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Regulatory Toolkit for Overloaded and Poorly Loaded Road Vehicles

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EXECUTIVE SUMMARY

The purpose of this project is to examine a number of regulatory tools, initiatives and reforms that economies can consider to address the incidence of overloading and poor loading of road vehicles.

This paper argues that excessive and poor loading of road vehicles can have a significant negative impact on safety, productivity and infrastructure quality outcomes. This in turn can erode wider economic and social outcomes through increased transport costs, diminishing returns on infrastructure investment, and reduced amenity and safety for road users and local communities.

To begin to address these problems, the paper outlines a number of steps for regulators and policymakers to consider. A summary of these follows.

1. Establish a framework for collecting and analysing data about the road freight sector. This is essential to understand the challenges and inform the development of efficient and effective regulatory measures and programs.

2. Regulation should be structured in accordance with a systematic pavement wear methodology. The key element of such a methodology is that pavement wear and infrastructure damage increase with higher vehicles masses in an exponential rather than linear fashion. Embedding this principle in heavy vehicle regulation ensures that stricter compliance and enforcement measures are targeted at the highest cost behaviours.

3. Technological tools that can support effective heavy vehicle regulation. These include weigh stations and weigh-in-motion technologies, on-board scales and telematics applications. These technologies can be assessed as to whether they are 'fit-for-purpose' for a particular economy depending on cost, availability, and whether the regulatory and administrative resources exist to properly utilise the information that is generated.

4. Access measures and models are explored, which allow transport operators access to certain roads in exchange for assurance of mass limit compliance or performance requirements. These include: accreditation schemes, mass management schemes, and performance-based standards.

5. A 'chain of responsibility' regulatory framework, under which all parties in the logistics chain have duties to ensure compliance with heavy vehicle regulations. This can provide for more effective compliance and enforcement than regulatory frameworks that apply penalties only to vehicle drivers.

6. Regulatory agencies should rely on a step by step strategy to implement measures. Following a structured approach ensures the right initiatives are considered as appropriate to the needs on the Economy and that process are in place to ensure their correct implementation.

7. The importance of implementation and evaluation planning to ensure that regulatory initiatives achieve the desired outcomes. Regulatory agencies implementing reforms for heavy vehicle regulation and other programs should undertake implementation and evaluation planning so that the effectiveness of changes can be objectively measured and opportunities for further improvement can be identified.

8. Effective leadership and highly trained and capable staff are the enablers of introducing good policy to support a robust regulatory environment. Without strong leadership with well managed workplaces and capable staff accountable to implement initiatives, the likelihood of success is limited.

INTRODUCTION

Project background

Deaths and injuries from road crashes are widely recognised by the international community as not just a transport problem but a serious public health and economic issue. The World Health Organisation has estimated that 1.25 million people die on the world's roads every year and up to 50 million people suffer non-fatal injuries annually. About 90 percent of road deaths occur in developing economies.[1]

In March 2010, the United Nations (UN) General Assembly proclaimed the Decade of Action for Road Safety 2011–2020 with the goal of saving lives by stopping and reversing increasing trends in road traffic deaths and injuries worldwide. The *Global Plan for the Decade of Action for Road Safety 2011-2020*[2] calls for economies to implement measures identified internationally as effective to make their roads safer.

Heavy vehicle safety is of particular concern to industry, communities and policy makers. A 2011 Asia Pacific Economic Cooperation (APEC) study estimated that there were 420,000 deaths and injuries per year across the APEC region as a result of heavy vehicle crashes. The 2011 study highlighted a number of factors contributing to these crashes including:

- human/business factors (driver fatigue, poor driver education, speeding, non-awareness of road safety issues, impaired driving, unreasonable work schedules and expectations, skills shortages);
- vehicle factors (overloading, poor load balancing, poor vehicle roadworthiness, inadequate technology, poor safety features, poor maintenance);
- infrastructure (inappropriate road type and speed limit, unsuitable road features); and
- legislation and regulation (absence of road safety guides for truck drivers, lack of availability of instruction manuals, inadequate vehicle and cross-border legislation and poor enforcement).[3]

Problem identification

The issue of overloading and load balancing identified in the 2011 APEC study is a significant problem in developing economies such as Papua New Guinea. While heavily loaded vehicles may have productivity benefits because they move large amounts of cargo at minimal marginal cost for the transport operator and consignor, they can also compound accident risks as a result of the vehicle operating outside its normal safety parameters, resulting in larger costs to the community and the economy.

Overloaded or improperly loaded heavy vehicles may also cause damage to road infrastructure, including pavements, shoulders, drainage and kerbs. As a result, infrastructure requires increased maintenance and capital investment to continue to operate at optimum performance.

Papua New Guinea's 2013 *National Transport Strategy* highlighted that, "urban streets that carry heavy traffic such as port access routes and industrial area roads are more susceptible to pavement

[1] World Health Organization, *Global status report on road safety 2015* (World Health Organization, 2015) vii. http://www.who.int/violence_injury_prevention/road_safety_status/2015/en/
[2] United Nations, *Global Plan for the Decade of Action for Road Safety 2011-2020* (United Nations, 2010). http://www.who.int/roadsafety/decade_of_action/plan/en/
[3] APEC, Road Safety Measures for Heavy Vehicles in APEC Transport Supply Chains (APEC, 2011) iv-v. http://www.apec-tptwg.org.cn/new/Archives/tpt-wg34/Land/Final/2011_tpt_roadsafety-measures.pdf

and kerb damage, including from overloaded vehicles, and this is reflected in the generally poor condition of these routes."[4]

For Papua New Guinea and in most APEC economies road transport facilitates the movement and access for a wide range of goods for communities located both in urban and regional areas. The success of the road transport sector in delivering the freight task is reliant on being able to appropriately access road networks safely and efficiently, and in being able to maximise the utility of the network without impinging on community safety.

Papua New Guinea transport officials have indicated that their challenge is to identify and implement suitable strategies to address (together with industry) the issue of overloading/inappropriate loading for heavy vehicles. There is therefore scope for Papua New Guinea and other APEC economies to work together on developing a framework of practical measures to address issues concerning overloaded heavy road vehicles.

Papua New Guinea has also identified a lack of understanding in the road transport industry about vehicle loading, load balancing and the long term consequences for network infrastructure. With a significant proportion of Papua New Guinea's main thoroughfares assessed by the International Roads Assessment Program (iRAP)[5] as being of the lowest safety standards (1 star), improvements in the regulation of heavy vehicle overloading can complement infrastructure asset management and strategic investment.

Self-funded APEC project

At the 42nd meeting of the APEC Transport Working Group in Port Moresby in April 2016, Secretary Roy Mumu OBE of the Papua New Guinea Department of Transport announced that Papua New Guinea, with support from Australia, would produce a regulatory framework toolkit to address overloading and poor loading of road vehicles. The purpose of the project is to develop a framework that embraces a range of regulatory, educational and other measures to assist Papua New Guinea transport authorities, infrastructure owners and industry to address the impacts of heavy vehicle overloading. The measures could be considered by other APEC economies if deemed applicable to their circumstances.

Project scope

Papua New Guinea and other APEC economies with similar heavy vehicle transport environments may benefit from a range of measures including:

- education programs that identify the safety, economic, asset management and environmental concerns to inform and educate the transport community in respect of high mass heavy vehicle transport;
- accreditation programs that provide assurance to regulators and put the responsibility on operators to implement a culture of training and safety;
- a compliance and enforcement program that provides a level of assurance and consistency to all road users and stakeholders that vehicles are compliant with mass limits and other regulatory requirements;
- the means to identify, intercept and assess overloaded heavy vehicles, including technology

[4] Papua New Guinea Department of Transport, *National Transport Strategy: Volume 3 Detailed Strategy* (Department of Transport, 2013) 52. http://www.transport.gov.pg/images/pdf/NTSVol3DetailedStrategy.compressed.pdf
[5] International Road Assessment Programme, *Highlands Highway: iRAP Papua New Guinea Technical Report (2015)* (International Road Assessment Programme, 2015) 4. http://www.irap.net/en/about-irap-3/assessment-reports?download=277:highlands-highway-irap-papua-new-guinea-technical-report-2015

options and compliance and enforcement strategies; and

- schemes that provide the availability of additional mass in return for stricter conditions of road use (such as limits on road access), which link to road infrastructure investment strategies.

Undertaking this work requires a review of existing approaches, a fit-for-purpose assessment of their value, and a stocktake of approaches from other economies. Many of the factors identified in the 2011 study relate to outcomes associated with overloaded heavy vehicles and poor load restraint. This discussion paper will examine the interrelated factors that have a detrimental impact on Papua New Guinea's road transport system. This analysis will provide other APEC economies with the opportunity to consider the issues in light of their own experiences.

This discussion paper represents a 'first draft' of the regulatory framework toolkit. It will form the basis of discussion at a major workshop to be hosted by Papua New Guinea and Australia in Brisbane in April 2017. A variety of APEC economies including Papua New Guinea, Australia, Viet Nam, Malaysia and Thailand will use the workshop to discuss ways to improve the regulation of overloaded and poorly loaded road vehicles. The aim will be to develop strategies to improve road safety, infrastructure investment and productivity outcomes.

Overloading and poor load restraint

Control of overloaded heavy vehicles is main focus of this discussion paper. However, load restraint is also important. Poor load restraint occurs as a result of disregard of good practices, or as is generally the case, a lack of awareness of correct load restraint procedures. Road authorities and operators should keep in mind that a vehicle can be within its legal mass limits but with a load poorly restrained. The associated impact of loads lost impacts road safety and transport times in delivering goods to their destination. This discussion paper will seek to address both overloading and poor load restraint in road transport.

How to Use this Report

This report has been designed to reach a broad audience. Ideally it should be read in its entirety. However, it is divided into five parts for the reader to easily access relevant areas of interest. There is a logical progression from PART 1 through to PART 5, which introduces the problem, examines initiatives to address it and then provides a framework on implementing actions considered appropriate for the Economy.

PARTS 1 and 2 were prepared as a Discussion Paper for the APEC Transportation Working Group. The Discussion Paper was used to guide discussion at a workshop held in Brisbane in Aril 2017. The Discussion Paper, PARTS 1 and 2, has been refreshed to include recommendations arising from the workshop.

PART 1 is the identification of the challenges and issues faced by economies due to overloading of heavy vehicles and poor load restraint. It considers the associated impact on the economic health of the economy and the road safety and amenity burden placed on the community. It also examines costs to transport operators and the logistics chain and associated costs as a result of overloading on road authorities. PART 1 should be of interest to policy advisors and decision makers as well as in-field practitioners.

PART 2 explores the challenge of overloading and poor load restraint through case studies and provides a detailed analysis of initiatives to reduce the problem. This section includes discussion on emerging technologies and policy levers. PART 2 should be of interest to policy advisors and decision makers as well as in-field practitioners.

PART 3 appeals to those who have a particular area of interest or responsibility on which to focus. Addressing the impact of overloading of heavy vehicles and poor load restraint requires: direction and leadership of the leadership team and a commitment to capability development; the input of the communications and stakeholder engagement team; data and its analysis and a clear response on policy and regulatory changes to introduce mechanisms to address the issue. PART 3 is a discussion on five categories of actions that could be adopted by economies, depending on their stage of development, to ameliorate the impact of overloading and poor load restraint. It should be noted that there is no one category of actions or one single action that can be used to successfully address the problem. The five categories of actions are:

1. Communications and engagement
2. Leadership and capability development
3. Data collection and analysis
4. Strategy and policy development
5. Legislative review and reform

PART 3 will be useful to anyone involved in the task of managing overloading and poor load restraint, whether it is from a leadership, policy, regulatory, data or communications and community/industry engagement perspective.

PART 4 complements PART 3. It acts as a checklist and is a simple look-up chart cross-referencing each of the five categories of actions (PART3) and recommendations (PARTS 1 &2). It is titled the Implementation Plan. Under the five categories of actions, it summarises the initiatives, objectives and actions discussed in earlier parts of the report and suggests an indicative timeframe and a sequencing for the actions. The Leadership Team and all personnel working across the five categories of actions will find this a useful tool.

PART 5 offers a pathway suggesting processes and procedures to follow to deliver on the actions. These frameworks will assist those responsible for delivering on the actions proposed. It is not intended to be definitive but could act as a starting point to undertake actions to address the problem of overloading of heavy vehicles and poor load restraint. In addition, economies more advanced in addressing the problem of overloaded heavy vehicles and poor load restraint, may find it useful as a check on their own procedures.

PART ONE

The Papua New Guinea experience

Road transport is a critical link in the social and economic development of all economies. The movement of goods on roads is the dominant freight mode in most economies and is responsible for 80 to 90 percent of Papua New Guinea freight movement.[6] The ultimate goal is to have a reliable, safe and efficient road transport system. The management of the road system and its maintenance affects the rate of deterioration and maintenance costs of road pavements and infrastructure. Therefore, it becomes critical in achieving sustainable economic growth and enhancing the social capital of the community.

Whilst mass limits for trucks are regulated in Papua New Guinea, the management and enforcement of controls on overloading and poor loading practices requires development. Trucks exceeding legal mass limits increase safety risks and damage infrastructure and road pavements. Unfortunately, overloading of vehicles in Papua New Guinea has been a costly problem for many years. Coupled with inadequate maintenance the result is accelerated deterioration of the road network, resulting in asset loss and deterioration to infrastructure worth millions of dollars. It increases the cost of logistics, which adversely affects all elements of the supply chain and challenges economic growth and social wellbeing.

Exacerbating the problem further, lack of management and enforcement of overloading can result in unfair competition between transport operators. This increases the likelihood of widespread non-compliance. Transport operators may argue that to remain economically viable and competitive they are forced to overload their vehicles. This is an unsustainable situation.

In a 2016 Transport Forum including representatives of the transport industry and facilitated by Department of Transport Secretary Mr Roy Mumu OBE in Lae, transport operators expressed their frustration with the 'cowboys' of the transport sector. These operators allegedly breach rules for their commercial advantage, knowing that the likelihood of detection was low.[7]

Figure 1 identifies the main roads in Papua New Guinea, all of which serve a freight task. The most important freight road in Papua New Guinea is the Highlands Highway, which ships export material from the Highlands to the coastal towns of Lae and Madang. Some freight also goes directly to the airport at Nadzab, near Lae. The highway accounts for eighty percent of Papua New Guinea's freight movement. The impact of overloaded vehicles has a long term and detrimental effect on economic sustainability and growth. Identifying key freight routes and analysing their condition is critical for all economies to develop sustainable rehabilitation and maintenance programs.

Traditional approaches to controlling overloaded heavy vehicles have had little success in Papua New Guinea and are unlikely to work in the future.

Reliance on prescriptive legal load limits and their enforcement is unlikely to ensure effective control. Working towards greater sustainability will require new approaches to manage institutional, technical, financial and economic structures. This will require cooperation between road authorities, the transport industry and the private sector to meet the shared needs of the economy. It will require engagement with and the support of political and social structures. By necessity, control and management of overloading will require a multi-dimensional approach.

[6] Peter Frauenfelder, Notes of meeting with the Papua New Guinea Department of Transport, Port Moresby, Papua New Guinea, August 2016.
[7] Peter Frauenfelder, Notes from Transport Forum, Lae, Papua New Guinea, August 2016.

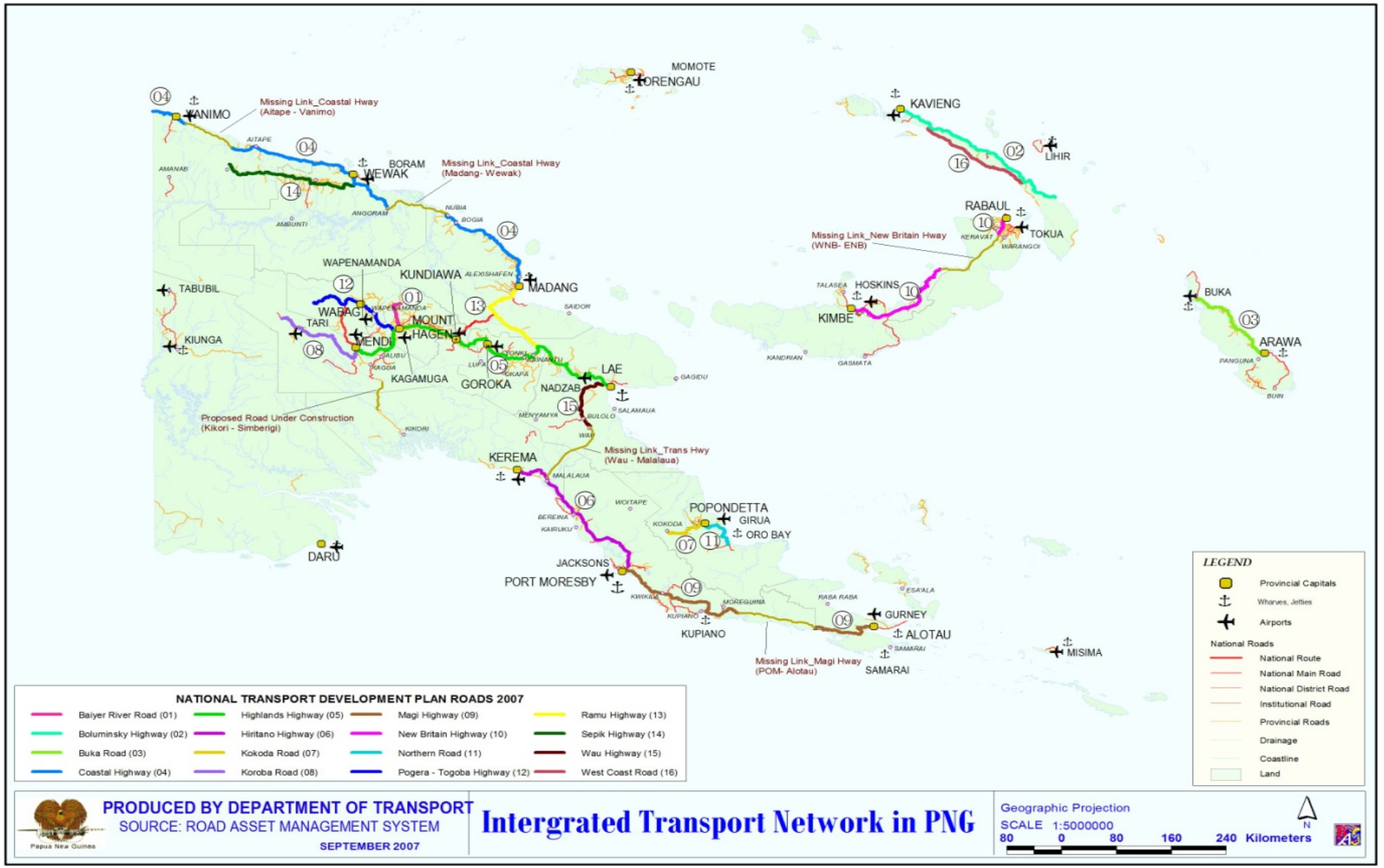


Figure 1: The National Transport Network in Papua New Guinea, 2007
Source: provided by Secretary Roy Mumu OBE to Peter Frauenfelder, August 2016

The social and economic cost of overloaded heavy vehicles is significant on the economy and all stakeholders in the logistics chain. Rather than working independently of each other, stakeholders are encouraged to have a shared vision for their future and that of their economy. In accepting responsibility and accountability, road and port authorities, enforcement services, and transport stakeholders–including transport operators, freight forwarders, consignors and consignees–need to work together to benefit the whole economy. This in turn will have benefits for each stakeholder in the logistics chain. Economic sustainability and growth is a goal to which all should aspire.

Ideally the draft findings and discussion points presented in this discussion paper can be applied to roads in both Papua New Guinea and other APEC economies.

Figure 2 below shows an example of a highway in a poor state of repair. The potholes in the road are so deep and destructive that the driver of this small van has followed a well-worn path off the road. Our driver waited for the van to pass crossing over to the other side of the road to use the same off-road track. Apart from the road safety implications, waiting like this increases travel time, increases transport costs and extends delivery times. Annually the cost of waiting, multiplied by many thousands if not millions of vehicle trips each year, impacts the health of the whole economy.

Figure 2: Highlands Highway, Papua New Guinea, August 2016
Source: Peter Frauenfelder, VicRoads

Understanding the impact of overloaded heavy vehicles is an important first step in considering appropriate interventions to address the problem.

The cost of overloaded heavy vehicles to the economy

A World Bank study in 2010 compared estimated transport costs in Eastern and Southern Africa with developed economies. The study found that overloaded heavy vehicles significantly accelerated the rate of deterioration of road pavements. When coupled with inadequate funding for road maintenance it also contributed significantly to very high transport costs, estimated to be four to five times higher

than costs prevailing in developed economies.[8]

Echoing this finding, Papua New Guinea officials have noted that, “the impact of disruptions to heavy vehicle operation, especially for goods into the hinterland, affects the prices of commodities, which is passed on to the end user. Uncontrolled loading affects the road conditions and damages bridges and culverts, which are repaired by the government.”[9]

Figure 3 illustrates the damaging effects of overloaded heavy vehicles on sections of road. Since being sealed, this road has deteriorated dramatically. This places a very high cost on the maintenance budget of the road authority and severely reduces the efficiency of the road and its reliability to get goods to market on time. This also compromises the safety of the truck’s driver and any other road user sharing the road with this heavy vehicle. A few hundred metres from this point lies the skeleton of a truck that had failed to take a bend. One can speculate on the cause of the crash but it is highly likely the condition of the road was a contributing factor.

Figure 3: Highlands Highway, Papua New Guinea, August 2016
Source: Peter Frauenfelder, VicRoads

According to the Papua New Guinea Department of Transport, the Highlands Highway, “serves 50 percent of Papua New Guinea’s population and provides access to its farms and mining companies critical to the development and sustainability of the economy.”[10] The Lae Port Authority’s capacity to function optimally is challenged when roads are unreliable, putting in question delivery times and meeting tight shipping schedules. The quality of perishable goods will deteriorate as delivery times increase. The reputation of the economy to provide agricultural goods as required by the consumer places additional burden on exporters competing for market share. Extracted commodities in the form of oil, gas, gold and nickel are also susceptible to the volatility of market

[8] Michael Pinard, *Overload Control Practices in Eastern and Southern Africa: Main Lessons Learned* (World Bank, 2010) xvi. https://openknowledge.worldbank.org/bitstream/handle/10986/17779/669360NWP0Box30WP910Synthesis0Cover.pdf
[9] Papua New Guinea Department of Transport, Response to APEC Heavy Vehicle Overloading Survey 2016 (Refer to Appendix 4).
[10] Ibid.

demands, which can be exacerbated by an unreliable and poorly functioning road system.

Thus in order to achieve acceptable levels of road transport efficiency the management and maintenance of road infrastructure are an important part of development programs in all economies. More specifically the control of overloading is of paramount importance as it affects the rate of deterioration and maintenance costs of road pavements.[11]

As Figure 4 shows, the United States has substantially lower logistics costs relative to GDP than most other economies.[12] While Papua New Guinea was not separately studied, it is probably reasonable to assume it is comparable to the general results for Asia as a whole.

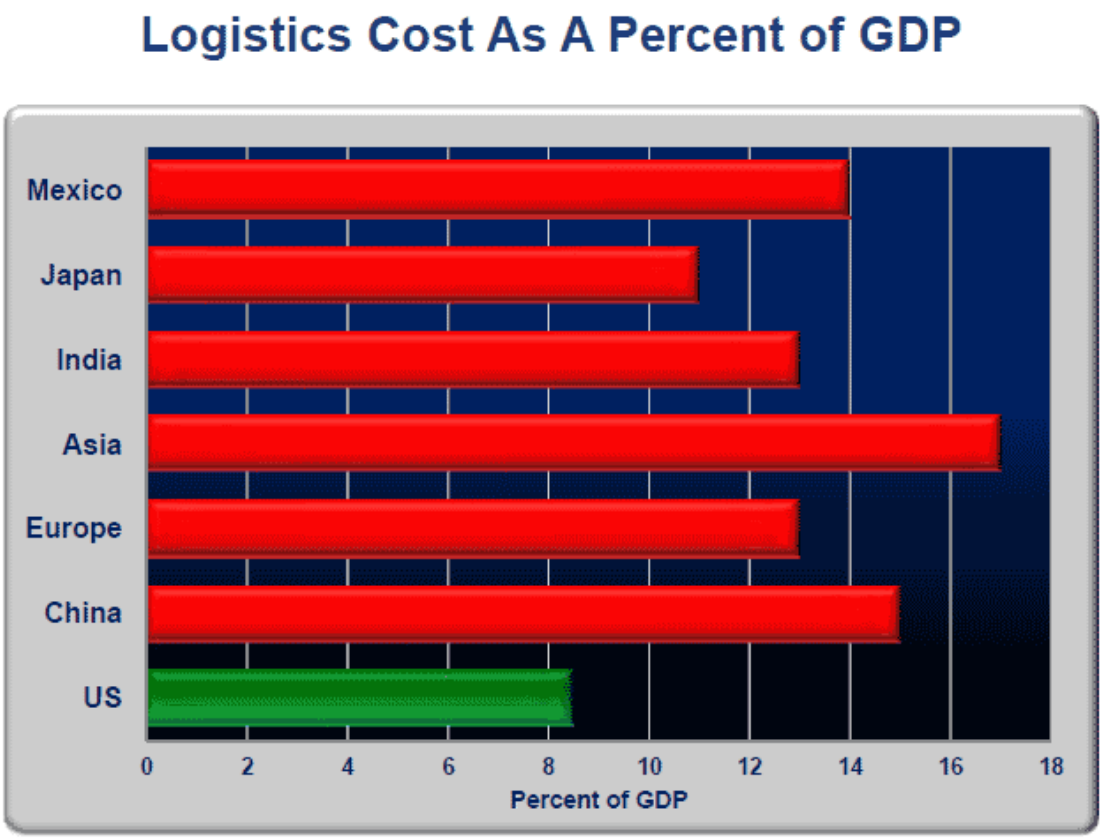


Figure 4: Logistics cost as a percent of GDP
Source: Refer to n12

There is a mutual obligation on the road user and the road authority to work together to improve the condition of the road for the safe and efficient transportation of goods. There is an obligation on the road user to ensure that their use of the road does not unduly damage the road. In turn there is an obligation on the road authority to develop and maintain roads that can provide the highest possible standard to meet the needs of all road users.

