework is being applied in practice

This section provides three examples of how the Framework is being applied in practice with new variants of Intelligent Access are presented in this section for illustrative purposes.

- Safety, Productivity and Environment Transport Construction Scheme (SPECTS)
- Farm Gate
- Hill Descent Monitoring.

5.1 Safety, Productivity and Environment Transport Construction Scheme (SPECTS)

SPECS enables heavy vehicles to transport greater payloads to transport construction materials in the Sydney urban area.

Table 1 – SPECTS

Objective	To minimise the number of vehicle movements associated with construction in the Sydney urban area.
What problem or challenge?	Sydney is experiencing significant growth in the construction sector.
How is the problem or challenge overcome?	SPECTS allows PBS-approved 7 axle Truck and Dog combinations to carry increased payloads in return for being monitored through Intelligent Access arrangements. Compared with traditional combinations, PBS-approved 7 axle Truck and Dog combinations contribute to a 12.5% reduction in vehicle trips.
Level of risk	Low.
Intelligent Access variant	Road Infrastructure Management (RIM).
Data, analysis and reports	Aggregated, de-identified reports of vehicle movements (see Figure 5). Individual vehicles movements *are not* identifiable.

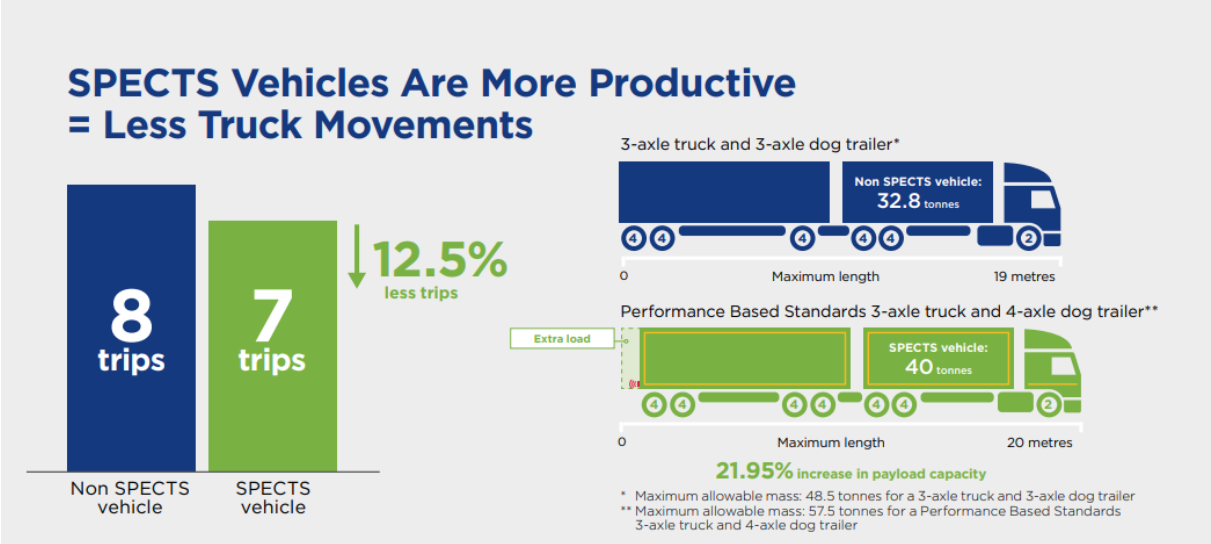

Figure 2 – Productivity benefits of SPECTS (TfNSW 2019)

5.2 Farm Gate

Farm Gate Access enables safe and legal heavy vehicle access on first and last-mile journeys – by connecting RAV networks to the 'farm gate' (TfNSW 2021).

Table 2 – Farm Gate

Objective	To enable the use of more productive vehicles to safely transport grain and livestock from the farm gate to market, meaning fewer trips for the freight task.
What problem or challenge?	Local road managers often resist granting RAV access on local roads. This often relates to: • The risk of RAV vehicles causing damage to lower-quality local road infrastructure • Community concerns about the operation of RAVs on local roads • Poor knowledge of the current volume of heavy vehicles operating on local roads.
How is the problem or challenge overcome?	Farm Gate allows RAVs to travel legally on local roads, in return for being monitored through Intelligent Access arrangements. Local road managers can quantify the number of vehicles transporting grain or livestock on local roads. This knowledge can be used as an evidence base to better manage infrastructure risks (and inform maintenance and investment decisions) and community concerns.
Level of risk	Low.
Intelligent Access variant	Road Infrastructure Management (RIM).
Data, analysis and reports	Aggregated, de-identified reports of vehicle movements (see Figure 5). Individual vehicles movements *are not* identifiable.