It is critical for economies such as Papua New Guinea to better understand the costs of transport and the impact that heavy vehicle operations has on the road system. This will assist to allocate an appropriate amount of funding to ensure road system sustainability. A study of transport costs as a sub-set of logistics costs will assist government to identify and develop policy levers to reduce the burden of transport costs on the road system. Specifically to the condition of the road, this study should compare current transport costs with estimates of likely costs if roads had been developed and maintained in good working order and provided a reliable service. The iRAP rating of 1 star

[11] Above n8.
[12] Rosalyn Wilson, "24th Annual State of Logistics Report: Is this the new normal?" PowerPoint presentation (online, 2013) slide 8. https://www.fhwa.dot.gov/planning/freight_planning/talking_freight/august_2013/talkingfreight08_21_13rw.pdf

represents the lowest road quality and safety standard, and is a benchmark position to begin the work.

These findings will support the argument that minimising the incidence of overloaded vehicles has a direct impact on the performance life and condition of the road system and related maintenance costs. The data is a necessary adjunct to assist in bidding for funding to increase rehabilitation and maintenance budgets.

Figure 5: Arterial Road, Port Moresby Papua New Guinea, April 2016
Source: Peter Frauenfelder, VicRoads

Figure 5 shows a road is in such poor condition that drivers use the incorrect side of the road creating a safety risk or they drive through potholes of significant depth damaging vehicles and most likely goods and people within the vehicles.

Recommendation 1: Undertake a study to determine baseline data for transport costs and broader logistics costs for evaluative purposes in future years.

Overloaded trucks and associated impacts on road safety and amenity

The severity of crashes involving heavy vehicles is far greater than that of other road vehicles due to the physics of the heavy vehicle once it loses control. Overloaded vehicles exacerbate this outcome. The heavier the vehicle, the greater the release of kinetic energy, impacting other road users, vehicles or infrastructure.

Severe adverse consequences are associated with an overloaded heavy vehicle because overloading impacts on braking efficiency, truck stability, manoeuvrability and compromise to tyres induced by overheating and excessive tyre fatigue.

An overloaded heavy vehicle can be less stable as its centre of gravity is higher. This increases the likelihood of rolling over. Braking systems are designed to meet the maximum allowable mass for the design specifications of the truck. Overloaded heavy vehicles exceed the capacity of the braking

system to operate effectively, compromising safety. When driven on poorly maintained roads affected by rutting and potholes, the truck's suspension becomes compromised and the braking system no longer operates as efficiently as designed.

Overloading impacts on the vehicle's torque, compromising its capacity to maintain speeds up hills. Compromised braking systems are also less effective in slowing a vehicle travelling downhill. Secretary Mumu has expressed his sadness at a recent tragic fatality in which a truck, possibly overloaded but certainly with a failing braking system, lost control descending a steep downhill road.[13]

In summary the vehicle's braking can be compromised, which endangers the driver and others sharing the road. Pedestrians who frequently walk on the road or just to the side are placed at greater risk of injury and death when the braking function of the vehicle is compromised due to overloading.

Figure 6: Highlands Highway, Papua New Guinea, August 2016
Source: Peter Frauenfelder, VicRoads

In Figure 6, the truck on the right in the distance is avoiding potholes by driving on the wrong side of the road, compromising safety for all road users. Dust created by vehicles travelling on the shoulders of the road to avoid potholes reduces road visibility and impacts amenity in nearby residential areas. In this case, in an attempt to reduce dust, the local community places logs on the side of the road (just to the right of the distant truck) to discourage trucks from using the unsealed edges.

Pedestrians use the roads and road shoulders as there are no designated footpaths. Such persons are at a greater safety risk because trucks encroach on their walking area. There is no margin for error and pedestrians must be vigilant when sharing the road space with trucks.

The practice of travelling in the back of a utility vehicle or tray truck, as depicted in Figure 6, is not encouraged at any time. However, this practice is made all the more dangerous when the vehicle swerves suddenly or jolts severely through potholes, catapulting unrestrained passengers on to the

[13] Personal correspondence from Secretary Roy Mumu, OBE, to Peter Frauenfelder, January 2017.

ground at speeds sufficient to cause significant injury.

Overloaded trucks and associated impacts on the economy–the transport operator

In figure 7, the stability of the flammable fuel carrying vehicle is compromised by deep potholes. Safety is compromised. Reliability and efficiency of the road is severely reduced, and with increased travel times business efficiency is weakened resulting in poorer economic outcomes.

Repeated overloading of trucks increases wear and tear of the vehicle components such as brakes and tyres. The mechanical integrity of the vehicle is severely compromised. This results in above average time-off-duty for the vehicle (and possibly the driver) impacting on the transport operator's capital expenditure to sales ratio. However, this additional vehicle maintenance cost may prove too difficult for transport operators to meet. Most likely operators will not spend the required amount to keep the vehicle in good working order, putting sub-standard vehicles on the road. This in turn escalates crash risk and puts at risk both the driver and other road users.

Figure 7: Highlands Highway, Papua New Guinea, August 2016
Source: Peter Frauenfelder, VicRoads

Unscrupulous transport operators may also be willing to overload vehicles for competitive advantage resulting in unfair competition between transport operators and increasing the likelihood of widespread non-compliance. Transport operators could argue that to remain economically viable and competitive they have no choice but to overload their vehicles. From a regulatory perspective the situation can be exacerbated by poor enforcement.

Figure 8: Port Moresby, April 2016
Source: Peter Frauenfelder, VicRoads

Transport operators should be advised of the benefits derived from maintaining a high quality maintenance regime for their vehicles. It is also imperative that everyone in the logistics chain understands the consequences of poorly maintained trucks.

Accredited operators in Australia's Mass Management Scheme are required to keep maintenance records and make them available to regulatory authorities.[14] In some Australian states regular compulsory roadworthiness checks are also required. Other states have a less stringent policy in place.

Recommendation 2: Review existing regulations on maintenance requirements and roadworthiness (for all vehicles) to determine their adequacy in light of accelerated damage to vehicles and roads. Determine options to require transport operators to make their records available to appropriate road authorities. Develop training modules for enforcement staff, on-road inspectors and policy officers involved in regulatory and policy development on the impact of vehicle damage and its association to road damage and the logistics chain.

Overloaded trucks and associated impacts on the economy–logistics chain (the consignor and consignee)

Consignors, consignees and freight forwarders are not immune from the costs associated with overloaded heavy vehicles. The higher costs to maintain a vehicle damaged by poor road conditions and replacement time for vehicles taken out of service for repairs can be partially funded by other components of the logistics chain. In turn increases in the costs of goods are relayed back to the general community and seen in higher prices for goods and services.

A commonly used freight performance indicator to measure optimum service is road reliability. Road reliability values, usually applied to urban congestion, could be adapted to measure the movement of goods in Papua New Guinea and other APEC economies if applicable. The value would be the ratio of travel time on the worst day of the month compared to the time required to make the same trip

[14] Refer to http://www.massmanagement.com.au/.

along the road in good condition.

A report by the United States Federal Highway Administration has found that, “reliability decreases, businesses need to adjust average inventory levels to compensate for delays in receipt and shipment of goods. This situation leads to higher overall operating costs, which imposes an economic drain on the business and a rise in producer and consumer prices”.[15] Obtaining data can inform policy decisions to “improve the contribution of the transportation system to the nation’s productivity and economic growth by supporting strategic investment decisions and policies that reduce costs, increase reliability and competition and satisfy consumer preferences more efficiently...”[16]

By way of example, the trip to the Kassam Pass is a journey of 185 kilometres from Lae, which is expected to take 2 hours and 37 minutes, an average speed of 70 kilometres per hour.[17] Although this is an optimistic travel time, the bigger problem is that a deteriorating road makes time travel unreliable causing difficulty for consignors and consignees to meet delivery times. In turn this places pressure on the operator to deliver the goods in a timely manner. The recipient of this pressure is likely to be the truck driver, who may speed or take unnecessary risks, increasing the safety risk for all.

Recommendation 3: Undertake a study to provide baseline data on road performance with a focus on establishing road reliability values. This data would assist policy makers and the logistics industry to determine the cost of transport as a component of the economy as a whole, which help to identify future policy directions to improve economic performance.

In this section the focus has been on each individual link in the logistics chain, including the road and port authorities, transport operators, consignors, consignees and freight forwarders. The co-dependency of each link in the chain extends to improving the situation to benefit all. Thus all players should be striving to work with each other. Economic growth and improved road safety outcomes will benefit in the process. The acts or omissions of each player impact on the other elements of the transport chain. A multi-faceted approach is required to address the impact of overloaded heavy vehicles.

[15] United States Federal Highway Administration, *2015 Status of the Nation's Highways, Bridges, and Transit: Conditions & Performance* (Federal Highway Administration, 2015) 11. https://www.fhwa.dot.gov/policy/2015cpr/pdfs/littlebook.pdf

[16] Ibid.

[17] Refer to Google Maps route plan, https://www.google.com.au/maps/dir/Yonki+Dam,+Highlands+Hwy,+Papua+New+Guinea/Lae,+Papua+New+Guinea/@-6.4193975,146.2100074,163885m/data=!3m2!1e3!4b1!4m14!4m13!1m5!1m1!1s0x68f790d5810909e7:0x2c121879a30d1139!2m2!1d145.9806612!2d-6.2505156!1m5!1m1!1s0x68fa1c8a84f38d5d:0x4ab7fc6fc9ae509!2m2!1d146.999905!2d-6.7155252!3e0

Figure 9: Google Maps image of road trip from the Yonki Dam in the Kassam Pass via the Highland Highway to Lae, Papua New Guinea
Source: Refer to n17

The damaging effect of overloaded heavy vehicles

A good road system in good condition is critical in developing a healthy economy. The condition of the road directly affects the reliability of the transport of goods, which ultimately determines the cost of transportation.

Road authorities have a social responsibility to their communities to ensure roads can function as well as possible. The economy depends on it and road safety in the community is directly related to it. Building and maintaining roads is hugely expensive. Therefore road authorities have a very strong incentive to protect and maintain pavements and infrastructure.

Although affected by environmental factors and age, trucks–and more particularly overloaded trucks–are the single most significant influence on the condition of the roads.

As a wheel passes over the pavement, the pavement bends. With bending, moisture seeps through to the pavement base and subgrade, which causes cracking and deterioration. This in turn results in further bending, greater cracking and finally pavement fatigue or failure in the form of rutting, cracked surfaces and potholes.

Pavement fatigue is measured by the number and mass of axle loads that lead to unstable pavements. With increasing axle loads or overloading, the pavement requires fewer passes before it fails. A decrease in axle loads will lengthen the life of the pavement as there is less bending action of the pavement.

A key understanding associated with overloaded heavy vehicles is that the damaging effect on the road is not a linear progression. An overloaded heavy vehicle causes an exponential rate of damage as axle weights and gross mass increase. A gross mass overload impacts on structures. Excessive axle loads damage pavements.

How is damage calculated?

Road pavements are designed to carry a range of 'standard' (8.2 tonne) axles over a period of time. The number of 'Equivalent Standard Axles' (ESA) is determined with respect to the type of traffic expected to use the road over its design life.

In 1961, the American Association of State Highway and Transportation Officials (AASHTO) reported that it had developed a formula to determine the relationship between axle loads and pavement wear.[18] The test resulted in the well-known formula–the 'Fourth Power Law'–which defines an exponential relationship between axle loads and damaging power resulting in pavement damage.

Recent research has led to a number of modifications and additions to the equivalence factors from the AASHTO road test. In addition to axle load, the damaging effect from traffic has been found, amongst others, to depend on the following factors:

- axle type and spacing (single, tandem and tri-axle configurations);
- uneven load distribution on dual tyres;
- wheel type (dual, wide-base or single); and
- tyre pressure.

[18] American Association of State Highway and Transportation Officials (AASHTO), *Standard Specifications for Highway Bridges* (AASHTO, 1961). https://bookstore.transportation.org/Item_details.aspx?id=1329

Discussion on pavement damage

Overloaded trucks increase pavement wear and thus contribute to premature pavement failure. It is important to understand that the rate at which a road deteriorates is proportional not to the vehicle's mass but to the 'fourth power' of its mass. This is shown in Table 1.

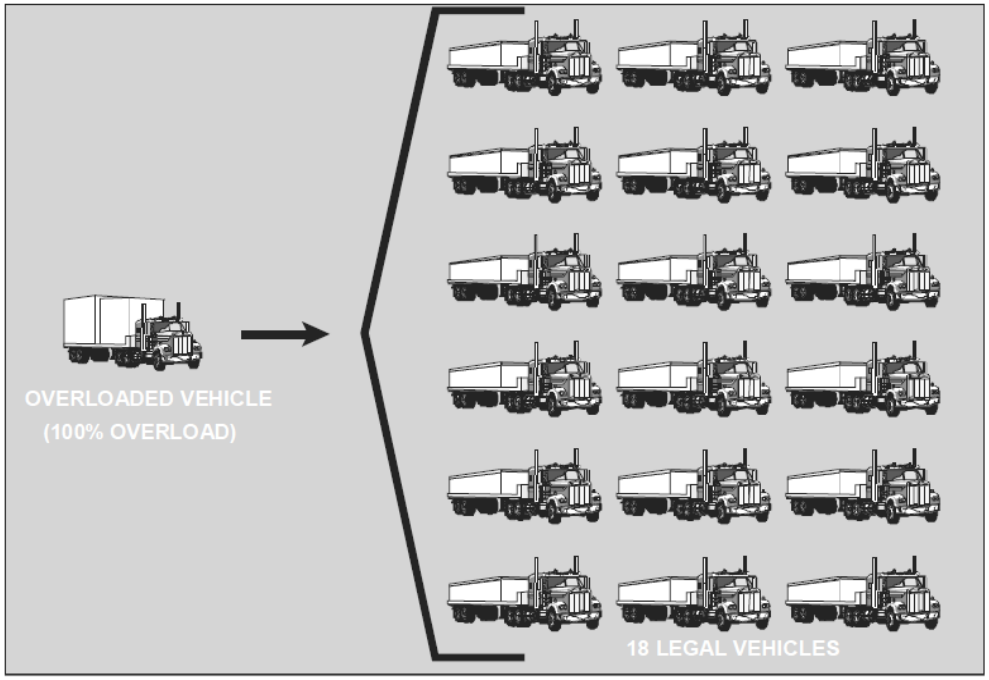
Table 1: The effect of axle load on pavement life[19]

Design axle load	*Carried axle load*	*Equivalence factor*			*Pavement life in years for varying power exponents*		
Tons	Tons	n = 4.0	n = 4.5	n = 5.0	n = 4.0	n = 4.5	n = 5.0
10.0	10.0	1.0	1.0	1.0	20.0	20.0	20.0
10.0	11.0	1.5	1.5	1.6	13.7	12.9	12.4
10.0	12.0	2.1	2.3	2.5	9.7	8.8	8.0
10.0	13.0	2.9	3.3	3.7	7.0	6.1	5.4
10.0	15.0	5.1	6.2	7.6	3.9	3.2	2.6

In figure 10, the diagram on the left depicts a vehicle overloaded by a factor of 100 percent, which has the damaging effect of 18 heavy vehicles of the same type loaded to the design standard. On the right, the image depicts, as an example, the experience in South Africa. It shows the number of vehicles loaded to the design limit (80 to 85 percent of all heavy vehicles) and the disproportionate damage caused by a smaller percentage of trucks that are loaded 15 to 20 percent above design limits. Although they represent a smaller number of vehicles in the heavy vehicle fleet, they are more significant contributors to pavement wear. Abnormal axle load not only stresses the pavement itself, but also the infrastructures of bridges and road structures. Short, medium and long span structures have varying stress levels resulting in different costs.

In relation to overloaded heavy vehicles it is critical that everyone in the logistics chain and the various road authorities understand that pavement and structural damage increases exponentially where mass exceeds design limits. This is most easily understood when considering the damage to pavement wear expressed as a dollar value.

[19] Above n8



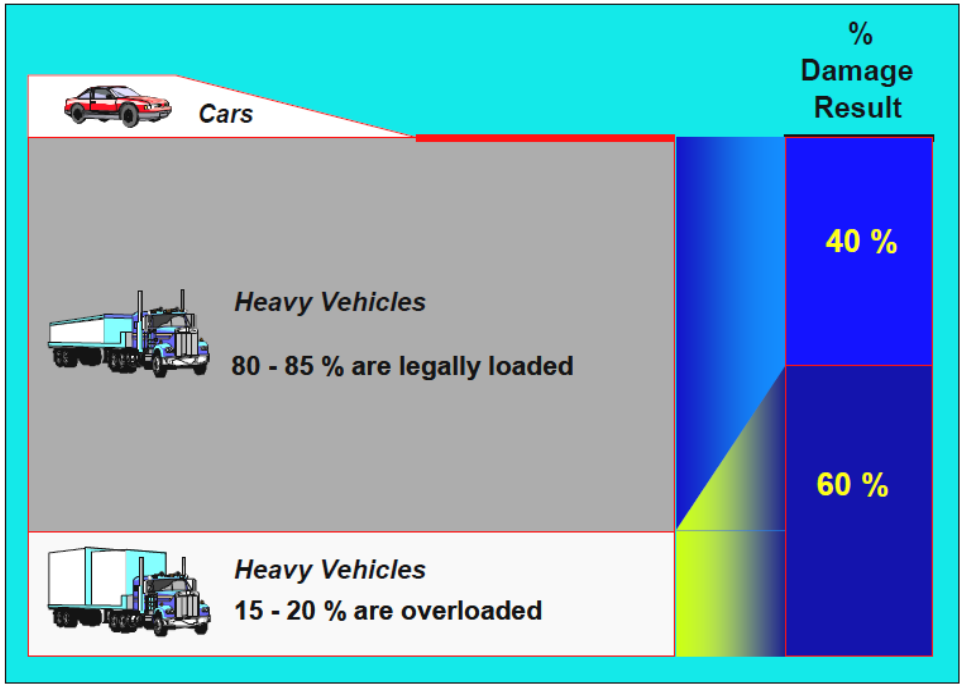


Figure 10: Overloaded heavy vehicle compared to legal loads
Source: Refer to n8

A study conducted in South Carolina in 2014 examining the fee structure applied to transport operators is valuable as it demonstrates, when converted to a dollar value, that costs associated with overloaded heavy vehicles are relative to the vehicle's mass (or 'weight', which is the term used in the United States).[20] The study exposes the problem of applying a flat fee to all vehicles. Some operators are overcharged and others do not pay according to the damage they inflict.

In South Carolina a permit and cost recovery fee is required for vehicles in excess of 36 US tons (32.66 tonnes). Table 2, column B, shows the set figure paid by operators regardless on a mass above 36 tons. Column C is a calculation of the damage caused converted to a dollar value. Column D shows the under or over-charge for the vehicle's mass as a percentage of the flat fee. (Note: the fees presented do not include other costs such as permit, access and administrative costs.)

Table 2: Comparing actual cost of damage to a flat fee for access above legal mass limits[21]

	A	B	C	D
		flat fee $	axle based damage cost recovery fee $	difference between flat fee and axle based cost recovery fee (%)
6 axle	36-40t	55	29	90
	40-45t	55	68	-19
	45-50t	55	121	-55

Therefore before introducing a fee mechanism it is important to undertake preliminary work to determine the appropriate fee according to the vehicle type. This matter will be addressed further in Part Two.

Discussion on infrastructure damage

Structural (bridge) engineers are most interested in axle weights, mass and axle spacings (the distance between each axle) as well as the overall dimension of the vehicle. Such information, coupled with data on loading capacity, trip numbers and design drawings for bridges, can enable engineers to estimate the capacity of a bridge. Whilst this information cannot replace bridge assessments conducted on the bridge structure and sub-structure, it can provide for a desktop analysis of bridges along a route.

It is incumbent on road authorities to establish reliable and repeatable methodologies to process, collect and analyse data for budget-planning and forecasting purposes in relation to the cost implications of damage to bridges and pavements. The data will assist policy makers to establish mechanisms to fund rehabilitation and maintenance works.

Recommendation 4: Prior to establishing a fee to recoup damage to roads, a full economic analysis should be undertaken to determine the actual cost of damage.

Recommendation 5: Undertake a comprehensive (empirical, not desktop) analysis of the condition of pavements and bridges in conjunction with other assessments such as iRAP.

[20] *Kakan C Dey, et al, Estimation of Pavement and Bridge Damage Costs caused by Overweight Trucks, Transportation Research Board,: Journal of the Transportation Research Board, No. 2411, Transportation Research Board of the National Academies, Washington DC, 2014, pp 62-71.*
[21] *ibid, p68 (extract of table)*

PART TWO

Vision framework

The social and economic cost of road vehicle overloading is significant. Rather than working independently of each other, stakeholders in the logistics chain are encouraged to have a shared vision for their future and the wider economy. In accepting responsibility and accountability, road and port authorities, enforcement services and transport stakeholders including transport operators, freight forwarders, consignors, and consignees need to work together to benefit the whole economy. This will in turn have reciprocal benefits for those stakeholders.

A multi-dimensional approach will require institutional leadership, supportive legislation, enforcement operations, infrastructure and technology, well trained and capable personnel and political will, alongside industry and community support. Sustainable social and economic growth is a goal that all should share and actively work towards achieving.

Traditional approaches to controlling overloaded heavy vehicles have had limited success in developing economies and are unlikely to bring about the desired change and compliance. Reliance on prescriptive legal load limits and their enforcement has not–and will not–ensure effective control. Working towards greater effectiveness and sustainability will require new approaches in the management of political, social, institutional, technical, economic, financial and environmental structures. This will require cooperation between road authorities, the transport industry and the private sector to meet the shared needs of the economy.

To achieve the objectives outlined in the beginning of this section–building a cooperative work environment between government (represented by road authorities) and private industry–it is clear that a guiding framework is required. By way of example the Papua New Guinea Department of Transport has in recent years re-organised its governance structure to support a more transparent and functional organisation.

In 2013, Papua New Guinea published its *National Transport Strategy* with the accompanying *Medium Term Transport Plan 2014-2018*.[22] As further evidence of its commitment to reshape the business of delivering services to the transport sector, in 2016 the Department of Transport published its *"Line of Sight" Corporate Plan 2016-2020*.[23]

Part Two of this paper considers how data, regulatory and technological actions, transport management schemes, workplace capability and education and training underpin the management of overloaded heavy vehicles. These are characterised by the need to develop greater awareness about the issues relating to overloaded heavy vehicles. Critical to the success of overloaded heavy vehicles control is industry and community-wide support. This can be achieved through the development of communication tools

The importance of data

Reliable data is critical to the establishment of an understanding of the extent of the problem, and then to measure the success of the changes introduced. Reliable data will inform maintenance priority work according to need. It is also the basis for business cases to seek and acquire funding from sources such as the World Bank or Asia Bank in an environment where funding is scarce. Reliable data provides confidence to private sector stakeholders and investors, particularly when road authorities seek private sector funding for contributions to capital and maintenance expenditure. Data shared with or paid for by industry can assist decision makers in the logistics chain to make informed

[22] Papua New Guinea Department of Transport, *National Transport Strategy: Volume 2 Medium Term Transport Plan 2014-2018* (Department of Transport, 2013). http://www.transport.gov.pg/images/pdf/NTSVol2MTTP.pdf
[23] Papua New Guinea Department of Transport, *"Line of Sight" Corporate Plan 2016-2020* (Department of Transport, 2016). http://www.transport.gov.pg/images/pdf/DoTCorporatePlan2016-2020.compressed.pdf

decisions. Analysis of data is the verification process necessary to ensure policy directions are viable, relevant and transparent.

Recognising that initiatives to implement and analyse data will take some time, it is critical that data collection and analysis is ongoing and sustained so that key findings can be communicated to the community, the logistics chain and investors.

There are substantial benefits to be derived from controlling vehicle access on the road network. Yet two distinct and potentially conflicting policy outcomes need to be balanced when considering the mass of heavy vehicles. These are as follows:

1. Lower mass and axle weights reduce the cost of maintenance for the road authority.
2. However, higher mass and axle weights can reduce transport costs.

The balance needed is to find the optimal mass and axle weights according to the vehicle type for the freight task, thereby not increasing the burden of maintenance due to the depleted service life of the road pavement and infrastructure.

In order to determine the optimal mass of vehicles to perform the freight task a study must be undertaken of daily traffic volumes per vehicle by heavy vehicle type. The data will categorise vehicle types and vehicle classifications, identifying those that produce the greatest damage through to those that produce the least damage.

Case study–Malaysia[24]

In 2013, civil engineering researcher Professor Mohamed Rehan Karim and his team published a paper entitled, “Degree of Vehicle Overloading and its Implication on Road Safety in Developing Countries.” The study examined data obtained in Malaysia from a weigh-in-motion system of 100,000 commercial vehicles between October 2009 and January 2010. One of the purposes of the study was to determine the incidence of overloaded heavy vehicles. On the whole, the rate of Gross Vehicle Weight (GVW) violations was found to range between 24 percent and 29 percent of the total commercial vehicles for each month.

In the Malaysian study the 3-axle truck represented about 20 percent of the total truck volume, yet accounted for almost half (45 percent) of overloaded heavy vehicles. The first point to note is that a 3-axle truck is about 22 tonnes in mass. It is by no means the largest truck in the fleet; a little over half the mass of a 6-axle semi-trailer. But it should be noted that a smaller vehicle does not necessarily correlate to less pavement or infrastructure damage.

A question to be considered by policy makers is: Could another vehicle conduct the same freight task with no additional transport costs and stay within legal limits? Such a vehicle would achieve the policy principles described above. In addition, identifying the overloaded heavy vehicles by type can trigger targeted enforcement operations on that truck category.

Data collection and analysis will enable a road authority to:

- develop a scale of penalties relevant to the damage per vehicle type and classification;
- apply targeted enforcement against known over-represented overloaded heavy vehicle types and classifications; and

[24] Mohamed Rehan Karim, Ahmad Saifizul Abdullah, Hideo Yamanaka, Airul Sharizli Abdullah and Rahizar Ramli, “Degree of Vehicle Overloading and its Implication on Road Safety in Developing Countries” *Civil and Environmental Research* 3(12) 2013 http://iiste.org/Journals/index.php/CER/article/download/8636/8832

- develop a program to remove over time the vehicle categories that do not achieve the optimal balance between permitted payload and maintenance costs.

The last objective could be achieved through legislation to:

- deregister vehicles over a certain age;
- restrict the import of poorly performing vehicles; and/or
- impose a scalable penalty based on the:
    - level of risk of damage to pavements and infrastructure;
    - the increase in road safety risk due to the compromised integrity of the vehicle; and/or
    - the level of environmental damage caused by exceeding prescribed particulate emission levels.

Working closely with the transport industry and logistics sector is critical in obtaining supportive data such as industry expectation of payload requirements, shipping logistics trends (such as the use of 40-foot shipping containers in preference to 20-foot containers) and preference for vehicle type to undertake the freight task.

Traffic volume and mass counts per vehicle and per type of vehicle can be conducted by utilising temporary devices such as slow speed portable weighing devices. This kind of operation is slow, labour intensive and requires constant surveillance. Therefore, only a small number of vehicles can be checked. It is less than ideal. Another option is to deploy a weigh-in-motion (WIM) system, which is discussed in a later section.

To ensure trends are established and a knowledge library of data can be analysed and compared over time, the collection process needs to be regular and should take into account seasonal variations (for example, during harvest season).

Recommendation 6: Conduct an analysis – a freight movement study – of commodity movements to determine the optimal mass of vehicles and axles to perform the freight task. The study would collect and analyse traffic volume counts and mass data for every vehicle, classified by type. This would identify vehicle types that produce the greatest damage through to those producing the least damage. In conjunction with the transport sector, identify the preferred vehicles for a freight task, clearly identifying preferences and assessing these views to determine their legitimacy. Publish the findings of analysed data annually against key performance indicators in an economy's transport plan. Publish the findings in the media to generate awareness about overloaded heavy vehicles in the freight industry and broader community.

Figure 11: Weigh station under construction 14 kilometres from the city of Lae, Papua New Guinea, August 2016
Source: Peter Frauenfelder, VicRoads

Technological solutions: weigh bridges and weigh stations

A weigh bridge is a measuring instrument that has one or more platforms capable of determining the mass of a vehicle. Some weigh stations have weigh bridges that can also measure the individual mass of each axle, which is the preferred situation when addressing overloaded heavy vehicles. Weigh bridges are a critical tool in determining the mass compliance of heavy vehicles in accordance with an evidentiary standard. When used for mass enforcement, drivers of trucks are directed onto the weigh bridge to confirm gross mass (and axle mass, if available).

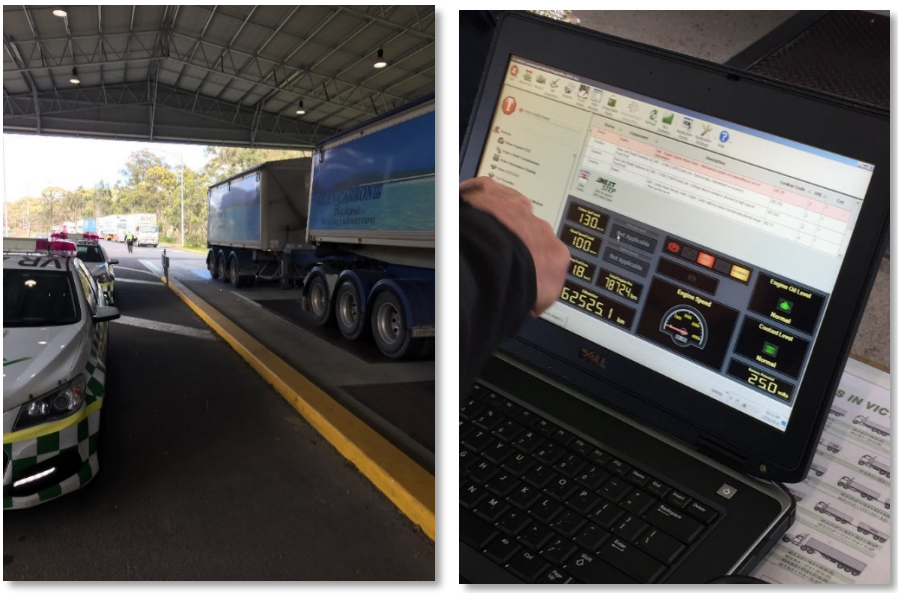


Figure 12: Broadford Weigh station with all-weather undercover facilities to hold and weigh vehicles for mass compliance, Victoria, Australia, December 2016
Source: Peter Frauenfelder, VicRoads

Figure 12 illustrates new technology being trialled at Broadford Weigh station in Victoria, Australia. The engine reader downloads data that was previously unavailable to ordinary inspection procedures. Within minutes the vehicle can be checked for registration compliance, mass management and maintenance scheduling compliance, speed management and compliance to fatigue and rest break obligations. The system can also advise the driver on the condition of the engine.

Weigh station personnel and operations

A weigh station can be a key centre of activity to change and address the problem associated with overloading and poor load restraint. A weigh station is prominent and therefore its performance is critical to the effective conduct of an enforcement strategy. A weigh station is an outdoor practical classroom and foundation stone to develop an enforcement program to address overloading and poor load restraint. Literally, a weigh station becomes a centre of excellence and place of pride.

The correct and legal operation of the weigh station requires personnel who are well trained and capable of implementing the law accurately, consistently and fairly. It is a question for the responsible road agency to ensure personnel are trained ready to commence their functions. Ideally weigh station personnel would be trained and accredited trusted nationals. It may be appropriate to provide support to the weigh station personnel from third parties who can provide expert assistance or, if deemed necessary for a third party to provide a service for a fixed time period whilst training local staff in the operations of the weigh station.

Automation can remove the human element from enforcement which can alleviate problems associated with lack of capability and untrained personnel, mistakes and other human shortcomings, including corrupt behaviours.

Automated Number Plate Recognition (ANPR) camera technology can identify a vehicle and, with associated data, capture techniques that can be analysed to detect recalcitrant behaviour. When enforcement procedures are being implemented, electronic recording, cameras and computer data capture can reduce the influence of human intervention. Portable heavy vehicle weighing scales can support weigh station operations and provide opportunity to train enforcement personnel on enforcement procedures.

A combination of technologies including ANPR, weigh bridge data, vehicle on-board scales, can collectively record a history of behaviour. Data recording of aberrant behaviour builds a history of the operator and driver which over time establishes trends to assist enforcement officers to target the least compliant operators and drivers.

Weigh stations – a microcosm of compliance and enforcement policy in action

It is here, at the weigh station, that the communication packages that convey the key messages can be seen in action and much of industry stakeholder engagement is made public.

It is here that the leadership capability development and training of enforcement officers and policy personnel and others requiring a practical understanding of the process and procedures can be actioned.

It is here that data is collected for the purposes of analysis to assist ongoing reporting on the success of an enforcement strategy and as evidence for future policy work.

It is here that accountability for strategic direction and policy development as provided by the leaders of the respective road agencies is revealed.

It is here that the processes that lead to legislative review and reform are actioned.

Recommendation 7:
Develop a checklist of actions to ensure the correct operation of a weigh station, whether opening a new weigh station or if reviewing the operations of an existing weigh station including an audit of its safe operation and a review of roles, responsibilities and accountabilities of operation.

Technological solutions: weigh-in-motion (WIM) systems and enforcement

Several types of WIM systems are available for use in the enforcement, monitoring and analysis of vehicles on the road. Figure 14 depicts a common application of a WIM system with detector plates fixed into the ground. As a truck passes the WIM system its axle mass and gross mass are recorded. A WIM installation consists of a sensor built into the road surface that allows estimation of vehicle axle mass while passing. The sensor is connected to an evaluation unit that adds the axle mass readings to give the full mass of the passing vehicle.

WIM is generally not used to provide data of an evidentiary standard data for enforcement purposes. However, in some economies, such as Chinese Taipei, it is used for enforcement with data accuracy tolerances of up to 30 percent.

Figure 13: Typical WIM set using in ground bending plates to record mass
SOURCE: http://www.irdinc.com/pages/its-solutions.html

WIM systems fall into two broad categories:

- Low-speed WIM (LS-WIM) systems with an operating speed generally in the range of 5 to 15 km/h. The accuracy of LS-WIM systems can be 3 to 5 percent for approximately 95 percent of the gross mass.

- High-speed WIM (HS-WIM) systems with an operating speed generally more than 15 km/h. The accuracy of HS-WIM systems varies from 10 to 25 percent for approximately 95 percent of the gross mass.

WIM scales can make weigh station operation more efficient by identifying potential violators for static weighing and inspection, while permitting vehicles of legal mass to continue without interruption. Known as pre-selection, when the WIM system detects an overloaded vehicle an image of the vehicle is taken and the target vehicle is guided to the 'dedicated weighing area' in a side lane or parking lot. At the 'dedicated weighing area' the selected trucks are weighed by a weighing instrument that is legally accepted for enforcement. This system provides for a very high accuracy of detection of overloaded vehicles. A penalty for overloading can be issued on the spot. Drivers for transport operators complying with mass limits can continue their trip unimpeded.

However, there are some installation challenges to be addressed should a permanent WIM system be preferred. An approach section, preferably paved with concrete for several hundred metres, needs to be flat to ensure that trucks do not bump up and down and speeds are constant.

WIM systems also require regular calibration and attention. Unless dedicated staff are responsible for their upkeep the WIM system can quickly fall into disrepair and become ineffective. This prevents this form of pre-selection and subsequent enforcement. Maintaining a WIM system can be very challenging and depends heavily on the professionalism and vigilance of the maintenance team.

Rather than using government employees to control the process a tender can be issued for a contractor to be responsible for the security and safe operation of the WIM site. The contractor will work in accordance with clearly defined performance requirements and will be required to provide data to enforcement officers. Enforcement officers employed by the regulator will be responsible for issuing infringement notices. Data provided by the contractor needs to be actioned and enforcement officers need to be held accountable. They must give reasons for any non-issue of infringement notices. Actions should be reported on a regular basis to management, who are responsible for operations and enforcement procedures.

WIM systems provide data that may identify trends in risky behaviour by non-compliant companies. Based on this information, transport companies are selected that qualify for further action by the enforcement agency. This action may take the form of the sending of a warning letter, a visit by enforcement officers to the premises of the company for an inspection, or further enforcement action for more serious non-compliance. However, it might be advantageous to consider this an opportunity to provide education rather than enforcement.

One of the aims of this paper is to provide opportunity to discuss measures that regulators can use to increase awareness of the impact of overloaded heavy vehicles. An option is to conduct compulsory toolbox meetings at the depot or to put a company 'on notice' and any ongoing non-conformance would escalate to non-compliance attracting legal action. These actions would be monitored and reported to determine their effectiveness.

WIM data also provides regulators with a rich source of statistical data to support policy development, report on road conditions and inform maintenance plans. It also supports an evaluation of the effectiveness of overloading controls and any downward trend in the incidence of overloaded heavy vehicles.

Figure 14: Heidelberg Traffic Management Centre in South Africa
Source: Refer to n8

Using a WIM system at an existing weigh station

WIM pre-selection systems can be an effective adjunct to the operation of a weigh station. A pre-selection WIM system with number plate recognition cameras would transmit the vehicle identification and mass of the vehicle to the control centre. The driver of the truck alleged to be exceeding mass limits would be advised by a message board placed on an overhead gantry to drive to the weigh station for checking. Any overspill of trucks required to pull in could be checked manually by portable weigh scales in another safe section of the weigh station. As described earlier, a contractor may be responsible for confirming the mass of the truck and recording and storing all of the relevant details. An enforcement officer would be informed electronically of the non-complaint vehicle and would issue an infringement notice accordingly. All of these actions would be recorded for audit purposes.

Overloaded vehicles would be issued with an infringement notice and would be required to offload excessive mass onto another vehicle provided by the transport company. It would not be permitted to offload onto the ground. Nor would the vehicle be permitted to continue the trip. A considerable amount of additional land around the weigh station would be required to accommodate a pull-in area, off-load area, vehicle inspection zone and control centre with staff facilities. The complete facility may look similar to the Heidelberg Traffic Management Centre in South Africa at Figure 14.

To calibrate the WIM system, complying vehicles would occasionally be required to enter the weigh station for weighing on the weigh bridge. Data would be compared to ensure the WIM system is weighing within prescribed tolerance. In addition, camera detection devices could be used to require vehicles that appear to be unroadworthy or in need of inspection for other reasons to enter the weigh station for inspection.

Information about complying vehicles according to WIM data could be electronically transmitted to the port, the most likely destination of the vehicle. This would permit complying vehicles access to the port without inspection. Any vehicle attempting to enter the port area without approved data issued by the weigh station would be checked for overloading. This process would reduce the number of overloaded heavy vehicles entering the busy urban areas where ports are typically located. It would also accelerate loading procedures at the port as vehicle mass has already been assessed. This enforcement activity should result in considerably fewer overloaded heavy vehicles on roads leading into the port area.

Once embedded and operating successfully, this type of operation can be repeated on other roads

leading into or away from the port.

Recommendation 8: Investigate the feasibility of establishing a weighstation and pre-selection WIM system.

Recommendation 9: Undertake a complete review of legislative requirements to implement enforcement procedures and data control. Consideration of the appropriateness and adequacy of Section 53 *Road Traffic Act 2014* Powers of Entry and Investigation and Section 56 Power of Minister to make Ordinary Rules are examples of the analysis to be undertaken.

Recommendation 10: Undertake a complete analysis of legislative requirements to implement an enforcement strategy as proposed.

In-vehicle mass detection devices (on-board scales)

In-vehicle mass detection devices (also known as 'on-board scales' or 'on-board mass' systems) are another form of pre-selection that could be implemented to support the operation of the weigh station. This pre-selection device would permit transport owners to bypass the weigh station and to continue through to the port without being delayed for weighing.

As recently as April 2013, the European Commission published a proposal for an amendment to Directive 96/53/EC on weights and dimensions of heavy vehicles.[25] In a study conducted in 2013 on behalf of the European Commission it was reported that on average one in three vehicles checked was overloaded. These excess loads often breach mass limits by 10 percent and sometimes by as much as 20 percent. This causes premature wear and tear of road surfaces and increases the risk of crashes. It can also lead to undue competitive advantages for those transport operators who choose to disobey regulations on mass limits.[26]

The proposed amendment by the European Commission includes better detection of breaches including the use of on-board scales. These systems would ensure that only those vehicles strongly suspected of infringement will be stopped for manual inspection. Member States shall encourage the equipment of vehicles and vehicle combinations with on-board scales (total mass and axle load) to enable the mass data to be communicated at any time from the moving heavy vehicle to a regulatory or roadside inspection authority.

Mandatory on-board weighing for screening in every truck would enable enforcement officers to guide non-compliant vehicles into the weigh station for further inspection and issue infringement notices. Data can be checked at any location using a hand-held device that communicates with the truck via short-range communication.

However, implementing mandatory on-board scales would require:

[25] The European Parliament and the Council of the European Union, *Directive (EU) 2015/719 of the European Parliament and of the Council of 29 April 2015 amending Council Directive 96/53/EC laying down for certain road vehicles circulating within the community the maximum authorised dimensions in national and international traffic and the maximum authorised weights in international traffic* (European Parliament and Council, 2015). http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32015L0719&from=EN

[26] Rapp Trans AG, *Study on heavy vehicle on-board weighing: Final report* (Rapp Trans AG, 2013) 1. https://www.transportenvironment.org/sites/te/files/publications/2014%2001%20RappTrans_Weight%20sensors%20report.pdf

- low cost equipment;
- sufficient accuracy level;
- calibrated and certified equipment; and
- a standardised communication interface

Fully automated mass checking processes would be ideal for achieving efficient controls of high traffic volumes. For legal purposes such as direct enforcement of legal mass limits (by, for example, fining on the spot) the accuracy of weighing solutions needs to be very high. Accuracy to within ±5 percent for 95 percent of vehicles checked would be a requirement.

Whilst cost can be a deterrent for the transport operator to invest in such technology, more efficient and reliable access to ports and the ability to by-pass weigh stations may be incentive enough to purchase the equipment. An added incentive is that transport operators participating in the scheme could have access to roads not available to other road users.

In situations where overloading control management and enforcement is very low, on-board scales have the potential to contribute to improved mass compliance in road transport. Australia is currently expanding the use of vehicle on-board scales. Research and development work in Australia has shown that on-board scales for screening of suspicious vehicles can make the enforcement process much more efficient. Mandatory automated mass checking process through on-board scales could become a viable option for enforcement purposes for all heavy vehicles in the long term.[27]

Recommendation 11: Undertake a feasibility study to determine Papua New Guinea's readiness to introduce on-board scales.

Recommendation 12: Investigate the development of the legislative measures required to introduce on-board scales for pre-screening and enforcement purposes. This would include a review of devices and technical protocols, as well as communication and privacy legislation.

Recommendation 13: Amend legislation to ensure that data from on-board scales meets evidentiary standards for the purposes of a pre-selection device.

Recommendation 14: Develop regulations that establish standards required of on-board scales.

Intelligent Access Program

Australia's Intelligent Access Program (IAP) is an example of another technological tool with compliance applications (rather than simply a mechanism for enforcement and issuing of fines). IAP is a program whereby heavy vehicle operators agree to remote tracking of the movement and location of their vehicles using satellite-based technology. This ensures transport operators are complying with

[27] Ibid, 46.

agreed operating conditions. In return the operator is granted improved or less restricted access to

Accreditation schemes and transport management levers: truck axle combinations and mass allowances

Papua New Guinea currently permits a mass tolerance of 10 percent when weighing vehicles at weigh bridges. However, this is contrary to the understanding that a 10 percent tolerance above mass design levels causes far more than 10 percent additional damage to pavement and infrastructure, in accordance with the 'fourth power law' as described in Part One.

Recommendation 15: Develop legislation to phase out the 10 percent tolerance. This will require education of enforcement officers and communication materials to be distributed to the transport sector and logistics chain explaining this initiative. The latter will explain the exponential road infrastructure damage caused by higher levels of overloading.

Mass management schemes

Currently in Papua New Guinea, General Mass Limits (GML) apply a maximum permissible mass to all axle groups for all heavy vehicles. Typically a Higher Mass Limits (HML) scheme, which is the scheme that operates in Australia, allows participating operators to access additional mass entitlements. These entitlements are available providing:

- operators are accredited under the Mass Management Module[28] with an accreditation label fitted to the hauling unit; and
- vehicles are fitted with certified, road-friendly suspension.[29]

HML provides a significant increase in the productivity of road freight transport vehicles. To be eligible for HML, vehicles must be fitted with certified, road-friendly suspension. Road-friendly suspension systems reduce the impact of laden axles on road pavements and most bridge structures. Road-friendly suspension can permit greater payload that is no more destructive to pavements and bridges than when operating under GML. This is a productivity gain at no extra cost to the maintenance and rehabilitation budget of a road authority.

In the example below the standard axle mass limit increases for vehicles fitted with certified road friendly suspensions.

[28] National Heavy Vehicle Regulator, *Mass Management Accreditation Guide* (NHVR, 2013). https://www.nhvr.gov.au/files/0001-mass_management_accrediation_guide.pdf
[29] National Heavy Vehicle Regulator, "Higher Mass Limits" webpage (NHVR, 2017). https://www.nhvr.gov.au/road-access/mass-dimension-and-loading/higher-mass-limits

Table 3: Maximum mass per axle group
Source: Refer to n32

Type of axle group	Maximum mass (tonnes) permitted under GML	Maximum mass (tonnes) permitted under HML
Tandem axle group	16.5t	17t
Tri-axle group	20t	22.5t
Single drive axles on buses	9t	10t
Six-tyred tandem axle groups	13t	14t

This scheme has proven to be effective in Australia and could be adopted broadly, provided appropriate auditing practices are adopted. It can reduce the incidence of overloaded heavy vehicles by permitting a greater payload with a correlating improvement in productivity. It is an example of finding the balance to achieve optimal mass and axle weights without unduly impacting on the design life of the road pavement and infrastructure.

Recommendation 16: Investigate the feasibility and legislative requirements to support the introduction of a mass management scheme. This would also estimate the likely uptake by transport operators of accreditation to operate at higher mass limits.

Chain of Responsibility

Chain of Responsibility legislation extends the responsibility for compliance with heavy vehicle regulations beyond the truck driver. It ensures that all participants in the logistics chain have duties to ensure regulatory compliance, including the truck owner, the transport operator (including senior executives), the consignor, the freight forwarder and the consignee. The intent of this approach is to ensure that everyone in the logistics chain is legally accountable for safe road transport.

Chain of Responsibility provisions are important because often the conduct of the driver is a symptom–rather than the cause–of non-compliance. Chain of Responsibility legislation has been in operation in Australia for more than a decade but has been progressively improved with transport Ministers agreeing in late 2016 on a further tranche of legislative amendments.

Each party in the Chain of Responsibility has an obligation to avoid or prevent breaches by ensuring that they do not directly or indirectly impose requirements on a driver that will result in the driver overloading the vehicle, committing a dimension breach, contravening work or rest times, or exceeding an applicable speed limit. Every person in the Chain of Responsibility is responsible for ensuring mass, dimension, load restraint, fatigue management and speeding compliance requirements are met. It is not sufficient for a Chain of Responsibility party to say that they were not aware of problems or had no reason to believe that there were problems. To avoid liability all parties in the Chain must put in place reasonable measures to prevent breaches of the legislation.

Chain of Responsibility legislation has the following key features:

- Drivers and operators understand their mass compliance obligations and use the right vehicle for the size and type of load.
- Drivers and operators stay within mass limits on the roads and routes approved for those vehicles and masses, so as to protect the road asset.
- Off-road parties meet their obligation to take all reasonable steps to ensure that the driver does not commit a mass offence.

When discussed at a Transport Forum in Lae in August 2016, there was a healthy level of interest shown by representatives of the transport industry in considering the use of Chain of Responsibility as a measure to assist industry to meet overloading requirements and other obligations.[30]

A hypothetical model of Chain of Responsibility mass compliance

A leading quarrying company has established a comprehensive system for mass management for heavy vehicles carrying with stone, gravel and other extracted materials at its quarry sites. Each truck entering any of the company's sites is weighed empty and provided with a mass certificate. The type and amount of product required is identified and the truck is directed to the appropriate location. The company has identified the likely volume of various products at various masses so that loader drivers are aware, on an indicative basis, of how high to fill the tray. The product required and the mass required are displayed in the cabin of the loader so that the loader driver knows what to load and how much of it to load.

The buckets used on the loaders are fitted with load cells that display to both the loader driver and the truck driver the amount being loaded. When loading is complete, the truck again passes over a weigh bridge and the driver is given a load ticket. If total mass or axle mass limits are breached, the site is configured to permit the driver to return to the loading location to have the load reduced or spread out as needed. The driver then returns to the weigh bridge and the process is repeated until the load complies. Once the load ticket indicates that the load complies with mass requirements, operations staff check with the truck driver to ensure that the product and mass are correct and the truck is permitted to depart. A permanent record is maintained of the total mass and axle masses and of any corrective actions taken in respect of non-compliant loads. This comprehensive system ensures compliance and also has commercial benefits in enabling the company to charge for the correct amount of material supplied to the customer. A company that has implemented such a comprehensive compliance system would satisfy mass limit control and could be permitted to by-pass the weigh station systems described above.

[30] Above n7.

Figure 15: Transport Forum, Lae, Papua New Guinea, August 2016
Source: Peter Frauenfelder, VicRoads

Recommendation 17: Investigate the feasibility and legislative requirements to support the introduction of a Chain of Responsibility approach to transport regulation.