Figure 3 – A local road accessible by Farm Gate

Figure 4 – A livestock vehicle in rural NSW

5.2 Hill Descent Monitoring

Hill Descent Monitoring enables High Productivity Vehicles (HPVs) to travel safely on long or steep descents.

Objective	To allow HPFs to travel down long or steep descents.
What problem or challenge?	Longer and heavier vehicles can raise significant road safety risks when travelling down long or steep descents.
How is the problem or challenge overcome?	Hill Descent Monitoring allows HPVs to travel on routes with long or steep descents in return for being monitored through Intelligent Access arrangements. The accumulation of too much speed can adversely affect the control of the vehicle and the safety of other road users. The presence of long or steep descents can often restrict access to networks.
Level of risk	Medium.
Intelligent Access variant	Telematics Monitoring Application (TMA).
Data, analysis and reports	Reports on the average speed of individual vehicles traversing a long or steep descent. Individual vehicles movements *are* identifiable.

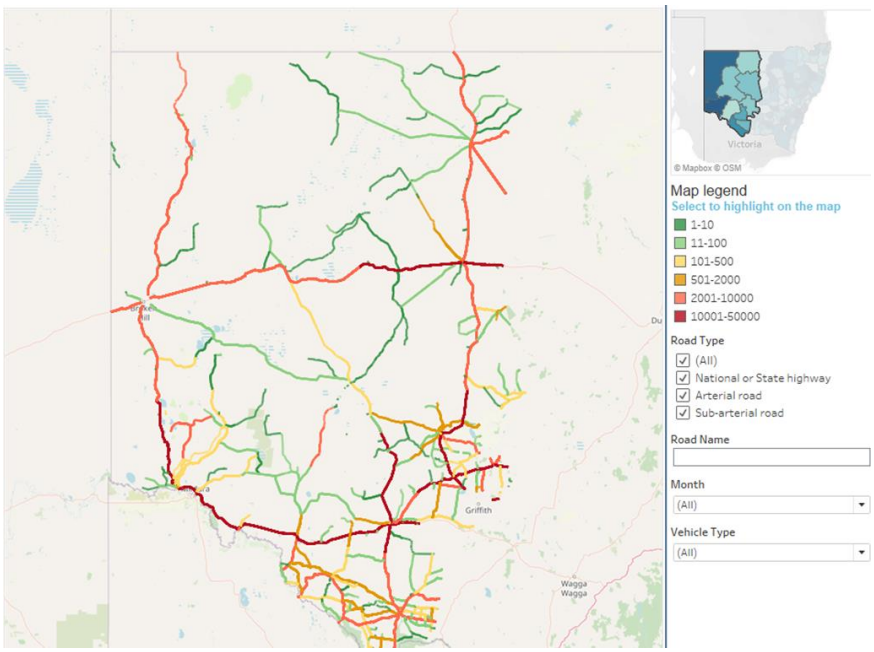

Figure 5 – Example of aggregated, de-identified vehicle movements (TCA 2021)

6. Conclusion

Road infrastructure managers and regulators – as well as the broader community – have been limited in their ability to derive insights into the movement of heavy vehicles across the network.

New variants of Intelligent Access, when used in conjunction with the NSW Heavy Vehicle Access Policy Framework, present new opportunities to manage infrastructure and safety risks while improving the understanding of road infrastructure utilisation (to inform maintenance and investment decisions). The practical examples presented in this paper, namely SPECTS, Farm Gate and Hill Descent Monitoring, combine traditional risk management approaches with contemporary arrangements and present renewed opportunities to advance productivity, asset management, and safety outcomes.

Critically, the availability of data from Intelligent Access arrangements is helping shift heavy vehicle policy and regulation towards a greater emphasis on ex post analysis, focusing on quantifiable measures. It is hoped that a data-driven approach will overcome the resistance to heavy vehicle reform, which can often be overtly influenced by some stakeholders' assumptions, opinions, and misunderstandings.

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