Performance Based Standards

Australia's Performance Based Standards Scheme, known as PBS, offers the heavy vehicle industry the potential to achieve higher productivity and safety through innovative and optimised vehicle design. Performance Based Standards vehicles are designed to perform their tasks as productively, safely and sustainably as possible. The Performance Based Standards Scheme also allows them to operate on roads that are appropriate for their level of performance. The basic principle of Performance Based Standards is matching the right vehicles to the right tasks. Performance Based Standards vehicles are tested against 16 stringent safety standards and four infrastructure standards to ensure they are suitable for the existing road network and are safe. The scheme has been in operation since October 2007. More information on Performance Based Standards is available on the website of Australia's National Heavy Vehicle Regulator.[31]

Recommendation 18: Investigate the feasibility and legislative requirements to support the introduction of a Performance Based Standards scheme. This would also estimate the likely uptake of Performance Based Standards by transport operators.

[31] National Heavy Vehicle Regulator, "About Performance-Based Standards" webpage (NHVR, 2017). www.nhvr.gov.au/road-access/performance-based-standards/about-performance-based-standards

Regulation: registration and other data sources

For any economy, regulations determine the permitted vehicle mass. Regulations are therefore core to developing mechanisms to address overloaded heavy vehicles. It is imperative that all economies have a clear vision for a safe, efficient and reliable transport system and a viable economic system reliant on transport control. As we have seen, the vision could not be achieved if overloading was permitted because this would result in costly damage to infrastructure and pavement.

Vehicle registration data can provide valuable insights into the number of vehicles operating by type. Combined with geographical data it can also provide an indication of the roads used by vehicle type, which is useful for predicting maintenance expenditure. Currently in Papua New Guinea, most vehicle data is captured at the time the vehicle is registered. The form used to capture registration data as required under Papua New Guinea's Motor Traffic Regulation 1967 Schedule 1 is relatively limited.

Useful information not currently captured would include:

- individual axle mass permitted in accordance with manufacturer's instructions;
- the inclusion of road-friendly suspension systems;
- vehicle dimensions and axle spacing;
- safety features;
- compliance with EURO standards for engines; and
- aftermarket modifications.

In addition, information about vehicle mass, axle weights and axle spacing can be examined by bridge engineers to determine the worst performing (most damaging) vehicles types. Collecting and analysing this data can assist in a wide variety of planning and regulatory tasks. These tasks include but are not limited to:

- pavement design;
- pavement maintenance;
- bridge design;
- development of pavement and bridge loading restrictions;
- evaluation of the need for, and success of, mass law enforcement actions;
- evaluation of the need for geometric improvements related to vehicle size, mass and speed;
- determination of the economic value of freight being moved on roadways;
- determination of the need for, and effect of, appropriate safety improvements.

Recommendation 19: Review the registration requirements required in Form 7 of the Motor Traffic Regulation 1967.

Transport operators can provide a valuable source of data to inform policy decisions. Many use GPS tracking services to monitor their drivers. To address concerns about privacy, data can be 'de-identified'. Regulations could be developed to require an operator or the service provider to provide data. The United Kingdom has been successful in encouraging transport operators to provide

data to assist with policy development for better freight movement. In order to implement such a measure in other economies, legislative change may be required to protect privacy.

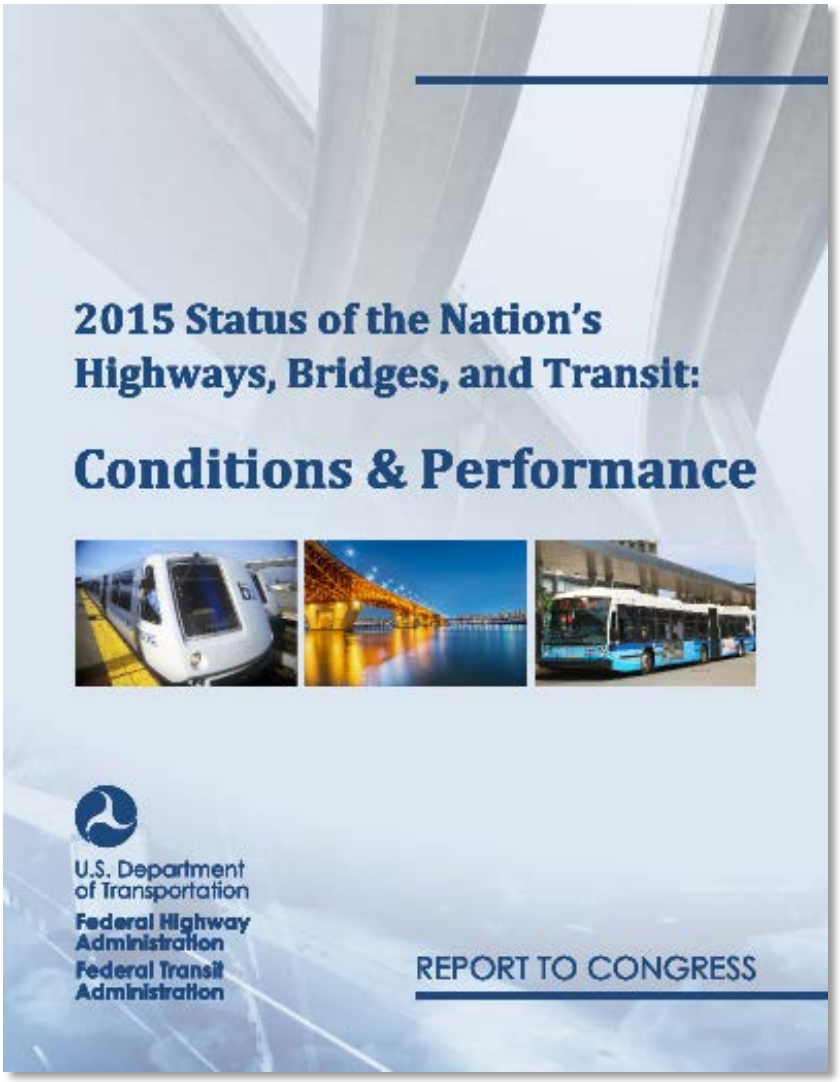


Figure 16: Cover page of the 2015 Status of the Nation's Highways, Bridges, and Transit*, prepared by the United Stated Federal Highway Administration*
Source: Refer to n15

Similarly the United States has for many years collected data on freight movement. The Federal Highway Administration (FHWA) measures freight highway congestion using truck probe data from more than 600,000 trucks equipped with GPS. These trucks provide billions of position signals, which the FHWA analyses to determine truck freight performance. This assists both routine monitoring and deeper analysis to understand truck movements and impacts, such as when an incident compromises highway network reliability. The FHWA estimates that the current number of probes represents approximately 30 percent of the truck population for the highest end of the heavy vehicle spectrum.[32]

Recommendation 20: Develop a policy framework, supported by regulatory changes as required, to collect heavy vehicle data for analysis by policy experts. (This could include examining the applicability of Privacy legislation.)

[32] Nicole Katsikides, "FHWA's Vehicle Probe Data" PowerPoint presentation (online, 2014). http://tnmug.utk.edu/presentations/2014May/FHWAprobeData.pdf

Regulation: application of penalties

The Papua New Guinea Road Traffic (Offences and Penalties) Regulation 2015 prescribes that a person operating a heavy motor vehicle commits an infringement offence if in breach of prescribed maximum gross mass limits for motor vehicles or prescribed maximum mass limits for axles or groups of axles for motor vehicles. Schedule 2 of the same regulation lists the applicable infringement penalty when the mass equals or exceeds the prescribed mass. The schedule prescribes that the maximum permissible mass is 42 tonnes. The penalty for 2.3 tonnes overmass is 200 Kina (approximately US$62 at the January 2017 exchange rate). Should the maximum permissible mass be exceeded by 10.8 tonnes, the associated penalty is 1,000 Kina (or approximately US$315).

Does this penalty structure adequately reflect the damage caused by overloaded vehicles?

As we have discussed, infrastructure and pavement damage results from overloaded heavy vehicles and bears a direct relationship to:

1. total mass or total load limits; and
2. axle load.

The Road Traffic (Offences and Penalties) Regulation 2015, Schedule 2 specifies the infringement penalty applied to the masses listed in the schedule. This penalty schedule uses a linear progression and inadequately represents the exponential cost and reduced life of the infrastructure or pavements caused by overloaded heavy vehicles. The rate of wear is proportional not to the mass of the vehicle but to the 'fourth power' of its mass. In addition, the current formula assigns a penalty for the total gross (overloaded) mass of the vehicle. No consideration is applied in Schedule 2 to the destructive nature of overloaded individual axles.

The Regulations are silent on the penalty for vehicles exceeding the maximum mass. The schedule applies a penalty to the maximum permissible mass of the vehicle plus 10 tonnes. Nor is there clear provision for an increasing scale of penalties for recidivist breaches.

Recommendation 21: Review the Road Traffic (Offences and Penalties) Regulation 2015, Schedule 2, to prescribe penalties relevant to the damage caused by overloaded heavy vehicles and recidivist breaches (supported by the findings of the freight movement study in Recommendation 6).

In addition, the penalties specified in Schedule 2 are fixed. This places an unnecessary burden on legislative processes to ensure penalties and fees are keeping pace with inflation and CPI measures. Rather than replace all penalties for all breaches, a simplified system can provide the same effect. An annual increment in a 'monetary unit' for fees and penalties can be adopted to replace the fees and penalties.

For example: the value of a 'fee unit' in the Australian jurisdiction of Victoria in 2016/17 is A$13.94. In 2010/11 it was A$11.95. The value of a 'penalty unit' in 2016/17 is A$155.46. In 2010/11 it was A$119.45.[33] The penalty or fee is recorded as a fixed multiplier of the monetary unit as determined by the severity if the penalty or extent of the fee as required.

[33] *Monetary Units Act 2004 (Vic).*
http://www.legislation.vic.gov.au/Domino/Web_Notes/LDMS/PubStatbook.nsf/f932b66241ecf1b7ca256e92000e23be/C203E7407189A5B9CA256E91002BBD03/$FILE/04-010adoc.doc

Recommendation 22: Establish a monetary unit that is applicable to all fees and penalties. This will remove the need to amend individual regulations every time there is a requirement to increase fixed amounts for fees and penalties.

Load restraint

Load placement impacts vehicle stability. When a load is not properly secured it poses an increased road safety risk, including an increased risk of rollover and possible injury to other road users as a consequence of a load or part of a load becoming dislodged.

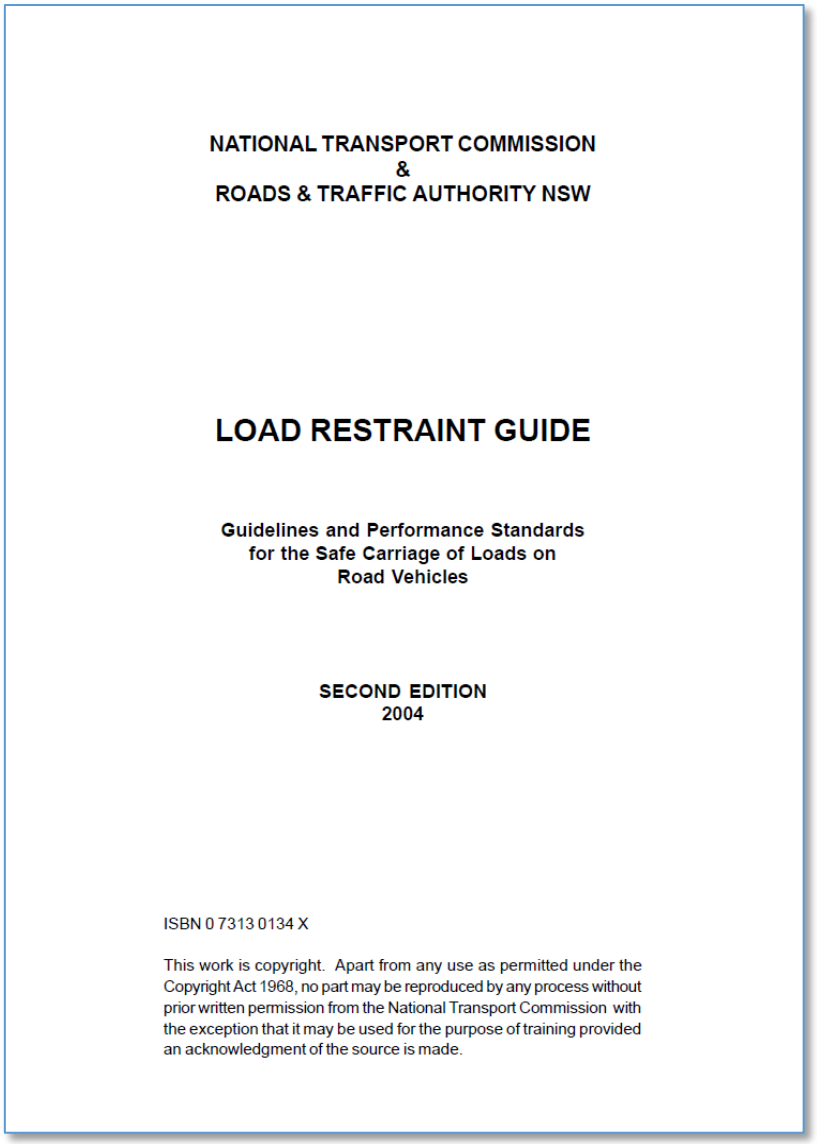
Key features of load restraint compliance obligations are as follows:

- Drivers and operators must understand correct loading procedures and methods.
- Appropriate methods of restraint must be deployed for every trip, every time.
- All participants in the logistics chain must meet their responsibility to take all reasonable steps to ensure that a loading or load restraint offence is not committed.

The enforcement of load restraint and ensuring good loading practices is a constant challenge for all economies. The Papua New Guinea Road Traffic (Offences and Penalties) Regulation 2015, which supports the *Road Traffic Act 2014*, outlines driver and operator obligations for load restraint. Section 10 of the Road Traffic (Offences and Penalties) Regulation 2015 requires a court to consider if operators are aware of codes of practice in relation to insecure load and load restraint procedures. However, it is difficult to clearly identify the codes of practice referred to in the Regulation and where they can be obtained.

Australia's Load Restraint Guide, which is available on the website of Australia's National Transport Commission, provides the necessary information in one publication for the transport sector to meet their regulatory obligations.[34]

[34] National Transport Commission, "Load Restraint Guide" webpage (NTC, 2017). http://www.ntc.gov.au/heavy-vehicles/safety/load-restraint-guide/



NATIONAL TRANSPORT COMMISSION
&
ROADS & TRAFFIC AUTHORITY NSW

LOAD RESTRAINT GUIDE

Guidelines and Performance Standards
for the Safe Carriage of Loads on
Road Vehicles

SECOND EDITION
2004

ISBN 0 7313 0134 X

Figure 17: Cover page of Australia's Load Restraint Guide*, 2004*
Source: Refer to n37

Some examples of poor restraint and loading practices

Figure 18 illustrates some poor loading and load restraint practices. This pallet should have been packed against the vehicle's head board with additional restraining ropes to secure the load. Alternatively it could have been repacked to half its height. The rope was loose and the driver was driving very slowly due to the high centre of gravity. In an emergency braking situation or crash the load was not secured effectively to avoid loss onto the road or intrusion into the driver's cabin, either of which could have caused serious injury or death.

Figure 18: Restraint inadequate to stop load shift and loaded for optimum safety or mass distribution, 2016
Source: John Meagher, VicRoads

At first glance the load in Figure 19 appears to be reasonably well secured. However, if this load was lost the consequence could be catastrophic for nearby road users. The Load Restraint Guide advises that steel on steel should be avoided as there is insufficient friction between load and deck. The load in this example has not been blocked (to avoid movement), nor was there any side-to-side restraint. Most importantly, the chains used to restrain the digger were less than adequate. The load to be restrained weighed 8.32 tonnes. The chains were delivering only 6 tonnes of load restraint.

Figure 19: Restraint inadequate to stop load shift, 2016
Source: John Meagher, VicRoads

Recommendation 23: Papua New Guinea road authorities should review all codes of practice and update or delete codes as necessary. The Australian Load Restraint Guide may be of assistance in developing and updating the Papua New Guinea load restraint code. The resulting code should be readily available and disseminated to industry.

Recommendation 24: A series of training programs to develop awareness about load restraint obligations should be scheduled to coincide with the release of a revised code for load restraint.

Education and training–enhancing capability

The success of controls to address overloaded heavy vehicles and poorly restrained loads is dependent on the quality of training provided to personnel responsible for ensuring that the transport industry complies with regulations. Undertaking a gap analysis of training requirements for staff is a

first step to attaining good overloaded heavy vehicle controls.

Implementation of the recommendations in this discussion paper will require strong leaders who are capable of leading and encouraging their staff to be accountable and take responsibility for their role. To support this, VicRoads, the author of this report, is providing leadership training for some of the key leaders in Papua New Guinea's road authorities. It is expected that the training will permeate and influence practices in road agencies in Papua New Guinea.

Technical training to help staff to deliver on their tasks is available in many forms. In Victoria in recent years, VicRoads has provided a successful program to reduce the incidence of rollovers in the transport sector. Known as the Rollover Prevention Program, it is targeted at transport operators in parts of the industry that have a higher incidence of rollovers than average. These include transport of timber, waste and cement. The affected operators are using tankers and prime mover/trailer combinations. The training sessions are presented by a subject matter specialist. The sessions are engaging and interactive, with strong clear messages and mechanisms for drivers and others in the supply chain to integrate into their daily operations. The sessions are conducted on-site at the driver's depot so as to enhance driver and supply chain interaction and to work through experiences with direct input from participants. A training program on load restraint has also been developed.

Figure 20: Enforcement officers working and training, 2015
Source: Alan Pincott, VicRoads

Recommendation 25: Good leadership ensures appropriate ongoing training. Institute a series of regular training programs to develop awareness about overloaded heavy vehicles and load restraint obligations. Training should be provided to enforcement officers to ensure knowledge is up to date. Policy officers should also be included in the training to allow them to familiarise themselves with compliance and enforcement activities. Staff should be trained in a 'train-the-trainer' environment to also educate the transport sector. Road authorities could also consider outsourcing training to accredited third parties.

Communications

Effective communication between government authorities, the transport industry and the general community can greatly increase the effectiveness of regulatory activities. It is worthwhile for authorities to publish a bulletin to educate members of the community and the logistics chain about the purpose of policies and regulations, including measures to address overloading. This will help explain the damage to the economy, risk to safety, excessive transport costs and the exponential costs in pavement and infrastructure damage that would result if overloading was not addressed.

Authorities should identify the most appropriate communication tools to advise respective groups of the purpose of the policy to control overloaded heavy vehicles. A staged approach should be adopted to discuss initiatives such as Chain of Responsibility legislation, accreditation programs and the use of pre-screening options at weigh stations. This will allow time for industry to comprehend the purpose and implications of policy changes and new initiatives. Before going public, staff and spokespeople involved in the initiative should be identified and appropriately trained in their responsibilities.

Information can be communicated through community forums, newspaper feature articles, news events, toolbox meetings for transport operators and drivers and regular meetings between the road authorities and the logistics chain. Embarking on a program to communicate to a variety of audiences can be intimidating for professionals whose expertise lies elsewhere. Yet developing awareness is the first step in achieving stakeholder 'buy-in'. Communication of the purpose and goals and how they are to be achieved is critical to the success of introducing initiatives that require cooperation. It may be valuable to obtain professional services to develop packages of information designed specifically to target audiences. Careful consideration should be given to determining an appropriate and auditable budget to meet this need.

Recommendation 26: Develop a communications package including information forums, bulletins and online media, on the impact of overloaded heavy vehicles on productivity, safety, and infrastructure.

Recommendation 27: Publish bulletins advising of legal and regulatory requirements about load limits and load restraint practices.

Recommendation 28: Embark on an information sharing and consultation program with the community, transport industry and logistics chain. This could include establishment of standing advisory groups to inform government of new and emerging trends in logistics and to have input into transport and infrastructure strategy.

An observation

As discussed at the beginning of this paper, we are more than mid-way through the United Nations Decade of Action for Road Safety. As communities we are challenged to reconsider practices that unnecessarily endanger lives. It is acknowledged that people need to work to support their families. This is a dilemma we all face: work, and food on the table, but at what risk?

Figure 21: Sweeping the street, main arterial road, Port Moresby, Papua New Guinea, August 2016
Source: Peter Frauenfelder, VicRoads

A public review of dangerous practices in Papua New Guinea is encouraged to improve road safety outcomes. This can raise general consciousness in the community about road safety matters. In Figure 21 a woman is sweeping the roadside. With vehicles travelling at speeds up to 80 kph this woman's life may be in danger. This is an all too common problem in Papua New Guinea and many other APEC economies.

INTRODUCTION TO PARTS THREE, FOUR and FIVE

PARTS 3 and 4 of this report is a 'regulatory framework toolkit' designed to assist developing economies in the APEC region to address the safety, productivity and infrastructure impacts of overloading and poor load restraint in road transport. PART 5 is a suggested pathway of potential procedures to bring this work together.

APEC Transportation Working Group (TWG) Workshop April 2017.

Overview of the APEC Transportation Working Group (TWG) Workshop, Brisbane April 2017.

Papua New Guinea hosted a workshop for the APEC Transportation Working Group (TWG) in April 2017 in Brisbane, Australia.

The goal of the workshop was to work towards establishing a 'regulatory framework toolkit' to assist developing economies in the APEC region to address the safety, productivity and infrastructure impacts of overloading and poor load restraint in road transport.

The workshop brought together participants from Chinese Taipei, Malaysia, Thailand, Viet Nam and host economy PNG, supported by subject matter experts from Australia and Australia's APEC representatives.

Opening the APEC TWG Workshop, Secretary Mr Roy Mumu identified many challenges for the transport system in Papua New Guinea including:

- The cost of overloading for the economy, transport operators, the supply chain and the impacts on safety
- A lack of cohesive legislation
- Lack of management of enforcement practices

Attendees were invited to nominate their top actions to address overloading and poorly restrained vehicles. The top three actions were: leadership and capability training, data and its analysis and a strong regulatory environment.

These themes were addressed by presenters and emerged as points of discussion during the workshop. The themes are discussed in PART THREE of this report - a 'regulatory framework toolkit' and implementation plan.

Figure 22: Mr Mumu addressing delegates at the TWG Workshop and a relaxed moment at the workshop April 2017
Source: Peter Frauenfelder, VicRoads

PART THREE

Five categories of actions and tasks

The five categories of actions are:

1. Leadership and capability development
2. Communications and engagement
3. Data collection and analysis
4. Legislative review and reform
5. Strategy and policy development

1. Leadership capability development and training

Attendees at the APEC TWG Workshop, ranked leadership capability equal first (alongside data collection and analysis) as the most important measure to address overloading and poor load restraint. Success in delivering the actions outlined in the implementation plan will require knowledgeable and task-oriented leaders. Without strong and effective leaders experienced to develop staff skills and capability and engage with industry, it is unlikely that improvements will be achieved.

Observation from the APEC TWG Workshop
At the workshop, Mr Peter Todd, Deputy CEO VicRoads, (Victoria's road authority) made the observation that 'good leadership results in good outcomes and successful projects'. He also observed that 'when an employee brings their best self to work, we as an organisation can perform at our best'.

As an adjunct to this project, the author of this report invited four key senior leaders from Papua New Guinea's transport authorities to participate in a week-long leadership development program. A program was devised to meet Papua New Guinea's Vision 2050 to up-skill and enhance staff capabilities and gender equality.

Assigning a mentor for each visiting leader to work shadow, as well as attending meetings at Board level through to team meetings, the leadership capability program provided opportunities for participants to interact with their peers gaining an insight into the qualities that make up good leadership. Secondments to other transport authorities or short term work shadow opportunities can accelerate and enrich the participants' experience.

Training, whether for leaders or operational personnel, will provide the confidence for staff to undertake their tasks. However, training and capability development must be ongoing to ensure transfer of knowledge and to maintain best practice. Putting in place proper procedures and acting on them with due diligence is a clear statement by the transport authorities of a coordinated approach to tackling overloading and poor load restraint.

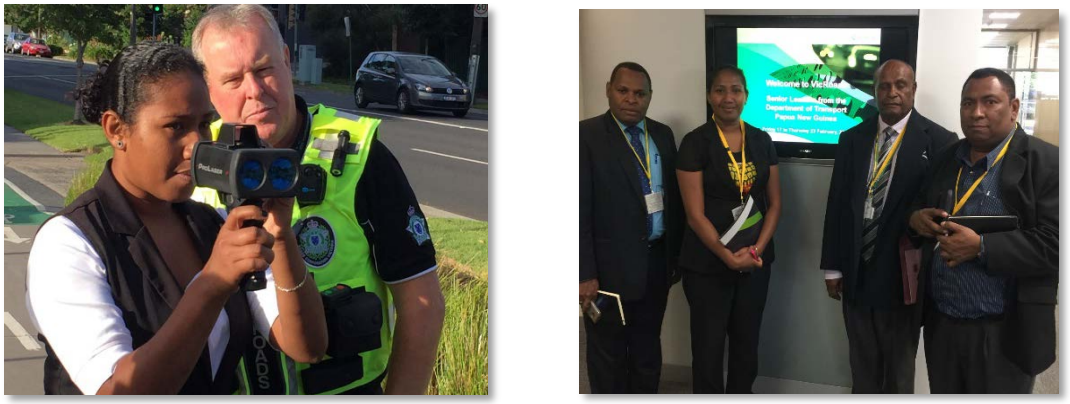


Figure 23: PNG leaders attending a Leadership Capability Program, VicRoads, Feb 2017,
Source: Peter Frauenfelder, VicRoads

Observation from the APEC TWG Workshop
At the workshop, Enforcement Officer and specialist trainer to the heavy vehicle industry, Mr Alan Pincott, declared that "good enforcement officers were well trained, had a deep knowledge of the law and applied the law fairly and consistently".

Training packages and manuals should be designed for all staff to cater for different learning styles and supported with appropriate written, video and other visual material. Leaders, senior executives, policy officers and practitioners with responsibility for road-side enforcement should all be trained and provide appropriate training materials. A schedule of training events with accompanying training modules and a set of learning goals for participants should be developed. Experts in developing training manuals should be engaged as well as experienced trainers to deliver the content.

Position descriptions for all staff should be reviewed and updated to ensure roles and responsibilities are clear. Position descriptions will identify the requisite level of knowledge and expertise expected of

the incumbent or applicant. A knowledge gap analysis should be undertaken to determine the level of leadership capability development and training required for:

- ✓ weigh station personnel and support staff
- ✓ enforcement and compliance officers
- ✓ data collection, analysis and interpretation personnel
- ✓ policy and support personnel
- ✓ finance, budgeting and invoicing personnel
- ✓ team leaders and managers and their reporting lines through to the CEO of each responsible agency

Training material developed should be aligned with government directions and align with communications about the *Long Term Objective* to reduce the incidence of overloading and poor load restraint.

It is evident that enforcement officers must know the laws that apply to load restraint. It is as important that regulators have an understanding for the application of the law and ensure that the law is written clearly and be interpreted by enforcement officers without equivocation.

Figure 24: Unrestrained beer kegs can pose a significant safety hazard. Load restraint training is imperative.
Source: Alan Pincott, 2015

Figure 25: Whilst the load is restrained it does not comply with Australian load restraint guidelines
Source: Alan Pincott, 2015

Summary of key actions

- ✓ Develop training material with the objective to meet this motto: highly capable, optimistic, confident, innovative and engaged staff led by courageous leaders who show the way[35]. Developing capable staff is the key to the organisation performing at its best.

- ✓ Review and update positions descriptions and perform a knowledge gap analysis.

- ✓ Engage experts if none are available in existing structures, to develop training manuals catering for various learning styles and developed with local participation.

- ✓ Engage the expertise of economies who are further advanced. Learn from their ways and mistakes through work shadow experiences and secondments.

- ✓ Develop a learning and development training schedule.

- ✓ Align training material with government directions and the *Long Term Objective* established through the communications and engagement strategy.

- ✓ Engage third party professional services to mentor and work with relevant agencies to develop personnel capability

2. Communications and stakeholder engagement

A well designed communications and engagement strategy is key to building awareness. It maps a pathway to address an identified problem. It is designed to alert stakeholders and the community that work is underway to address an objective; in the case of Papua New Guinea that is to reduce the incidence of overloading and poor loading practices. The strategy will build awareness of the problem and together with other measures, such as strategic policy and enforcement, work towards changing behaviours of field practitioners and enforcement officers and regulatory agencies.

The strategy, with its inherent objectives, goals, strategic initiatives and measureable targets and evaluation process, will outline actions to be taken[36]. The action plan will articulate a communication package with the ultimate aim of gaining commitment from those tasked with responsibility to address the problem and to demonstrate a method to relieve people adversely affected by the problem. As discussed in PART 1, overloaded and poorly restrained vehicles have a detrimental impact on the economy, organisations and individuals in the supply and logistics chain, other road users and communities living adjacent to the roads for whom safety, noise, dust and pollution can be a concern.

Development a communication package of messages should be target specific, although a key message can concentrate everyone's mind on the *Long Term Objective*. Australian transport authorities and road safety agencies, have in recent times, developed the road safety messaging titled 'Towards Zero' which, with subsequent actions, has enjoyed remarkable success. This message is an adaptation of the earlier concept of 'Vision Zero' that had its origins in northern Europe.

Thus developing a key message, such as Towards Zero, is a principal pillar to support the development of a communication package. The key message, aspirational and long term, could be drawn from the list below. Preferably it would be developed and designed, with the intrinsic value of ownership conferred by the process, by a Communication and Engagement Working Group.

- Working towards an improved economy and improved road safety or
- Working towards a more productive economy and better road safety or
- Better Roads, Better Economy, Better Safety or
- Better Compliance, Better Economy, Better Safety

[35] APEC Transportation Working Group Workshop, Brisbane Conference, Peter Todd, 5 April 2017.
[36] For a useful exposition on this approach and other related tasks for a strategic leader refer to *Strategic Leadership of Portfolio and Project Management,* Timothy J. Kloppenborg and Laurence J. Laning, pp 26 - 29

Embodied in the key message and the communication package is an articulation of the *Long Term Objective* to address the problem identified. In the case of Papua New Guinea, the *Long Term Objective,* is to reduce the impact of overloading and poor load restraint in road transport.

A successful communication and engagement strategy will identify appropriate mechanisms to engage key audiences. Fundamental to all communications will be the key message and supported by additional messaging for specified target audiences. Targeted audiences will include:

- Prime Minister, Cabinet and Transport, Ports, Treasury and Finance Minsters
- Heads of Department of Transport, National Road Authority and Department of Works
- Personnel within responsible road agencies
- Weight station personnel, other enforcement officers and staff supporting these functions
- Transport operators for whom these proposed changes will impact considerably
- The supply and logistics chain
- Neighbouring communities and the broader community
- Media

The type of messaging to be conveyed could be informational – to assist weigh station personnel to educate and respond to potential grievances from weigh-bridge and weigh station users. Diagrams and visual aids can be useful for this task.

Ministers and politicians, will require information incorporating strategic directions and aspirations, data and its analysis and a discussion and account on performance targets and measures. It is critical to provide information on progress to ministers, who are ultimately responsible for strategy and policy and the funding decisions. Similarly, department heads and Chief Executive Officers of road agencies require this type of information, with a strong emphasis on evidence through data and greater attention to detail.

Communication and ongoing engagement with the next cohort is critical. Transport operators, the logistics and supply chain will benefit through lower operating costs, reduced maintenance expenditure and more reliable road services once roads can be maintained to a higher standard. A future campaign will highlight the benefits of certain technologies for the industry should a policy decision by made to adopt any of the measures discussed in PART 2 of this report. The transport industry can learn and benefit from better load limit and load restraint practices.

Conducting industry forums and regular meetings can clarify challenges confronting the transport industry, supply and logistics chain. Consideration could be given to establishing a Freight Advisory Council to update road agencies on freight related matters. The council can play a pragmatic role in assisting government to set a policy and program agenda for road transport.

Figure26: Transport Forum, Listening to members of the transport industry, Lae, Papua New Guinea, August 2016
Source: Peter Frauenfelder, VicRoads

Observation from the APEC TWG Workshop
At the workshop, Mr Peter Todd, Mr Alan Pincott, Mr Peter Garland, Department of Transport and Main Roads Queensland and Mr Michael Crellin, National Heavy Vehicle Regulator agreed on the importance of developing a strong relationship with the transport industry, understanding their needs and working together to shape policy and enforcement training activities.

The community should be informed on the *Long Term Objective* with a discussion on the benefits to be derived from addressing overloading and poor load restraint, showing how a more productive economy can lead to better health and a higher standard of living. Improved road safety is also an objective of reducing the impact of overloading and poor load restraint.

Regular briefings with the media can assist to build communal knowledge on measures being adopted to attain the *Long Term Objective.* Obtaining support of the media is a critical challenge of the ongoing success of the project.

SUMMARY OF KEY ACTIONS

- ✓ Establish a team dedicated to communications and engagement.
- ✓ Develop a communications and engagement strategy.
- ✓ Identify and develop communication packages and an engagement strategy for specific audiences.
- ✓ Develop a strategy to utilise paid and un-paid sources to promote the *Long Term Objective.*
- ✓ Establish a work program so that messaging becomes ingrained in all facets of work undertaken to achieve the *Long Term Objective.*

3. Data collection and analysis

Data is collected and analysed to support development of business cases. It supports policy from conception and scoping stage to the implementation stage and through to evaluation. It is a tool to monitor infrastructure condition and to ensure infrastructure investments are delivered and evaluated properly.

The value of collecting and analysing data is extended as it begins the process to:

- Understanding the challenges of moving freight
- Improved road safety and assurance of well-maintained vehicles
- Establishing a cost recovery protocol with penalties to reflect damage caused by overloaded heavy vehicles

Observation from the APEC TWG Workshop
At the workshop, Economist, Mr Ed McGeehan, stated, “In Transport Economics, the condition of the road has an impact on the cost of operating heavy vehicles in terms of travel time costs, travel time reliability, vehicle operating costs and accident exposure. Therefore it is important to collect this data to understand transport and supply chain costs to develop effective policy”.

DATA FOR ASSET PROTECTION

Empirical data analysis of the condition of pavements, bridges and other infrastructure informs policy and business cases of infrastructure lifecycle expectancy and underpins rehabilitation and maintenance schedules. This type of data can be used in conjunction with other data sources, such as those conducted through the International Road Assessment Programme (iRAP)[37]. Many APEC economies have had roads assessed under the iRAP process. Developing systemic methodologies to collect and retain data enables data analysts to report on trends and measure achievements.

In addition, an analysis of the costs of road damage attributable to heavy vehicles can become the basis for a business case to recoup maintenance costs from the heavy vehicle industry. The analysis could inform transport authorities of the budget required to support a rehabilitation and ongoing maintenance program, the costs attributable to road safety, as well as lost productivity for the transport industry and supply and logistics chain.

Observation from the APEC TWG Workshop

At the workshop, Mr Mike Pickering, Department of Transport and Main Roads Queensland, spoke about how pavement damage caused by a heavy vehicle depends on the pavement materials and configuration, and well as the vehicle characteristics and loading. The example considers pavement damage caused by vertical loading only*. To illustrate the effects of overloading, the relative damage caused by a vehicle overloaded by 6 tonnes (all of which is on the rear axle group) on different pavement materials was calculated to be:

- Unbound granular (gravel) material - 157%
- Asphalt - 220%
- Cemented (stabilised) materials - 3310%

*Note: pavement damage is caused by vertical, horizontal and dynamic loading and exacerbated when overloaded.

At the APEC TWG Workshop it was disturbing to hear anecdotally of the very high capital expenditure on trucks by a transport operator to ensure an adequate supply of vehicles for the freight task. It was reported that two thirds of the operator's fleet was off the road being repaired mainly due to the poor road conditions[38]. This significant cost will permeate through the supply chain and eventually be borne by the consumer. These costs magnify transport costs with a direct impact on the competiveness of an economy. The objective to collect and analyse data to develop a case for road pricing is a trend developing in many economies; Australia is currently embarking on this task and New Zealand has had a road user charge scheme in place for many years.

Observation from the APEC TWG Workshop

At the workshop, Department of Transport and Main Roads Queensland, Mr Geoff Smith, spoke of the importance of obtaining data to assist with asset preservation and management, asset maintenance and operations and road safety.

Infrastructure investments require data to prioritise projects based on cost-benefit analysis evaluation. An option which can be evaluated through the use of cost-benefit analysis is the estimation of a partial contribution by private industry to enable the upgrade of the road. Alliances of this sort have been successfully used in many economies to improve productivity supplementing governments with limited funds. Such an approach requires comprehensive and rigorous analysis of data to explore its many elements.

[37] **International Road Assessment Programme (iRAP)** assessment conducted in 2015 http://irap.org/en/irap-news/english-news/559-planning-safer-roads-in-papua-new-guinea accessed 20 July 2017

[38] APEC Transportation Working Group Workshop, Brisbane Conference, Panel discussion, 5 April 2017

A good framework to use when considering infrastructure investment decision making processes, in conjunction with a private partnership arrangement or a process for governments to follow for major project works, can be found in Infrastructure Australia's Better Infrastructure Decision Making guidelines and case studies[39].

Observation from the APEC TWG Workshop
At the workshop, Mr Chris Nagel and Mr Andrew Golding, Department of Transport and Main Roads Queensland, spoke about using data to assist with road design and maintenance planning, thereby obtaining best value for capital expenditure and maintenance budgets.

Similarly, conducting a baseline study of logistics, supply chain and transport costs can map the impact of transport costs on the operator and the eventual end user and therefore the profitability of transport operations. Collected regularly, this knowledge becomes the basis of a productive dialogue with industry on reducing costs and improving safety. The data can be used to show trends in operating costs by vehicle type and illustrate relative safety records of different types of vehicles by highlighting their crash involvement. It also provides opportunity for industry and transport authorities to work together on achieving the *Long Term Objective*.

A fundamental principle of providing a safe transport system is to ensure that truck operators understand that they have a legal responsibility to ensure their vehicles are well maintained. This could be achieved by establishing protocols to obtain roadworthy and maintenance data from transport operators to assist the industry to meet their obligations. Collecting data for this purpose is an extension of functions conducted at weigh stations. Other opportunities, such as collecting data from a vehicle's engine management system and GPS tracking devices can also provide evidence of adherence to roadworthy and maintenance standards, as well as other information about time on road (fatigue or hours of driving legislation), speed and driving performance (safety and eco-driving[40]).

Policy objective will dictate data requirements

Accurate data on traffic volumes, the volume of commodity movements, (and therefore each commodity's value to the economy), vehicle type, transport costs, the extent of overloaded vehicles, road and infrastructure condition data, road repair costs and projected sustainability of the repair will inform decisions on where expenditure should be directed in developing economies. Although for some economies this data may be unknown, the situation does not negate the requirement to begin the process to collect and analyse such data to inform future infrastructure investment plans. A policy direction may be to direct funds to projects where there is a high return to the economy on the investment. Acknowledging this situation, two broad principles follow:

1. Utilising existing data to establish a baseline (a weigh station provides opportunity to collect data).
2. Identify gaps in the data to meet policy objectives and devise mechanisms to obtain the data

Here is an example of data that could be collected at a weigh station to help inform enforcement decisions. A second example is included for the purpose of policy development. Note the following discussion is not comprehensive and is used solely for illustrative purposes.

If the intention is to use the weigh station for enforcement purposes only, data that could be collected may include:

[39] http://infrastructureaustralia.gov.au/policy-publications/publications/files/Australian_Infrastructure_Plan.pdf and https://infrastructure.gov.au/infrastructure/publications/files/Best_Practice_Case_Studies_Vol_2.pdf accessed 20 July 2017
[40] Eco-driving, the practice of driving to minimise fuel use and carbon dioxide emissions.

Policy Objective – enforcement of mass breaches by overloaded heavy vehicles	
Data Source	**Data collected**
Weigh station	Vehicle details – registration, type, axle configuration, gross mass. Vehicle and axle mass at time of detection Maintenance scheduling and adherence Date and time of day
Weigh station verified with department of transport records	Vehicle operator and owner details: - driver licence details - owner's registration details - other data as required to issue a penalty

However, if the policy direction is to address the cause of the problem of overloaded heavy vehicle (not the symptom), further data and information needed might include,

What industries contribute most to overloading?

What commodities do they freight?

What are the reasons that encourage or lead to overloading – competition for (driver vehicle) employment – labour practices, poor loading practices (wet loads have a greater mass than dry loads) or simply greed, low level risk of enforcement or lack of knowledge of damage caused to trucks and roads? What stevedoring and loading practices might promote overloading – time slots and space availability?

NOTE: In addition to the following, some of the data in the previous example would be collected at the weigh station.

Policy Objective - Reduce overloading by targeting the worst offenders	
Data Source	**Data collected**
Weigh bridge / station	Vehicle and axle mass at time of detection Date and time of day Roadworthiness
Weigh station verified with department of transport records	Vehicle operator and owner details: - driver licence details - owner's registration details - other data as required to issue a penalty
Weigh Station and industry sector analysis	- Commodity – observation and driver trip documents to verify industry data
Government analysis and industry consultation	- origin and destination studies - logistics and supply chain studies - transport costs - labour practices - loading and unloading activities - stevedoring arrangements

Establish methodologies to collect, store and analyse data;

- ✓ To measure road and infrastructure rehabilitation and repair costs.
- ✓ To calculate asset lifecycle expectancy.
- ✓ To develop a maintenance scheduling program.
- ✓ To measure productivity costs for the transport industry and supply and logistics chain, including transport costs.
- ✓ For infrastructure investment and possible funding options, including alliance and private investment arrangements.

Figure 27: Delegates from the workshop at the Brisbane weigh station TWG Workshop April 2017
Source: Peter Frauenfelder

4. Legislative review and reform

In the short term a legislation reform package could be developed by the Legislative Reform Working Group to establish a sound base for an ongoing legislative work program. Any proposed changes to legislation should be evidenced based and must align with the Department of Transport's vision, guiding strategies and policy decisions. A cost-benefit analysis, and possibly a Regulatory Impact Statement, underpins the legislative reform package[41]. Once data is assembled any strategic information gaps can be determined prior to evaluating the policy position.

[41] A Regulation Impact Statement (RIS) is a process to analyse the most efficient and effective options available, including the possibility of regulation. The RIS may be required if a decision is made to impose additional regulatory burden (either regulations or for example, additional government charges fees on truck operators). The aim is to produce the greatest net benefit to society, whilst simultaneously meeting the needs of government.

The objective is to ensure the fundamental principles are in place, prior to embarking on a number of possible legislative changes and other actions to address overloading and poor load restraint.

Legislation is the basis of an effective enforcement strategy. It outlines investigation, entry and search powers vested in authorised officers. It frames the purpose and objectives of the tasks of authorised officers, the evidence to be collected and the manner in which it can be obtained.

Data acquisition and reporting on performance can be challenging for most economies. Legislation compelling provincial transport authorities to provide road performance data can assist the central road authority in its reports to government. Such reports highlight for government potential risks to deliver an efficient freight task. This process could be achieved by the central road agency providing a template to provincial agents to ensure consistency. In addition, compelling provincial transport authorities to provide data and report on performance could be tied to road funding arrangements.

Observation from the APEC TWG Workshop
At the workshop, Mr Marcus James, Department of Infrastructure and Regional Development, suggested that a long term aspiration may be to establish an independent regulatory body such as Australia's National Transport Commission. This body would have "legislative responsibility of the reform process looking to the future, whereas the road authority's task is typically to respond to current and immediate need".

OVERLOADING AND POOR LOAD RESTRAINT SUPPORTIVE LEGISLATION

Registration data is critical to develop policy and prosecute offence breaches efficiently. In the case of Papua New Guinea, Form 7 of the Motor Traffic Regulation 1967 captures insufficient data about the vehicle and the registered owner for the process to operate smoothly. Adapted for local conditions, the VicRoads registration application template is a form that could adequately capture required data.

An adjunct to this is to review existing regulations on vehicle maintenance requirements (and roadworthiness for all vehicles) to determine their adequacy in light of accelerated damage to vehicles and roads.

It is noted that in Papua New Guinea a 'liquid' tolerance allowing up to ten per cent mass in excess of permitted mass limits. This position has a significant impact on the condition of pavements and bridges and has little justification. A manufacturer's vehicle mass or general mass limits (GML) should be captured in registration details. Transport operators should comply with these limits unless a concessional mass limit is regulated in law and appropriate permits are issued and carried in the vehicle for presentation to enforcement officers on request.

It should be an objective to introduce Chain of Responsibility legislation (discussed in PART 2 of this report). By making all participants in the chain that contribute to the movement of product on freight vehicles accountable, the legislation removes some of the onus for overloading from the driver to the less visible but equally responsible parties. In discussions at the APEC TWG Workshop, a number of economies indicated their interest in examining the possible application of Chain of Responsibility legislation. The practical application of legislation such as this takes time to apply and requires cooperation and input from all participants in the supply chain. Thus it is considered a long term objective.

Figure 28: Trainer and enforcement officer Mr Alan Pincott, uses models and graphics to demonstrate the effects of centrifugal force on a vehicle that is overloaded. TWG Workshop April 2017
Source: Peter Frauenfelder

Observation from the APEC TWG Workshop
At the workshop, Mr Marcus Burke, National Transport Commission (Australia) reminded attendees that everyone (every link) in the supply chain has a vested interest in a productive, efficient supply chain thus everyone should be accountable.

CATEGORIES OF OFFENCES

A risk-based categorisation of offences can impose escalating penalties to reflect the level of the additional vehicle mass. Breaches can be classed as minor, substantial or severe in terms of the level of risk the additional mass could impose on infrastructure and safety. Australia's National Heavy Vehicle Law provides the following categories of breaches with the category being proportionate to the severity of the offence[42]:

Minor breach – risk of someone gaining a minor unfair commercial advantage over those who operate legally, but no risk to safety or infrastructure.

Substantial breach – risk of damage to infrastructure, increasing traffic congestion and unfair competition. It may also involve some risk to safety, although not an appreciable risk.

Severe breach – appreciable risk to safety, more severe risk to infrastructure, greater risk of traffic congestion or a greater level of unfair competition.

Risk categories simplify the process for enforcement officers to determine the powers they may use on the road and the level of penalty that could apply to an offence. This reinforces the idea of an 'Enforcement Pyramid' where intervention escalates from Informing > Helping > Checking > Enforcing. Does your economy look like the ideal pyramid below or is it misshapen and weighted too heavily at the top?

[42] https://www.nhvr.gov.au/safety-accreditation-compliance/chain-of-responsibility/risk-based-categorisation-of-offences, cited 30 June 2017

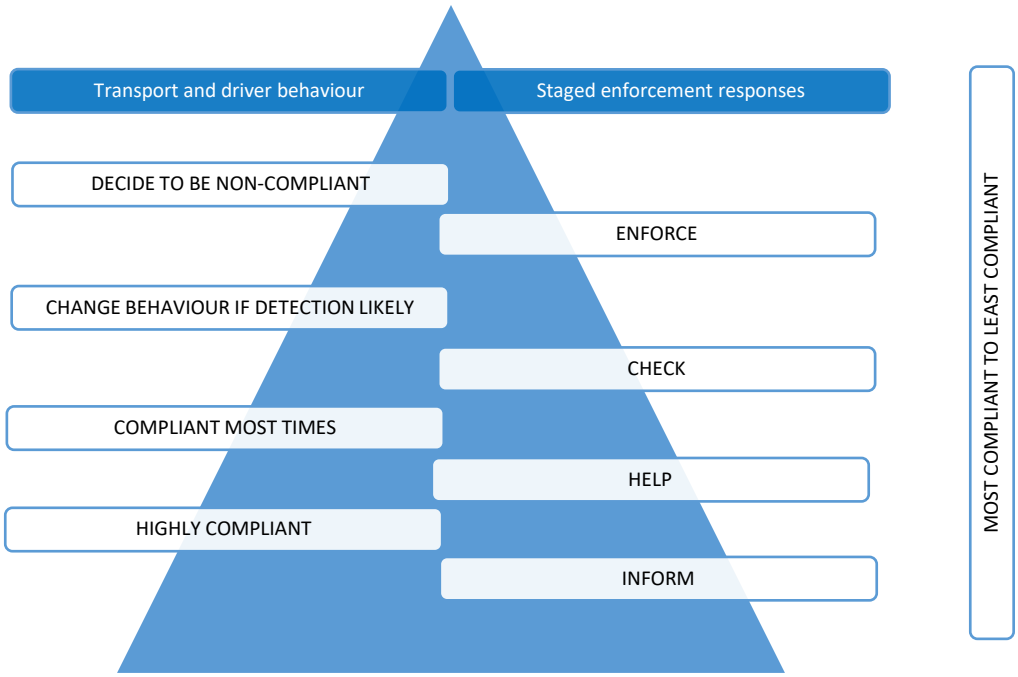


Table 4 Enforcement pyramid

Categorising penalties under such a regime will be predicated on a mature legislative program that can define the damage caused due to exponential increases in mass, and a sophisticated measure of delay to traffic, risk to safety or the consequences of unfair competition.

A study on the levels of safety risk, infrastructure risk and levels of unfair competition due to increased payloads, is the starting point for this work. An understanding of which vehicles and the incremental increases in mass pose the highest risk would form the basis of data for this work. Categorised by vehicle type a picture would soon arise of the risk posed to infrastructure. Accurate registration data could pinpoint the vehicles that pose the highest risk. Incidentally, such information and freight movement studies would also assist policy decision and be the foundation of data for business cases for infrastructure investment.

The purpose of such a study is to determine the appropriate penalty structure. Thus it is appropriate that the legislative arm of the department of transport co-lead this work with their policy colleagues and that the work has a high priority on the work program.

ADMINISTRATIVE

Annual indexing of penalties ensures that the deterrent factor of penalties remains relevant and fees derived reflect an appropriate pecuniary amount at the time of the offence. Where legislation stipulates a penalty, it remains relevant only as long as the purchasing power of the dollar unit remains constant. Indexing enables penalty increases without the legislative burden of amending law. Consideration should be given to simplifying the process. The Australian Schedule of Heavy Vehicle National Law Penalties, Infringement Penalties and Demerit Points[43] may provide insight into developing appropriate structure.

[43] https://www.nhvr.gov.au/law-policies/penalties-and-infringements, viewed 06 August 2017

ROAD ACCESS

The ‘liquid’ tolerance, discussed earlier in this section, could be replaced by an accreditation scheme. This would demonstrate genuine need by transport operators to load to limits higher than general mass limits (GML). Then as accredited operators, they would demonstrate conformance to conditions set by the road traffic authority. Such conditions relate to safety and vehicle performance. Performance Based Standards and Mass Accreditation Schemes are discussed in PART 2 of this report.

Advantages of participating in the scheme can result in access to roads, such as truck by-pass roads or routes crossing bridges that would otherwise be restricted. It could also mean preferential treatment at weigh stations, whereby a vehicle can be waved through if it is identified to be a participant. Automatic number plate recognition (ANPR) technology can be used to detect and verify participating vehicles.

Once on-board mass scales are investigated, and if adopted, a legislative program would be required to implement their introduction, supported by regulations to establish standards and other necessary instruments.

A thorough investigation of the legislative framework required to enable accreditation schemes or on-board mass scales should be a part of the legislative work program. A national body could do this work, as discussed earlier in this section, however if not established in the short term, work should be initiated by the legislative arm of the appropriate transport authorities.

The introduction of High Productivity Freight Vehicles (HPFV) in Australia in recent years has enabled transport operators to marginally increase payload yet provide confidence to government that these vehicles meet specified higher standards for safety and emissions. Before this can be instigated the Department of Transport will need to determine which vehicles are appropriate for specific tasks. The transport industry is a great innovator for such vehicles and dialogue should be encouraged to determine industry needs. Matters of compliance need to be addressed. Evidence of compliance can be demonstrated through on-road and in-vehicle systems.

Pavement and Infrastructure Strategies, discussed in the Strategy and Policy Development section of PART 3, should have as an objective a program to identify the best type of vehicle for the freight task, optimising productivity whilst simultaneously limiting the detrimental impacts of overloading. Shaping a fleet of vehicles that become ‘the right vehicle to do the job’ may also require the introduction of an incentive scheme, which could include an accreditation scheme providing access priority for accredited vehicles. Similarities to this approach can be found in the PBS scheme and HPFV.

VEHICLE IMPORTATION LAWS

Vehicle importation laws can be designed to reset the type of vehicles permitted to use the road network. Through such laws there is opportunity to prescribe safety standards, emission standards axle configuration and mass ratings for task specific freight movements. A long term objective, this law has the potential to the average age of the fleet and could be linked to contracts to allow the operation of a business. Law could be drafted to require that by a certain year all new vehicles must comply with pre-determined safety, performance and environmental standards.

STANDARDS AND CODES

Economies should update their load restraint requirements in accordance with best practice. The Australian Load Restraint Guide[44] is currently under review and expected to be refreshed for publication in mid-2018. Training for enforcement and policy support staff to implement the guide is

[44] Information about Australia’s Load Restraint Guide can be viewed at https://www.ntc.gov.au/heavy-vehicles/safety/load-restraint-guide/

critical. Legislation should be reviewed to ensure enforcement officers have adequate powers to enforce the provisions of the Guide.

SUMMARY OF ACTIONS

Develop a legislative work package to include amendments of procedures to capture data of registration, licensing and vehicles owner details as well as freight movement data.

- ✓ Review legislation that permits a mass tolerance.
- ✓ Review and simplify the penalties regime and annual indexing for heavy vehicles.
- ✓ Develop a legislative work package to tighten load restraint codes and standards with associated enforcement procedures.
- ✓ Once policy has been established develop a legislative work package to adopt accreditation schemes, Chain of Responsibility legislation and technologies and a review of vehicle importation laws.
- ✓ Establish an independent body to be responsible for developing legislation to control heavy vehicles if appropriate.

5. Strategy and policy development

DEVELOP AN ENFORCEMENT STRATEGY

An effective enforcement strategy is likely to contain the following directives:

- Compliance with any relevant legislation. In Victoria, Australia the enforcement strategy reinforces other regulations to protect the safety of road users and safeguard roads and bridges from damage by ensuring heavy vehicles comply with legislation and regulations.
- Sets out the law and plays a critical role in educating industry on its legal obligations. This works reasonably well in economies with well established procedures and a long practice of working directly with transport operators. In the context of economies where corruption and compromise can be an issue, it may be best to build trust where enforcement officers are observed to be applying the law fairly, justly and consistently.

Automation, removing the human element from enforcement, can alleviate problems associated with lack of capability and untrained personnel, corrupt behaviour and human error or misjudgement.

ANPR technology can identify a vehicle and, with association data capture techniques, can detect recalcitrant behaviour. When enforcement procedures are being implemented electronic recording, cameras and computer data capture reduce the influence of human intervention.

A combination of technologies - ANPR, cameras, weigh bridge data, transport vehicle on-board scales - collectively records a history of behaviour. Data recording of aberrant behaviour builds a history of the operator and driver which overtime establishes trends to assist enforcement officers to target the least compliant operators and drivers.

Some objectives that could be included in an enforcement strategy include:

- Promotion of enforcement that is fair, just and consistent,

- Ensure authorised officers have powers to enter and search heavy vehicles and premises, collect evidence and the power to direct a person of any vehicle,
- Increased awareness and understanding between industry and road agencies represented through enforcement agencies with enforcement officers involved in awareness campaigns where their subject matter expertise is highlighted and valued,
- Data and intelligence sharing between transport authorities,
- Capability development and training for enforcement personnel,
- Analysis of the relationship between mass enforcement and frequency of offences. (Understanding this relationship could lead to improvement in the cost-effectiveness of enforcement).

Observation from the APEC TWG Workshop

At the workshop, Mr John Wroblewski and Mr Mark Mitchell, Department of Transport and Main Roads Queensland, advised attendees that introducing initiatives to address the issue of heavy vehicle overloading firstly required transport authorities to establish the right policy setting' and in doing so it is critical to talk with the transport sector and supply chain representatives, 'to understand industry practices and expectations'.

BRIDGE AND INFRASTRUCTURE STRATEGY

Protecting bridges from damage aims to optimise safety, mobility and freight efficiency. Management of bridges and other structures requires a balance between meeting road transport needs with maintenance. A review of the bridge strategy should be undertaken so that it aligns with the policy direction and complements the work of the enforcement strategy. A bridge strategy incorporates procedures for monitoring bridges. Failed bridges can cost lives but can also delay freight causing increased costs to consumers.

PAVEMENT STRATEGY

Road pavements consist of a surface layer (with a lifespan of between 10 – 15 years) and a structural layer (which can have a lifespan in excess of 40 years). A pavement strategy identifies investment where it is most needed to meet the growth in freight and private vehicle use.

Roads can be categorised according to the class of road and/or the critical function they provide. Maintenance work can be categorised in three service levels – critical, needed and desired.

A matrix, such as Table 5, can assist in prioritising maintenance funding. Hence a pavement management strategy is a useful tool in planning works and securing funding for maintenance.

	Critical Works	Needed Works	Desired Works
Road Class 1	Priority 1	Priority 1	Priority 2
Road Class 2	Priority 1	Priority 1	Priority 2
Road Class 3	Priority 1	Priority 2	Priority 3
Road Class 4	Priority 2	Priority 3	Priority 4

Table 5 Maintenance priority matrix

POLICY ON MEASURES TO ADDRESS OVERLOADING AND POOR LOAD RESTRAINT

Policy initiatives to develop enforcement, pavement and infrastructure strategies require clear articulation of the purpose and procedures for collecting, storing analysing and reporting data. Data will be used by the Department of Transport in its reporting to government, and for its dialogues with the transport operators, supply chain and community. A weigh station can provide a rich source of data for initial reporting against performance measures to support the objectives of the enforcement strategy and support further policy development.

Development of sound policy will enable adoption of technologies or schemes. Tasks to determine the policy include a scope of works, cost-benefit analysis, and consideration of land acquisition, legal, maintenance and security matters. In addition, there are management procedures to be established, including road authority processes, reporting and enforcement training and education programs. These are only some of the tasks to be considered for inclusion in developing effective policy.

On-board mass systems[45] propose an alternative and could by-pass older technology, such as weigh-in-motion (WIM), to measure and report mass. The flexibility and mobility offered by on-board scales to perform compliance tasks has significant advantages over static weigh stations that are designed to capture vehicles that travel along a specified route[46]. Close monitoring of data output would be required to ensure vehicles fitted with the technology are consistently compliant and the technology has not been disabled. This is achieved through the use of the Intelligent Access Program (as identified above). Policy would need to be developed articulating how to introduce the technology, to whom it would apply and the benefits that could be derived for the transport industry. Such benefits could include access to roads at a higher mass or access to specific roads or routes permitted only to those vehicles being monitored which provides government with assurance of compliance.

In determining which stand-alone or in-combination technologies and or accreditation schemes are best suited to individual economies, as an example for consideration, traditional weigh-in-motion deals with schemes that apply to all heavy vehicles, whilst on-board mass monitoring solutions can be made applicable to individual or groups of vehicle/operator types.

Observation from the APEC TWG Workshop

At the workshop, Transport Certification Australia CEO, Mr Chris Koniditsiotis, stated that, “It is an incorrect assumption that technology, such as on-road and onboard mass systems, could not work in a developing economy in the same way it can in a developed economy – this is especially the case were such systems can be used to provide industry with improved access in return for better demonstrating compliance”. The same technology allows greater engagement between government and industry and a data set for improved network planning.

Accreditation schemes such as mass management accreditation, Performance Based Standards and High Productivity Freight Vehicles (HPFV) provide opportunity to allow increased mass under strict controls (refer to PART 2 of this report). A mass management scheme offers the advantage of improved productivity by permitting additional mass in exchange for greater confidence transport authorities have for compliance. Such a scheme requires heavy vehicle operators to demonstrate, through the audit of their management systems, compliance with business rules and standards. Policy on how to introduce these approaches, conditions of access and benefits to be derived by the community, could be assessed through development of performance measures.

Automatic Number Plate Recognition (ANPR) can be used with WIM or as a stand-alone system to detect vehicles that are under an accreditation scheme permitted to by-pass a weigh station or Recalcitrant offenders would be identified through other enforcement practices.

A WIM site that pre-selects vehicles can optimise the function of the weigh station by separating vehicles with a legal mass and directing overloaded vehicles to the weigh station. However, this

[45] TCA OBM Specification available at https://tca.gov.au/ntf/specifications/obm-spec Webpage visited 4 September 2017
[46] TCA Intelligent Access Program available at https://tca.gov.au/tca/publications-reports Webpage visited 4 September 2017

outcome can be achieved by other means – on-board mass systems and or accreditation schemes – requiring a thorough cost-benefit analysis comparing the options.

The Performance Based Standards (PBS) scheme provides the opportunity to have the right vehicle available to undertake the freight task. A PBS vehicle contributes to greater productivity, efficiency and safety. It can also have a lower damaging effect on infrastructure. A study is recommended to determine the opportunities to adopt a PBS scheme investigating the cost, benefits and implications of implementation.

Observation from the APEC TWG Workshop
At the workshop, Mr Anthony Germanchev, stated that vehicles designed to comply with a Performance Based Standards regulatory scheme can achieve up to a 40% increase in payload through better configuration of existing trailers, couplings and axles to form an innovative vehicle combination.

Chain of Responsibility legislation provides the opportunity to ensure industry wide accountability along the logistics and supply chain. Actions in the logistics chain can result in unacceptable driver behaviour such as speeding and driving alcohol, drug or sleep impaired. Heavy sanctions on parts of the logistics chain can change behaviours. A study on the implications and mechanisms of introducing Chain of Responsibility legislation should be conducted.

It is common practice to trial limited versions of schemes to test their practical application and management. Development of policy to investigate any such schemes could consider a trial limited to a geographical location, route or commodity being freighted. Targeted invitation to transport operators to participate can contain and manage difficult to manage broader interest.

All of these measures can be stand-alone or complementary. A study comparing the social, economic, administrative, technological and implementation costs and benefits of each or combination of measures is recommended prior to proceeding with their introduction. Monitoring and auditing is the foundation for success for these systems and schemes. In economies where audit and monitoring practices are rare, and may attract strong resistance from transport operators, clear policy supported by strong enforcement and compliance powers and political commitment to empower the policy is essential.

SUMMARY OF ACTIONS

- ✓ Develop strategies for enforcement, pavements, bridge and infrastructure
- ✓ Develop a policy position on the possible use of technologies and accreditation schemes
- ✓ Consider the development of Chain of Responsibility legislation as an approach for greater compliance.

PART FOUR

The implementation of actions

PART 4 summarises initiatives discussed under the five categories of actions in PART 3. Each is cross-referenced to recommendations discussed in PARTS 1 and 2.

The five categories of action are:

1. Leadership and capability development
2. Communications and engagement
3. Data collection and analysis
4. Legislative review and reform
5. Strategy and policy development

The time frame suggested in the implementation plan for each action is a guide on the timing for a package of works to be scoped through to being implemented. However, many actions are ongoing and will continue beyond 48 months.

Embarking on a works program may require engagement of professional services. Any agreement to engage a third party should include a clause on skills transfer. As part of the procurement process it would be a requirement that the third party works with relevant agencies to simultaneously develop capability in road agency personnel.

NOTE. Attempts to address overloading and poorly loaded vehicles are complex and time consuming. This list of actions should be viewed as key actions to begin to address the problem and not as a definitive list.

Action number	Initiative	Objectives	Actions	Timeframe & Sequencing
1 Leadership Capability and Training				
1	Leadership development	> Good leadership results in good projects, well managed workplaces and high levels of accountability (Cross-reference Part 2 Recommendation 25)	✓ Develop a Leadership Capability program	0 - 36 months
2	Training and capability development	> Build staff capability and align with position descriptions > All staff including Policy officers should be familiar with compliance and enforcement activities > Trained non-operational staff are better equipped to develop policy and converse on enforcement and compliance matters with industry (Cross-reference Part 2 Recommendation 25)	✓ Develop training modules for enforcement staff, on-road inspectors and policy officers on the impacts (PART TWO) of overloaded and poorly loaded vehicles	0 - 24 months
3	Determine the personnel to operate and prosecute the activities of the weigh station	> Prepare for weigh station operations (Cross-reference Part 2 Recommendation 25)	✓ Train weigh station personnel to conduct operations, enforcement and prosecutorial functions at the weigh station. ✓ Develop a training regime - such as a 'train-the-trainer' model - ensuring highly trained, qualified and accredited staff can operate the weigh station at all times	0 - 24 months
4	Building awareness and knowledge and engaging with industry	> Enhance capability and accountability on load restraint practices > Demonstrate genuine approach of government working with industry > Utilise the opportunity to promote the *Long Term Objective* (Cross-reference Part 2 Recommendation 25)	✓ Develop and deliver a training series on the revised load restraint guide to enforcement personnel ✓ Develop a training package for enforcement personnel to deliver to transport drivers and operators ✓ Develop a certificate-based training series on the revised load restraint guide to transport drivers and operators	24 - 48 months

2 Communications and Stakeholder Engagement				
5	Identify stakeholders and develop a staged communications strategy and Action Plan	> Develop awareness about the government's strategy to address overloaded and poorly loaded heavy vehicles (Cross-reference Part 2 Recommendation 26)	✓ Development of a series of communication packages of length and depth appropriate to the target audience to explain the *Long Term Objective*. TARGET AUDIENCES - PRIORITY 1 All government Ministers and department secretaries All personnel working at a weigh station All PNG enforcement officers PRIORITY 2 All road agency personnel Transport industry - Those using and likely to use a weigh station People living and working in close proximity to the weigh station - mainly pedestrians and road users, Media Logistics and Supply Chain Road agency within each Province, Industries peripheral to the supply chain The general community ✓ Engage a communications and stakeholder engagement specialist, if not available in-house, to develop and deliver the communication packages	0 - 24 months
6	Where weigh stations are used, develop an awareness package on its purpose	> Immerse road authority personnel about the operations and outputs of the weigh station > Develop a sense of ownership and pride in weigh station operations for weigh station personnel (Cross-reference Part 1 Recommendation 7)	✓ Develop an awareness package on weigh station operations and arrange visits to the Weigh Station	0 - 24 months

7	Develop information package on the *Long Term Objective*	> It is an opportunity to work closely with the transport industry to communicate messages in accessible language and utilise industry's distribution networks > Utilise the opportunity to promote the *Long Term Objective* (Cross-reference Part 2 Recommendation 27)	✓ Develop communication packages to advise and educate the transport industry and logistic chain about load limits and load restraint practices.	0 - 24 months
8	Working together to improve productivity and safety outcomes	> Understanding the challenges of moving freight > Build partnerships to address common challenges (Cross-reference Part 2 Recommendation 28)	✓ Establish Industry forum partnerships and conduct regular meetings between transport industry, supply chain and road authorities ✓ Establish a Road Freight Advisory Council to inform government on industry challenges	12 - 36 months
9	Building awareness and knowledge and engaging with industry	> Communicate revised load restraint guide for greater compliance > Demonstrate genuine approach of government working with industry > Utilise the opportunity to promote the *Long Term Objective* (Cross-reference Part 2 Recommendation 24)	✓ Develop a manual and Code of Practice for the transport sector on a revised load restraint guide ✓ Replace outdated manuals and Codes of Practice	24 - 48 months
3 Data collection and analysis				
10	Report on the functions of weigh stations	> Agency accountability to the RTA Board > Develop a database of weigh station activities as evidence for: enforcement performance and for policy development and business cases (Cross-reference Part 2 Recommendation 7)	✓ Develop a list of reportable activities on the output of the weigh station. Reporting on such matters as: - Number of vehicles entering site, registration details, owner details, driver details, vehicle combinations axles and vehicle class - Mass recorded on axles, axle groups and total GMV mass - Extent of overload in percentage, mass and as an ESA (damage) calculation. - Record the percentage of overloading offences that can be categorised as minor, substantial or severe - Records details of recalcitrant companies for further investigative work - Report on weigh station performance measures - Prepare regular reports for the RTA Board for reporting to Minister for Transport	0 - 24 months

11	Data provides the basis for responsible policy development	> Understanding the costs associated with moving freight by analysing data to: 1. Measure performance of initiatives to address overloading 2. Report on progress of initiatives to stakeholder groups 3. Support policy work 4. Underpin businesses cases to fund infrastructure investments and regulatory projects 5. Discuss with industry opportunities to reduce freight costs 6. Communicate working on the *Long Term Objective* to stakeholder groups (Cross-reference Part 1 Recommendations 1 & 3)	✓ Establish a baseline study of logistics, supply chain and transport costs to appreciate the impact of overloading on the economy, community and transport operators. ✓ Devise a program to conduct this study regularly - every 3-5 years.	12 - 36 months
12	Repair and rehabilitate freight roads	> Develop business cases to fund a schedule of works (Cross-reference Part 1 Recommendation 5)	✓ Undertake a comprehensive assessment of bridge and pavement conditions. ✓ Develop a bridge monitoring program to guide scheduling of repair works.	12 - 48 months
13	Making the transport industry more accountable	> Improved road safety outcomes and assurance of well-maintained vehicles > Integrate with conditions of road access programs, such as onboard mass systems and accreditation schemes. Learn from the lessons of this application and when data processes have matured apply broad (Cross-reference Part 1 Recommendation 2)	✓ Establish protocols to obtain road worthy and maintenance data from transport operators based on the legislative requirement that transport operators have a duty of care to ensure vehicles are well maintained.	24 - 48 months
14	Data provides the basis for responsible policy development	> Determine the optimal vehicle mass and axle configuration to perform the freight task (Cross-reference Part 1 Recommendation 6)	✓ Conduct an analysis – a freight movement study – of commodity movements. ✓ Collect and analyse traffic volume counts and mass data for vehicle classifications, identifying vehicle types that produce the greatest damage through to those producing the least damage.	24 - 48 months

4 Strategy and Policy Development				
15	Weigh station audit	> Weigh Station personnel accountability based on the audit principles of ISO 9001 Quality Management System (Cross-reference Part 2 Recommendation 7)	✓ Establish protocols and conduct internal audits to determine compliance, opportunities for improvement and non-compliant behaviours of weigh station operators.	0 - 24 months
16	Strategies to guide processes	> A strategic approach to support enforcement operations > A framework to shape policy> Principles to inform business case development for capital and maintenance expenditure (Cross-reference Part 2 Recommendation 10)	✓ Develop enforcement, pavement and bridge and infrastructure strategies	0 - 24 months
17	Data to support policy	> Collection and analysis of data to inform policy development (Cross-reference Part 2 Recommendation 20)	✓ Develop processes and procedures to collect, store and report data from weigh stations as they provide a rich source of data for initial investigation	0 - 24 months
18	Compare technological and policy solutions	> Determine which combination of technological and policy options best addresses overloading suitable for application for each unique Economy (Cross-reference Part 2 Recommendations 8, 11, 16 & 18)	✓ Conduct a comprehensive benefit-cost analysis comparing WIM pre-selection measures, onboard mass systems, PBS system and mass management accreditation, as stand-alone measures or in combination.	12 - 36 months
19	Repair and rehabilitate freight roads	> Repair and rehabilitate roads that will provide the highest return on investment (Cross-reference Part 1 Recommendation 5)	✓ Develop a maintenance prioritisation program for pavements and infrastructure ✓ As an interim measure utilise iRAP Assessments data to propose a schedule of works	24 - 48 months
20	Data provides the basis for responsible policy development	> Establishing a cost recovery protocol with penalties to reflect damage caused by overloaded heavy vehicles (Cross-reference Part 1 Recommendation 4)	✓ Conduct an analysis of the costs of road damage attributable to heavy vehicles to establish a basis to recoup costs.	24 - 48 months

21	Greater compliance through Chain of Responsibility legislation	> Determine the appropriateness of introducing Chain of Responsibility legislation that can provide (Cross-reference Part 2 Recommendation 17)	✓ Conduct a study on the implications and mechanisms of introducing Chain of Responsibility legislation.	48 months or beyond
5 Legislative review and reform				
22	Review legislation and regulations for weigh station	> Agency accountability to the RTA Board (Cross-reference Part 2 Recommendation 7)	✓ Review legislation and amend as required to ensure responsibility for the function of the weigh station is assigned to the NRA. NRA to work with legislative department to ensure completeness and accuracy of intent of legislation and reporting requirements.	Prior to weigh station operations commencing
23	Develop auditable manuals for weigh station operations	> Weigh station operators are accountable (Cross-reference Part 2 Recommendation 7)	✓ Develop a clear statement (MOU) of expectations on operations, documented and auditable procedures, resource allocation and evaluation protocols of work practices and targets. Included, but not limited to, such matters as: - Review Position Descriptions to include Roles, responsibilities and accountabilities of management and personnel, including security for personnel - Reporting lines, rostered hours and training programs - Calibration procedures - Conducting weighing operations, dealing with non-compliant vehicles, enforcement and prosecutorial procedures - Data collection, retention and transfer. Data matching with owner registration details - Develop measureable targets- Site security	Prior to weigh station operations commencing
24	Road safety audit on weigh station	> Ensure weigh station is safe for road users and personnel (Cross-reference Part 2 Recommendation 7)	✓ Conduct a road safety audit to confirm safe operations and that all road users leading up to and around the site will not have their safety compromised. This includes truck drivers, pedestrians passing the site and other road users who will be directed away from the site and those who will contend with trucks re-entering the main road. For example, satisfying the 5 C's of good signing: Conspicuous, Clear, Comprehensible, Credible and Consistent. Refer to the Australian Road Sign Standards for further information.	Prior to weigh station operations commencing

25	Weight station project close assessment	> Ensure weigh station contractor has met design principles (Cross-reference Part 2 Recommendation 7)	✓ Refer to Australian design manual of correct access and egress and signage etc. prior to handover control from contractor to NRA	Prior to completion of construction and ancillary works
26	Legislate to enforce	> Appropriate powers are critical to controlling overloaded heavy vehicles(Cross-reference Part 2 Recommendation 10)	✓ Undertake a complete analysis of legislative requirements to establish and implement an enforcement strategy, a pavement strategy and a bridge and infrastructure strategy	0 - 24 months
27	Enforcement powers	> Support operations of enforcement and investigation officers. (Cross-reference Part 2 Recommendation 9)	✓ Undertake a complete review of legislative requirements to implement enforcement procedures and to conduct investigations of businesses, data storage and data transmission (of transport operators and supply chain operators).	0 - 24 months
28	Tighten registration legislation	> Detailed registration information is critical to successful enforcement practices (Cross-reference Part 2 Recommendation 19)	✓ Undertake a review of vehicle registration (and licensing) requirements	0 - 24 months
29	Reduced regulatory administrative burden	> Penalty amounts keep pace with inflation and remain a deterrent (Cross-reference Part 2 Recommendation 22)	✓ Annual indexing to increase penalties will ensure the deterrent factor of penalties remains relevant and fees derived reflect an appropriate pecuniary amount at the time of the offence. Establish a baseline of penalties and introduce annual indexing of penalties. (The baseline amount should reflect the work on Recommendation 4 and 21)	0 - 24 months

30	Ensuring the safest vehicles are permitted access	> Legislation is robust to ensure all vehicles operate safely and are well maintained (Cross-reference Part 1 Recommendation 2)	✓ Review existing regulations on maintenance requirements and roadworthiness (for all vehicles) to determine their adequacy in light of accelerated damage to vehicles and roads.	0 - 24 months
31	Update industry guides	> Tighten load restraint regulations > Demonstrate genuine approach of government working with industry > Use the opportunity to educate on the *Long Term Objective* (Cross-reference Part 2 Recommendation 23)	✓ Update load restraint guides in accordance with best practice (Australian Load Restraint Guide is an example).	0 - 24 months
32	Replace the tolerance allowance with a scheme that can be monitored	> Uncontrolled tolerance scheme provides no benefit to the community and considerable loss through damaged roads (Cross-reference Part 2 Recommendation 15)	✓ Establish an accreditation scheme to replace the current 10% 'tolerance' scheme.	12 - 24 months
33	Determining the best outcome of options available	> Provide legislative support to introduce a combination of technological and policy options best addresses overloading suitable for application for each unique economy (Cross-reference Part 2 Recommendations 8, 12 13, 14 ,16 & 18)	✓ Examine the legislative instruments required to be developed to support preliminary policy work to introduce stand-alone measures or in combination WIM pre-selection measures, onboard mass systems, PBS system and mass management accreditation.	24 - 48 months
34	Road user pay options	> Establishing a cost recovery protocol with penalties to reflect damage caused by overloaded heavy vehicles(Cross-reference Part 2 Recommendation 21)	✓ Reform overloading offences and penalties to reflect the exponential damage caused by vehicles of increasing excessive mass. Note this work should be conducted, or reviewed again once in parallel with Recommendation 4 is complete	24 - 48 months

PART FIVE

Implementation Strategy

An implementation strategy assists all active participants responsible for the implementation of actions to keep to task. It has mechanisms to identify the best initiative comparing it to others and a process to measure, evaluate and report on the introduction of actions to address a well-defined problem.

This process of implementing initiatives and actions is presented diagrammatically in Figure 26 and explained after the flowchart.

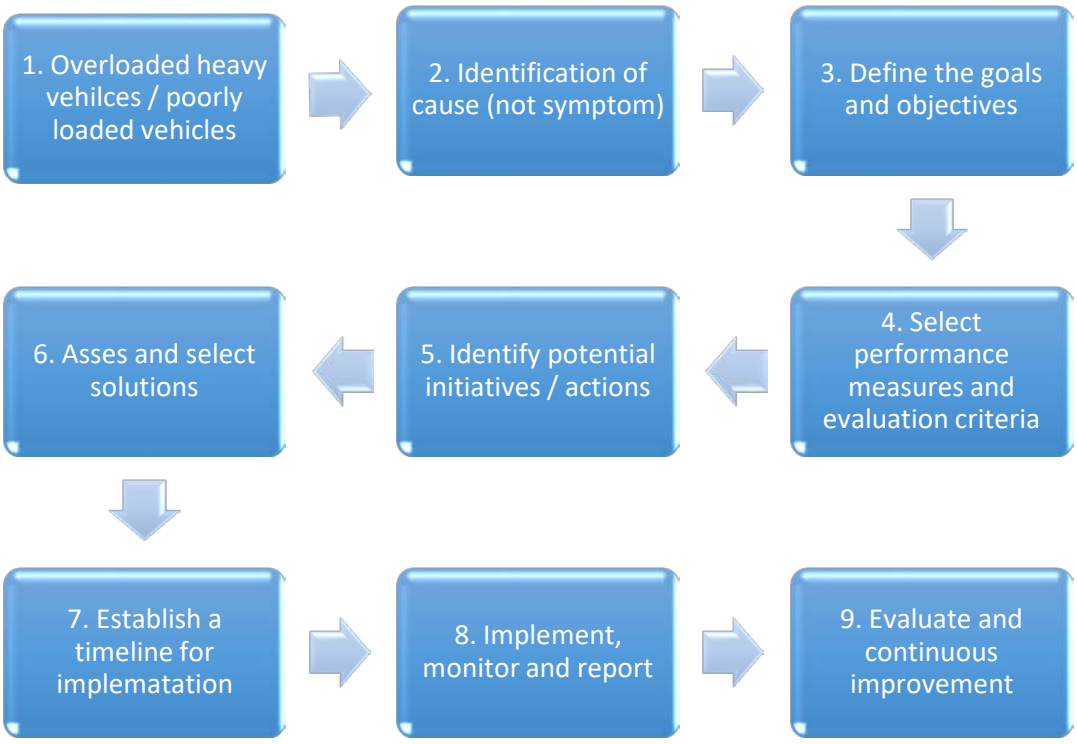


Figure 29: Flowchart of an implementation strategy

The process incorporates the following:

Note: All necessary groups and organisations need to be represented, at appropriate levels of seniority, considering the need to commit the organisation to decisions.

1. **Identification of the problem.** These two problems share many attributes but separating them will identify unique mediation measures for each problem as well as those that can address each problem simultaneously

2. **Focus on root causes** not symptoms
   Several reasons might explain overloading/poorly loaded vehicles:
   - Poor or no enforcement or detection
   - Opportunistic behaviour by operators for unfair competitive advantage
   - Truck drivers placed under time pressures / low wages
   - Lack of knowledge, training and education

- Loading practices
- No accountability along the supply chain
- Lack of control on the number of consignors loading during the freight trip

Enforcement investigations, data analysis and a clear understanding of the challenges faced by the operators in the supply chain can help identify the root causes.

3. **Define goals and objectives**
   - Identifying the outcomes to be achieved to address the root cause.

4. Select **performance measures and evaluation** criteria
   - Targets for the overall objective and for selected initiatives
   - SMART (Specific, Measurable, Achievable, Reliable and Timed).

5. Identify and consider **as wide a range of actions as possible** – single action 'fixes' are rarely successful and determine an achievable timeline

The five categories of **actions** discussed in PART 3 and 4 of this report include:

Figure 30: The five categories of actions

6. **Establish a process and criteria to determine which if the potential actions will deliver the best outcomes.** In most cases this requires a cost-benefit analysis comparing each of the possible initiatives. Refer to APPENDIX 1.
   - It is important that at this stage that the most involved groups support the proposals, or at least not actively oppose the proposals. **'What's in it for them?' is a key question for policy makers to apply in investigating the benefit of each initiative.**
   - **It is also important to consider the perspectives and priorities of all involved** and those who are potentially affected by initiatives to gain their support along the journey and limit the need to re-visit issues with stakeholders.

7. **A timeline for implementation** should be realistic and achievable but also tight to keep the project from languishing.

    - This is a stage within the Program Evaluation (the next section) process when undertaking a cost-benefit analysis comparing each of the possible initiatives

8. **Implement, monitor and report** is a check on the success of the initiatives implemented. At this stage reports prepared for a variety of audiences including Ministers, transport authorities, industry and the broader community is an account of the achievements measured at a point of time.

9. A Program Evaluation, prepared in the developmental stages of addressing the problem, **measures successful implementation and the success of the initiative**. It considers the process of introducing initiatives and what could be done to improve their introduction for future reference. Refer to APPENDIX 2.

Working groups to manage and implement initiatives

Whilst the work program to deliver the actions arising from the recommendations is considerable, it is not insurmountable. A documented strategy, approved by the Secretary for the Department of Transport would identify governance protocols with clear guidance on the work to be undertaken by the project sponsor, project manager, project team leaders and working group members. The work program would comprise a list of tasks (or activities) derived from the actions in the implementation plan. It will be important to have dedicated staff, with clear position descriptions and funding available to carry out these functions.

A possible governance structure

Establish a steering committee to report to the Secretary of the Department of Transport seeking approval for a program of works and funding and a reference group to act as a leadership group to align each work package with the overall government objectives. Finally, appoint a working group responsible for the package of works with work distributed to subject matter experts to meet milestones and timeframes. The governance structure would ideally ensure that work groups be headed by leaders representing the relevant area within the road authority.

To assist with shortfalls in capability it is recommended a work program that includes visits to economies, including Australia, where the hosts act as guides/mentors/trainers. The purpose of the visit should be targeted and comprise a level of accountability.

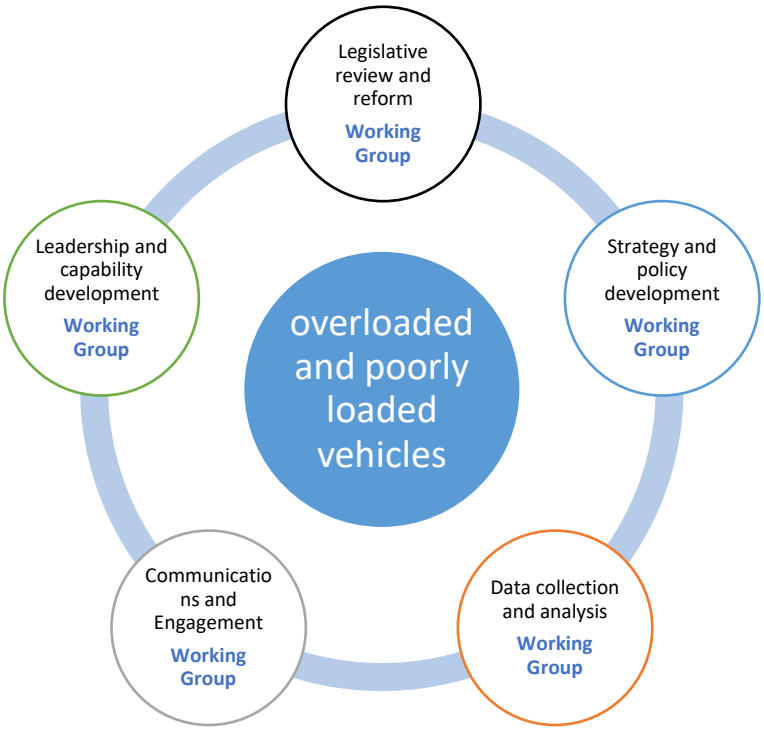


Figure 31: Five working groups each with responsibility for a package of works from one of the categories of actions in the implementation plan.

GLOSSARY

Term	Definition
Axle mass	Axle mass is the fraction of a vehicle's total mass resting on a specific axle.
Chain of Responsibility (CoR)	Chain of Responsibility is the concept that everyone in the logistics supply chain shares responsibility for ensuring compliance with heavy vehicle regulations. Under Chain of Responsibility laws, any person who exercises (or has the capability to exercise) control or influence over any transport task is considered part of the supply chain and therefore has a responsibility to ensure compliance. Chain of Responsibility recognises that multiple parties may be responsible for offences committed by the drivers and operators of heavy vehicles. A person may be a party in the supply chain in more than one way. For example they may have duties as the employer, the operator, and the consignor of goods
Equivalent Standard Axle (ESA)	Equivalent Standard Axle is a method for determining a standardised wheel load, which allows the pavement damage caused by different wheel load configurations to be calculated. Refer also to 'fourth power'.
Evidentiary standard	Information of an evidentiary standard means information that can be used as evidence in a legal proceeding. A high degree of accuracy is usually required to satisfy an evidentiary standard.
Fourth power	Road damage rises steeply with axle mass, and can be estimated to be proportional to the 'fourth power' of the axle mass. This means that doubling the axle mass will increase road damage by a factor of 16 (2x2x2x2). As mass increases, damage thus increases along an exponential, rather than linear, curve. The fourth power is a key concept for implementing an efficient system to calculate and recover the cost of road damage caused by (overloaded) heavy vehicles.
Intelligent Access Program (IAP)	Australia's Intelligent Access Program uses satellite tracking and wireless communication technology to remotely monitor where, when, and how heavy vehicles are being operated on the road network. IAP provides an opportunity for transport operators to achieve improved road access or increased allowable mass in exchange for data assuring compliance with regulations.

iRAP star ratings	The International Road Assessment Programme (iRAP) star ratings measure the level of safety which is 'built in' to a given road. Five-star roads are the safest, while one-star roads are the least safe. The star ratings are based on road inspection data.
Mass limit (including 'general mass limit', or GML and 'higher mass limit', or HML)	General mass limits are the maximum masses at which heavy vehicle classifications may operate under ordinary regulation. Higher mass limits allow heavy vehicles to operate at increased masses in exchange for assurance of compliance, such as under a mass management scheme.
Mass management scheme	A mass management scheme is a quality assurance system under which transport operators have systems in place to meet required standards of heavy vehicle accreditation. In return, operators can receive regulatory benefits, such as access to increased mass limits. Accredited operators are required to have their systems regularly audited.
On-board scales	On-board scales use load cell technology or suspension pressure readings to calculate the mass on the vehicle axles. On-board scales can be linked by wireless communications to provide data to compliance systems at remote locations.
Performance Based Standards (PBS)	A Performance Based Standards scheme allows heavy vehicle operators to achieve higher productivity and safety through approval of innovative and optimised vehicle design. In Australia, nominated heavy vehicles are tested against 16 safety standards and four infrastructure standards in order to meet Performance Based Standards.
Weigh-in-Motion (WIM)	A weigh-in-motion device can capture and record axle mass and gross vehicle mass as the vehicle drives over a measurement sensor. Weigh-in-motion systems are capable of measuring vehicles traveling at a reduced or normal traffic speed and do not require the vehicle to come to a stop.
Weigh station/weigh bridge	A weigh station is a highway checkpoint at which the mass of heavy vehicles is tested using a weigh bridge. A weigh bridge is a large set of scales capable of measuring the mass of stationary heavy vehicle.

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APPENDIX 1 Cost-benefit analysis

In preparing to consider various proposed technical or regulatory options discussed in this report it is advisable to undertake a cost-benefit analysis. The process requires a systematic evaluation and assessment comparing the costs and benefits of alternative proposals. It expresses in monetary terms the gains and losses of an initiative to all members of society resulting in a single measure of net benefit, that is, whether the benefits outweigh the costs. It also compares alternative proposals to identify which one has the greatest net benefit.

A cost-benefit analysis, in conjunction with the program evaluation process, aims to demonstrate the contribution an initiative will make to government's transport safety objectives. In the broadest sense, transport safety objectives that government's aim to promote are

- Economic efficiency
- Economic development and trade
- Environmental amenity and sustainability
- Safety
- Security
- Accessibility, social cohesion and equity

The Transport and Infrastructure Council of Australia has developed a very useful tool to assist with this process[47].

[47] Transport and Infrastructure Council, Australian Transport Assessment and Planning Guidelines, T2 Cost Benefit Analysis, reviewed 07082017, https://atap.gov.au/tools-techniques/cost-benefit analysis/files/t2_cost_benefit_analysis.pdf

APPENDIX 2 Program Evaluation

The most common types of Program evaluation within government are process evaluation; outcome evaluation and economic evaluation. Process evaluation is mainly but not solely used for formative purposes, and both outcome evaluation and economic evaluation are used mainly for summative purposes. An analogy might be 'how well did the teacher teach' (formative evaluation) and 'how well did the student learn the lesson' (summative evaluation).

What policy makers want to know is:

Was the process used to design and develop the initiative to address the problem successful? Was the process efficient in identifying the objectives and did it meet the needs of the target audience? Did internal and external stakeholders have a clear understanding of their roles and were their objectives met?

The focus is on the process and identifying lessons learned for future work. This is in the formative stage. In the teaching profession a teacher might reflect on how well they prepared the lesson that was taught to the student.

An outcome evaluation seeks to determine if the initiative achieved the defined targeted outcomes. It identifies for whom, in what ways and under what circumstances the outcomes were achieved. It can also identify unintended impacts, both positive and negative.

This is the summative stage – determining how well the project met its objectives or 'how well the student has learnt the subject'.

Note there is a two way examination and interdependency between the teacher and the student. Each have their own expectations of the success of the project or initiative to address the problem. It is important that when designing a project or initiative that all views of stakeholders are considered so that expectations can be met.

A third program evaluation tool useful for examining the success of a project is to conduct an economic evaluation. This process will undertake a cost-benefit analysis determining the cost effectiveness and question the monetary value of a project. It is useful in the formative stage when comparing different options that could be implemented.

In the case of overloading and poor load restraint the government is looking for better road safety outcomes and improvements in sustainability and economic growth. Transport authorities have a mandate to deliver on road safety outcomes and continued improvements in providing and maintaining the road system. Transport operators and the supply chain will want to know what benefits and the advantage of compliance they will be afforded through changes in regulatory, policy and access processes. Approached early, these expectations can be prepared and managed in advance.

A set of guiding questions can assist in the process of program evaluation. Evaluation processes and data sources will need to be established to deliver the answers. The source of the table of questions below is the Australian New South Wales Department of Premier and Cabinet webpage on policy makers and evaluation toolkit.

Key evaluation questions for three types of evaluation[48]

Type	Typical key evaluation questions
Process evaluation	How is the program being implemented? How appropriate are the processes compared with quality standards? Is the program being implemented correctly? Are participants being reached as intended? How satisfied are program clients? For which clients? What has been done in an innovative way?
Outcome evaluation (or impact evaluation)	How well did the program work? Did the program produce the intended outcomes in the short, medium and long term? For whom, in what ways and in what circumstances? What unintended outcomes (positive and negative) were produced? To what extent can changes be attributed to the program? What were the particular features of the program and context that made a difference? What was the influence of other factors?
Economic evaluation (cost-effectiveness analysis and cost-benefit analysis)	What is the most cost-effective option? Has the intervention been cost-effective (compared to alternatives)? Is the program the best use of resources? What has been the ratio of costs to benefits?

Some key questions to consider at the implementation planning stage:[49]

1. Have you put your intended policy outcome into words?
2. What does success look like and how will you get there?
3. What are the measures your performance will be judged by?
4. Have you collected enough benchmark data to assess whether your policy has had the desired effect over time?
5. Who are the decision makers and how are they accountable?
6. Have you adequately considered governance?
7. Are the roles and responsibilities of each person, group or agency involved clearly defined and documented?
8. Is there a shared understanding of who is responsible for each decision?
9. Are there reporting and review arrangements in place?
10. Are you keeping it simple? Don't allow project management processes to become an end in themselves.

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[48] http://www.dpc.nsw.gov.au/programs_and_services/policy_makers_toolkit/steps_in_managing_an_evaluation_project/2._develop_the_evaluation_brief#key_evaluation_questions
Webpage visited 4 August 2017

[49] Some key principles in implementation and evaluation planning are set out in the *Australian Government Guide to Regulation* (Australian Government, 2014) 49-52.
http://www.dpmc.gov.au/sites/default/files/publications/Australian_Government_Guide_to_Regulation.pdf

11. Are you able to manage problems proactively and escalate issues, risks and disputes to the right person or body quickly?

12. Are your stakeholders adequately involved or informed about progress?

13. Do you have the right number and type of stakeholders? Not too many, just enough to provide useful feedback and keep you on your toes?

14. How are you keeping them informed of progress?

15. Are you listening to stakeholders as well as talking to them? Ask them for ideas on implementation or risk issues; if they are the right kind of stakeholder, they will have a helpful view you might not have previously considered.

16. Have you identified risks and threats to success?[50]

[50] This checklist is taken from the *Australian Government Guide to Regulation*, ibid.

APPENDIX 3 Focus questions for workshop discussion

The following questions are intended to act as focal points for discussion at the workshop in Brisbane on 3 to 6 April 2017.

1. Does your economy have a system for collecting data on the movement of freight by road? Do you collect data on:
    a. the number, types, and classifications of freight vehicles;
    b. vehicle dimensions and masses;
    c. the roads most frequently used by transport operators;
    d. the value of the freight that is being moved and the cost of road transport;
    e. patterns of compliance and non-compliance with road regulations; and
    f. the state of repair and service life of roads and road-related infrastructure.
2. Is your regulatory framework consistent with a systematic pavement wear methodology, including concepts such as the “fourth power”?
3. Does your economy use weigh stations to enforce mass limits? Is there scope to implement a targeted pre-selection system using, for example, weigh-in-motion sensors?
4. Do the weigh stations produce readings of an evidentiary standard for enforcement purposes?
5. Does your economy have any medium or long term plans to introduce in-vehicle mass sensors, telematics, or other technology to improve oversight of mass limits and regulatory requirements? What are the barriers to implementation?
6. Does your economy have a heavy vehicle access system, under which heavy vehicle operators can be granted access to certain roads in exchange for assuring compliance with mass limits? What would be the barriers to implementing and enforcing such a system in your economy?
7. Does your economy focus enforcement action (fines and other penalties) on the vehicle driver, or can other parties such as company executives be prosecuted for violations? What is the scope for ‘chain of responsibility’ legislation and enforcement in your economy? Are there other areas where laws of this type apply (such as work health and safety)?
8. Are the detailed regulations or codes of practice for overloading and load restraint easy for transport operators to identify, obtain and understand? Are they up to date and consistent?
9. Does your economy include education, training and communication in its heavy vehicle strategy? Do regulatory personnel have access to formal training and professional development opportunities? Are there training programs for industry? How do the regulatory authorities communicate with the industry? Is it effective?

10. Does your economy require implementation and evaluation planning for major regulatory initiatives and other reforms? How do you ensure that existing regulatory frameworks are still necessary and achieving their objectives?

For workshop discussion

The April 2017 workshop will be an opportunity for a variety of APEC economies to share their experiences with overloading and poor load restraint. The information exchanged at the workshop will assist to validate or refine the proposed regulatory measures that are being developed through this project. In 2016, Viet Nam conducted a survey of APEC Transportation Working Group participants on road vehicle overloading. The results of the survey are included in this discussion paper at Appendix 4. Further data will be collected at the workshop. This will add context and strengthen the evidence base for the regulatory framework toolkit.

For workshop discussion

The workshop will be an opportunity for various APEC economies to discuss the collection and analysis of data to develop policy and programs to address the challenge of roads in poor condition.

For workshop discussion

The workshop will be an opportunity to share information about the impacts of overloading on the mechanical performance of the vehicle, with consequences for safety. This may include issues with rollover stability, torque, braking systems, and other aspects of safety performance.

For workshop discussion

What is the experience of APEC economies attending the workshop in providing advice to transport operators and others in the logistics chain, about the damaging effect of overloaded heavy vehicles? This discussion could also extend to the experience of APEC economies obtaining trip data and access to maintenance records from the private sector.

For workshop discussion

What is the experience of APEC economies attending the workshop of collecting and analysing data to establish road reliability values?

For workshop discussion

The workshop will be an opportunity to share information on methodologies for calculating pavement wear and bridge damage costs using, for example, equivalent standard axle data.

For workshop discussion

The workshop will be an opportunity to share information on the classification of vehicles used in various economies to perform the freight task identifying vehicles that cause the least damage to road infrastructures.

For workshop discussion

The workshop will be an opportunity to share information on operations at weigh stations and the use of pre-selection systems designed to assist in the effective functioning of the weigh station. The discussion could also focus on the type of regulatory instruments required to empower officers to conduct inspections without impinging on privacy rights.

For workshop discussion

The workshop will be an opportunity to share information on experience with on-board scales and the evidentiary standards and supportive legislation required to implement their use.

For workshop discussion

The workshop will be an opportunity to share information on the experience economies have with such programs as IAP, mass-management schemes and the damaging impact of ‘tolerance’ schemes can have on roads and infrastructure.

For workshop discussion

The workshop will be an opportunity to share information on the experience economies have with schemes such as Chain of responsibility and Performance Based Standards.

For workshop discussion

The workshop will be an opportunity to share information on the legislation, fee and penalty structures and data systems in place to deter overloading practices and simplify ‘back-office’ and administrative systems.

For workshop discussion

The workshop will be an opportunity to share information on the use and dissemination of load restraint guides and training programs to assist the industry and enforcement officers in developing awareness on their collective responsibilities.

For workshop discussion

The workshop will be an opportunity to share information on consultation programs conducted with the community, transport industry and logistics chain. These may take the form of standing ministerial advisory groups to inform government of new and emerging trends in logistics or less formal advisory groups.

APPENDIX 4: Heavy vehicle overloading APEC survey responses

Economy: Papua New Guinea

Provide a broad summary of your economy's heavy vehicle industry.

- PNG has a road network of 31,000 km with 10,000 km as national highways and provide strategic connectivity within and between the 22 Provinces as well as the cities and towns of the economy. The main operators are the Freight companies that support; the transportation of agricultural products between markets, trade between the coastal and highlands provinces, logging companies and mining companies.

- Due to the rough terrain of the economy and high freight costs by sea and air modes of transport, most of the cargos are transported by road using these heavy vehicles. The establishment of the Road Transport Association for users along the most important Highlands Highway provides an avenue for heavy vehicle operators to discuss common logistical issues including providing an independent voice to Government. This highway serves 50% of the population and provides access to agricultural farms (sugar, coffee & tea) and the mining companies (oil, gas, gold & nickel) which are important for PNG's economy.

- The regulatory responsibilities for these heavy vehicle operations are with the Department of Transport and the 22 Provinces (through their respective Provincial traffic registries).

- Any disruptions to these heavy vehicle operations, especially for goods into the hinterland of the economy affect the prices of commodities which are passed on to the end users. Uncontrolled loading affects the road conditions and damages to bridges and culverts which are repaired by the Government.

Provide documentation that describes your economy's approach to the planning and regulation of heavy vehicles with specific reference to overloading or incorrectly or unsafely loaded heavy vehicles.

- The PNG National Transport Strategy (NTS) approved by the PNG government in July 2013 provides the overall policy document for the three (land; sea & air) modes of transport. It (NTS) also provides the investment plan from 2014-2018 which included the establishment of a new Road Traffic Authority (RTA) to merge all the existing legislations relating to vehicle registrations, drivers licensing and permits for heavy vehicles and their operators. It included the proposal for new Rules & Regulations for heavy vehicle fines and penalties.

- The new RTA legislation was passed in 2014, while the new rules and regulations were approved in 2016 and is intended to be in operation in early 2017 after the existing legislations are repealed.

- Our PNG APEC Policy theme is "Advancing Growth, Connectivity for All" and the Department of Transports Vision contained in the current Corporate Plan (2016-2020) is "To be a high performing policy organization that facilitates a safe, secure and sustainable transport system that is accessible and affordable by everyone".

Describe the agencies responsible for controlling overloading of heavy vehicles in your economy (road authority, traffic police, others).

- The Government agency that is currently responsible for controlling overloading of heavy vehicles is the Department of Transport but this was delegated to the National Roads Authority (NRA) in 2007 as part of the road maintenance management responsibilities for the

national roads in PNG.

- This may continue after the new RTA is operationalized in 2017 which this project is part of our Department of Transport's changed approach to regulatory oversight of this category of vehicles.

Provide legislation relating to regulation of heavy vehicles, particularly for overloading or incorrectly or unsafely restrained loads.

- The current Primary legislation is the Motor Traffic Act (1950) which is being subsumed under the new Road Traffic Authority (RTA) 2014 anticipated to be in operation in 2017;
- New Rules under the RTA was approved by the Minister for Transport & Infrastructure in 2015 and the new Regulations were approved by the Executive Government in November 2016;
- Issuance of permits to regulate heavy vehicles with specific reference to practices that relate to overloading or incorrectly or unsafely restrained loads, although were allowed for in the current legislation, enforcement is very weak. It is anticipated that the outcome of this project and lessons learnt from other economies will guide the PNG transport sector in ensuring that such practices are properly regulated to deter industry from these practices;
- PNG will learn from other economies when developing documentations for compliance and enforcement penalties by our transport inspectors.

What are the regulations to control load distribution on vehicles in your economy?

- The Motor Traffic Regulation, Chapter 243, Section 119 (Weight and Load Limitations)

Provide any documentation, such as codes of practice or industry guidelines that assist in the interpretation of, and compliance with, the above legislation.

- Section 119 (Weight and Load Limitations) of the MTR refers to the loads that should be carried by any axle groups in vehicles or combination of vehicles with load sharing suspension systems:
- Single axles fitted with single tyres: weight carried does not exceed 5.5 tonnes
- Tandem axles fitted with dual tyres: weight carried does not exceed 16 tonnes
- Tri-axle group fitted with dual tyres: weight carried does not exceed 20 tonnes
- Apart from other axle configurations stipulated under section 119, most heavy vehicles used in PNG fall within the above axle groupings. Therefore, operators are encouraged to maintain a Gross Vehicle Weight (GVW) of 41.5 tonnes across the length of the vehicle.

Do you have significant problems with overloading and/or poor load restraint practices? Please describe.

- Recent collapses of cross drainage structures (culverts & bridges) and early deterioration of new road sections being reconstructed indicates overloading and /or poor load restrains onto trucks at point of loading.

What is the maximum permissible single axle load of heavy vehicles in your economy in tonnes?

- The current permissible single axle load of heavy vehicles in PNG is 5.5 tonnes.

What is your economy's maximum gross vehicle mass (GVM) in tonnes?

- PNG's maximum gross vehicle mass is 42 tonnes.

What are the maximum permissible dimensions of heavy vehicles in your economy in terms of::

- maximum height of vehicles: 4.3m
- maximum width of vehicles: 2.5m
- overall length of rigid vehicles: 11.3m
- overall length of articulated vehicles: 17m
- overall length of combination vehicles: 18m

How are these maximum permissible dimensions regulated, controlled and monitored?

- Regulatory oversight to control and monitor these maximum length, width and weight are very weak in PNG and needs to be improved under the new RTA legislations.

Describe the measures for penalties and remedies for vehicle overloading. Who is responsible for compliance (driver, vehicle owner, transport company, others)?

- The "overload infringement scale", Schedule 12 of the Motor Traffic Regulation clearly identifies the penalty fines applicable, however, these fines cannot be implemented as there is lack of portable weigh scales or weigh bridges to physically measure the heavy vehicle suspected of being overloaded makes it difficult. Therefore, enforcement of overloaded vehicles cannot be achieved or implemented.
- Furthermore, there is currently no remedy for overloaded vehicles although the responsibility remains with the driver, vehicle owner and the transport company to ensure that overloading is avoided for the safety and wellbeing of other road users.

Do you use on-road enforcement to reduce the incidence of overloading and poorly loaded heavy vehicles? Please describe these operations.

- PNG's enforcement activities are biased towards registration, drivers licensing and general vehicle safety but weak in the enforcement of overloaded trucks.
- Maybe not so much for overloaded vehicles but poorly loaded vehicles sometimes get infringement notices for "insecure loading" and often happens during enforcement exercises only.

Do you have controls or limits in place to restrict heavy vehicle access to certain roads? If yes, please provide a brief description of these measures.

- In PNG, the Road Maintenance Act provides for restrictions of use by heavy vehicles on certain category of roads but again enforcement is very weak.
- Poor awareness is most probably the reason for industry lack of understanding of the different design loadings for each category of road type.

Do you collect and analyse information on the status of bridge infrastructure and have a program in place to monitor bridge loading capacity? Please describe these technologies and their use.

- The Department of Works has a Bridge Management System (BMS) that has been absorbed

into the existing Road Asset Management System (RAMS), which contains an inventory of all “Cross Drainage structures” located along the 10,000 km of the national road network and continuously develops a maintenance and rehabilitation program. This system does not monitor the loading capacity.

Do you capture and analyse data to inform policy development to mitigate overloading or incorrectly or unsafely restrained loads on heavy vehicles? If yes, what methods do you use to measure the impact?

- PNG does not have any data or any mechanism to monitor and analyse any information on overloading and may need to learn from other economies.

Do you use technology to measure the problem (or example, weigh stations, weigh-in-motion facilities and other pavement detectors)?

- PNG through the Department of Transport was using weigh bridges located along the first 5 km of the Lae port for load control on heavy vehicles using the Highlands Highway.
- The National Roads Authority (NRA) has recently reinstalled 2 weigh bridges at the 9 km section of the same highlands highway.
- Apart from the above, there are no other technologies used to address the problem of overloading.

What, if any, measures do you take to educate transport department officials and those working in the transport industry on their responsibilities to reduce the incidence of overloading and poorly loaded heavy vehicles?

- Transport department officials - Training is required on the provisions of the existing and new legislations and related rules and regulations. This should include the basic principles of roads and bridges design axle loading and relating to the maximum GVM.
- Transport industry - The same training for transport officials should include industry participants as well.

Have you evaluated any of the above measures (regulatory, enforcement, educational)?

- It has been discussed at length in Divisional Toolbox meetings to improve our strategies to control overloading, address discrepancies etc. Training and acquiring new weighing scales etc. have also being mentioned but not much has materialized over the years.

Provide documentation that assesses the impact of measures and initiatives to reduce overloading or incorrectly or unsafely loaded heavy vehicles. It would be particularly useful if sections within the documentation relating to overloading or incorrectly or unsafely restrained loads on heavy vehicles were highlighted or identified in some manner. Please provide these as email attachments or with links to websites.

- We do not have existing data available but the outcome of crisis meetings held between the Department of Transport and stakeholders (mostly trucking companies) some years ago after serious heavy vehicle accidents on the Poreporena Freeway in Port Moresby, the National Road Safety Council (NRSC) was tasked to assess and report its findings on the causes of heavy vehicle accidents, near misses and other freight transport related incidents.

Provide challenges, success stories and lessons learned on the regulation of heavy vehicles in your economy.

- One of the main challenges would be for all heavy vehicle operators to comply with the licensing requirements. Most of the logging industry and mining townships have now being reached and made aware of regulatory aspects of heavy vehicles after years of non-compliance.

- Monitoring, control of overloading which has caused a lot of fatal accidents will remain a difficult task unless we embrace new technology and equip ourselves with the knowledge and skills to counter it. With the boom in economic activity, the use of heavy vehicles has increased a lot and funding for enforcement activities has declined drastically.

- The integration and coordination of networking between national and provincial authorities is very critical so that whatever improvements are experienced at the national departments must also be implemented at the provincial level. This will ensure that all regulatory, enforcement and other necessary functions must meet requirements that are of high quality and that safety is maintained for the good of all road users.

Please provide any other information you consider relevant to this survey.

- This Project will enhance the regulatory oversight of the heavy vehicles industry in PNG with respect to total loads allowed on all our roads, the loading practice and enforcement. Training of the sector agencies staff and industry personnel will be necessary to understand the issues associated with the implications of overloads on the land transport infrastructure assets (bridges, culverts and roads).

Economy: Chinese Taipei

Provide a broad summary of your economy's heavy vehicle industry.

- According to the Highway Act and the Regulations for Automobile Transportation Operators, the profile or definition of Chinese Taipei's heavy vehicle industry is as follows:
    - "Automobile Cargo Transportation Business (ACTB)": ACTB is a business which provides freight delivery service with trucks. The amount of capital must be more than 25 million NT Dollars (0.83 million USD), and have more than 30 new trucks. The businesses are normally operated by small scale operators and have no specific customer and transportation route.
    - "Automobile Cargo Transportation within Designated Route(s) Enterprise (ACTDRE)": ACTDRE is an enterprise which provides delivery services with trucks in designated route(s). The amount of capital must be more than 50 million NT Dollars (1.67 million USD), and have more than 30 new heavy trucks. The operator settled operation office in each location along the designated route(s). They also have regular service route(s) and timetable. This business operation scale is bigger than Automobile Cargo Transportation Business. The businesses are operated by enterprises.
    - "Container Truck Transportation Enterprise (CTTE)": CTTE is an enterprise which transports containers with container trucks in designated areas. The amount of capital must be more than 30 million NT Dollars (0.83 million USD), and have more than 20 new tractors/ 30 new semi-trailers. It's the biggest operate scale than other transportation businesses. The main customers are carriers, importers, exporters and customs brokers. The main operated route is between port, terminal and shipper.

Provide documentation that describes your economy's approach to the planning and regulation of heavy vehicles with specific reference to overloading or incorrectly or unsafely loaded heavy vehicles.

- Highway sector: The Heavy Truck Cargo Volume Specification Inspection and Crackdown Guideline which specify scope of heavy dump truck and semi-trailer loading gravel and sand or soil was released by Ministry of Transportation and Communications (MOTC) in 1992. When the heavy dump truck or semi-trailer loads gravel, sand and soil above 20 tons, it should be equipped with pay load meter certified under the type approval of vehicle component since 2001/7/1. The installing position, metering range and weight metering tolerance should comply with regulation.
- Freeway and Expressway sector: When traffic accidents happen, the accidents occurred by large cargo vehicles will be more serious than other kind of vehicles, the stopping distance of large cargo vehicle has to be longer. In that case, large cargo vehicles have to be controlled in more aspects and listed below. Speed Limit: the maximum speed limit for large cargo vehicle (more than 20 tons) is 90km/h, and the minimum speed limit is 60km/h. Lane Usage: large cargo vehicles can only run on the outer lane, but they still can run on the left lane when an overtaking driving is needed. No Entering Route: some roads like the Hsueh-Shan Tunnel (12.9km), and freeway No.1 Xizhi-Yangmei Elevated Road (paralleling to the plane of freeway No.1). It is danger if the goods falls from large cargo vehicles on the freeway, so there has penalties for the unsafe loading, overloading, etc. The National Highway Police Bureau is responsible for the enforcement. There are 44 weight stations for managing the large cargo vehicles on the freeway.

Describe the agencies responsible for controlling overloading of heavy vehicles in your economy (road authority, traffic police, others).

- The responsible authorities for controlling overloading of heavy vehicle in Chinese Taipei are listed as followed:
    - Legislation authority: the Department of Railways & Highways, Ministry of Transportation & Communications.
    - Enforcement authority: the National Police Agency, Ministry of the Interior, and the National Highway Police Bureau.
    - Road management authority: Directorate General of Highways (THB), and the Taiwan Area National Freeway Bureau (TANFB), Ministry of Transportation & Communications.
    - Port management authority: Maritime Port Bureau, Ministry of Transportation & Communications. (MPB)
    - Local governments.

Provide legislation relating to regulation of heavy vehicles, particularly for overloading or incorrectly or unsafely restrained loads.

- Highway sector: The Road Traffic Management and Penalty Act, Article 29, Article 29-1, Article 29-2
- Freeway and Expressway sector:
    - Goods loading: Freeway and Expressway Traffic Control Regulations, Subparagraph 1, Paragraph 1, Article 21. The loading of cargo by the trunks running on freeways and expressways should comply with following regulations:
        - Cargo should be tightly covered, sealed and fastened.
        - Any granules (such as gravel) should be tightly covered and may not exceed the height of the carriages.
    - Road Traffic Management and Penalty Act, Subparagraph 2, Paragraph 1, Article 30. Car drivers shall be fined from NTD 3,000~9,000 (USD 100~300), be required to make corrections or be prohibited from driving in the event of any of the following conditions concerning the loading of goods: To carry goods that leaking, scattering, or spraying foul odour. For the serious situation, the penalty of irregularities is up to NTD9,000 (USD 300) since 2011/8/1.
- The weigh station: Road Traffic Management and Penalty Act, Subparagraph 4, Paragraph 2, Article 29. If a vehicle driver carries goods to enter the road section within 1 km front of a weight station, he doesn't follow the instructions to enter the scales as provided by relevant road traffic signs, markings, signals, and given instructions by traffic police officers or personnel conducting traffic inspections pursuant to laws. The driver will be fined NTD10,000 (USD330) and forced to enter the scales.
- Freeway and Expressway Traffic Control Regulations, Article 24. When any truck, coach, and link vehicle enter a weigh station, it should observe the instructions of traffic signs, road markings and road signs. No emergency brake is allowed on the weight. Any parking or driving should follow the instructions of service staff or signs. If the loaded cargo exceeds the

total allowed weight or the weight of total links by over 20%, the load cannot be redistributed immediately. If the owner fails to make amends after being reported to the competent authorities, there would be continuous penalties.

- Lane Usage: The provision of lane usage in freeway and expressway is specified in Freeway and Expressway Traffic Control Regulations, Article 8. In addition to the temporary or movable signs set up for traffic accidents, road constructions and the instructions from traffic police on duty, drivers should observe the regulations stated on traffic signs, traffic marks and road signs when driving on freeways and expressways. Drivers should observe the following regulations if there are no established signs or instructions. If there is a driver whose speed is below 80 km/h on the freeways and the speed limit is over 90 km/h, or whose speed is below 70 km/h on the expressways and the speed limit is over 80 km/h, they should keep running on the outside lanes. If they want to overtake other cars, they can drive to the inside lanes. Large vehicles should run on the outer lanes. They can drive to the outer lanes temporarily if they want to overtake the other vehicles in front of them. The inside lanes are passing lanes. However, small vehicles may drive on the inside lanes within the speed limit specified for the road sections as long as they do not block the traffic. Large cargo vehicles and trailers should run on the outer lanes when they run on steep and downward slopes. They are not permitted to change lanes unless special situations happen. When the vehicles run at the speed lower than the minimum speed limit on the climbing section, they should stay on the climbing lanes. They are not allowed to change lanes unless special situations happen. Towing vehicles should stay on the outside lanes and must not change lanes unless there is a special situation. Small vehicles may be exempt from the restrictions of Article 1 and Article 3 if traffic is jammed. Ambulances, fire engines, police cars, engineering vehicles and recovery vehicles are not subject to the aforesaid speed limit when they are executing tasks. However, they should install obvious warning signs as stipulated.

- Maritime Port area sector: As for the limitation of vehicle loading in port area sector, they should be followed the Road Traffic Management and Penalty Act specified by the road administration laws and regulations.

What are the regulations to control load distribution on vehicles in your economy?

- Road Traffic Safety Regulations
    - Subparagraph 2, Paragraph 1, Article 77: Passengers and goods on the vehicles must be firmly placed, and vehicle doors must be able to close properly. Objects on vehicles must be firmly tied or placed.
    - Subparagraph 1, Paragraph 1, Article 79: Loads must not exceed the prescribed gross weights and weight limits of bridges through which they pass.
    - Subparagraph 2, Paragraph 1, Article 79: Loads must be evenly placed on the floor.
    - Subparagraph 2, Paragraph 1, Article 80: Loads exceed the limits of gross rail load on axle, gross weight, or combined weight specified in Article 38.
    - Subparagraph 2, Paragraph 1, Article 38: The axle weight limitation of vehicle.
    - Subparagraph 3, Paragraph 1, Article 38: The restrictions of gross vehicle weight and gross combination weight for motor vehicle.

Provide any documentation, such as codes of practice or industry guidelines that assist in the interpretation of, and compliance with, the above legislation.

- Road Traffic Management and Penalty Act
- Road Traffic Safety Regulations

Do you have significant problems with overloading and/or poor load restraint practices? Please describe.

- Highway sector: Vehicle drivers carry goods enters the road section within 5 kilometres in front of a weight station sometimes fail to follow instructions to enter the scales as provided by relevant road traffic signs, markings, signals, or given instructions by traffic police officers or personnel conducting traffic inspections pursuant to law.
- Maritime Port area sector: It will endanger road users' safety and damage roads, bridges and other facilities if the overloaded container haulage travels on the road within port area.

What is the maximum permissible single axle load of heavy vehicles in your economy in tonnes?

- Road Traffic Safety Regulations, Subparagraph 2, Paragraph 1, Article 38:
    - Single axle load: each unit should not exceed 10 tons.
    - Double axle load: each unit should not exceed 14.5 tons.
- The axle weight limitation of Vehicle Safety Testing Directions:
    - Single axle load: each unit should not exceed 10 tons.
    - Double axle load: each unit should not exceed 17.5 tons.
    - Triple axle load: each unit should not exceed 22 tons.

What is your economy's maximum gross vehicle mass (GVM) in tonnes?

- The restrictions of gross vehicle weight and gross combination weight for motor vehicle: (Road Traffic Safety Regulations, Subparagraph 3, Paragraph 1, Article 38):
    - Single axle (front & rear) vehicles should not exceed 15 tons.
    - Front single axle and rear double axle vehicles should not exceed 21 tons.
    - Front double axle and rear single axle vehicles should not exceed 20 tons.
    - The gross combination weight limit of heavy truck functions as tractor should not exceed 42 tons.
    - The gross combination weight limit of semi-trailer should not exceed 35 tons.
    - The vehicle has been approved that should measure up the requirements in Appendix 11. The articulated buses should not exceed 28 tons.

What are the maximum permissible dimensions of heavy vehicles in your economy in terms of:

- Road Traffic Safety Regulations, Subparagraph 1, Paragraph 1, Article 38
    - Maximum length

        - The large passenger vehicle should not exceed 12.2m and the articulated buses should not exceed 18.75 m.
        - The heavy truck should not exceed 11m.
        - The Full Trailers should not exceed 20 m.
        - The semi-tractor-trailers should not exceed 18 m.
        - The firefighting vehicle approved by Ministry of the Interior (MOI) should not exceed 15m.
    - Maximum width
        - The maximum width of motor vehicles should not exceed 2.5m.
        - The firefighting vehicle approved by MOI should not exceed 2.6m.
    - Maximum height
        - The double decker city bus should not exceed 4.4m. However, for double decker city bus without a roof, its deck should not exceed 4m.
        - Passenger vehicle's maximum height should not exceed 3.5m.
        - The firefighting vehicle approved by MOI should not exceed 4.2m.
        - The other large vehicle of various categories should not exceed 3.8m.

How are these maximum permissible dimensions regulated, controlled and monitored?

- Regulations:
    - Vehicle Safety Testing Directions: 2. The requirement of specification for motor vehicle.
    - Road Traffic Safety Regulations, Subparagraph 1, Paragraph 1, Article 38.
- Control: According to Road Traffic Safety Regulations article 17, the vehicle should apply for the tests conducted by technical services or certification institution to acquire test reports according to the Vehicle Safety Testing Directions, proceed with the application toward certification institution and acquire the Vehicle Safety Type Approval Certificate. They should apply for registration, inspection and get the new license plate from the motor vehicle authorities.
- Supervision: Road Traffic Safety Regulations Article 39, Article 39-1.

Describe the measures for penalties and remedies for vehicle overloading. Who is responsible for compliance (driver, vehicle owner, transport company, others)?

- According to Road Traffic Management and Penalty Act Article 29, Article 29-1, Article 29-2, the measures are listed below:
    - The driver should be fined and charged with 2 traffic violation points
    - The vehicle's owner should be fined and charged with 1 traffic violation.

- If the overload weight under gross weight 20%, the driver should be redistributed immediately within 2 hours. Otherwise, it could be paid consecutive penalties. If the overload weight exceeds over 20%, the government will prohibit it from driving.
- The vehicle owner is responsible to ensure the heavy duty truck carries goods and should conform with the regulations.

Do you use on-road enforcement to reduce the incidence of overloading and poorly loaded heavy vehicles? Please describe these operations.

- Highway sector: According to Road Traffic Management and Penalty Act, Article 7, traffic condition inspection and traffic violation recording should be conducted by traffic police officers or personnel conducting traffic inspections pursuant to laws. If the drivers violate the regulations for loading of goods, they should be charged in accordance with Road Traffic Management and Penalty Act Article 29, Article 29-1, Article 29-2.
- Freeway and Expressway sector:
    - Goods loading:
        - Freeway and Expressway Traffic Control Regulations, Subparagraph 1, Paragraph 1, Article 21. The loading of cargo by the trucks running on freeways and expressways should comply with following regulations: Cargo should be tightly covered, sealed and fastened. Any granules (such as gravel) should be tightly covered and may not exceed the height of the carriages.
        - Road Traffic Management and Penalty Act, Subparagraph 2, Paragraph 1, Article 30. Car drivers shall be fined from NTD 3,000~9,000 (USD 100~300), be required to make corrections or be prohibited from driving in the event of any of the following conditions concerning the loading of goods: To carry goods that leaking, scattering, or spraying foul odour. For the serious situation, the penalty of irregularities is up to NTD 9,000(USD 300) since 2011/8/1.
    - The weight station:
        - Road Traffic Management and Penalty Act, Subparagraph 4, Paragraph 2, Article 29. If a vehicle driver carries goods to enter the road section within 5 km front of a weight station, he doesn't follow the instructions to enter the scales as provided by relevant road traffic signs, markings, signals, and given instructions by traffic police officers or personnel conducting traffic inspections pursuant to laws. The driver will be fined NTD 90,000 (USD3000) and forced to enter the scales.
        - Freeway and Expressway Traffic Control Regulations, Article 24. When any truck, coach, and link vehicle enter a weight station, it should observe the instructions of traffic signs, road markings and road signs. No emergency brake is allowed on the weight. Any parking or driving should follow the instructions of service staff or signs. If the loaded cargo exceeds the total allowed weight or the weight of total links by over 20%, the load cannot be redistributed immediately. If the owner fails to make amends after being reported to the competent authorities, there would be continuous penalties.

- Lane Usage: The provision of land usage in freeway and expressway is specified in Freeway and Expressway Traffic Control Regulations, Article 8. In addition to the temporary or movable signs set up for traffic accidents, road constructions and the instructions from traffic police on duty, drivers should observe the regulations stated on traffic signs, traffic marks and road signs when driving on freeways and expressways. Drivers should observe the following regulations if there are no established signs or instructions.
    - If there is a driver whose speed is below 80 km/h on the freeways and the speed limit is over 90 km/h, or whose speed is below 70 km/h on the expressways and the speed limit is over 80 km/h, they should keep running on the outside lanes. If they want to overtake other cars, they can drive to the inside lanes.
    - Large vehicles should run on the outer lanes. They can drive to the outer lanes temporarily if they want to overtake the other vehicles in front of them.
    - The inside lanes are passing lanes. However, small vehicles may drive on the inside lanes within the speed limit specified for the road sections as long as they do not block the traffic.
    - Large cargo vehicles and trailers should run on the outer lanes when they run on steep and downward slopes. They are not permitted to change lanes unless special situations happen.
    - When the vehicles run at the speed lower than the minimum speed limit on the climbing section, they should stay on the climbing lanes. They are not allowed to change lanes unless special situations happen.
    - Towing vehicles should stay on the outside lanes and must not change lanes unless there is a special situation.
- Small vehicles may be exempt from the restrictions of Article 1 and Article 3 if traffic is jammed. Ambulances, fire engines, police cars, engineering vehicles and recovery vehicles are not subject to the aforesaid speed limit when they are executing tasks. However, they should install obvious warning signs as stipulated.

Do you have controls or limits in place to restrict heavy vehicle access to certain roads? If yes, please provide a brief description of these measures.

- Highway sector: Carrying goods that exceed the weight, length, width, and height limits should apply for permission from the roadway supervisory authority in advance. The vehicles carry goods should comply with the related regulations. Road and bridge maintenance should be in accord with Specification of the highway route design.
- Freeway and Expressway sector: When traffic accidents happen, the accidents occurred by large cargo vehicles will be more serious than other kind of vehicles, the stopping distance of large cargo vehicle has to be longer. In that case, large cargo vehicles have to be controlled in more aspects and listed below.
    - Speed Limit: the maximum speed limit for large cargo vehicle (more than 20 tons) is 90km/h, and the minimum speed limit is 60km/h.
    - Lane Usage: large cargo vehicles can only run on the outer lane, but they still can run on the left lane when an overtaking driving is needed.

    - No Entering Route: some roads like the Hsueh-Shan Tunnel (12.9km), and freeway No.1 Xizhi-Yangmei Elevated Road (paralleling to the plane of freeway No.1).

- It is danger if the goods falls from large cargo vehicles on the freeway, so there has penalties for the unsafe loading, overloading, etc. The National Highway Police Bureau is responsible for the enforcement.

- There are 44 weight stations for managing the large cargo vehicles on the freeway.

Do you collect and analyse information on the status of bridge infrastructure and have a program in place to monitor bridge loading capacity? Please describe these technologies and their use.

- Institute of Transportation implemented the "Taiwan Bridge Management System" for people to inquire the information about bridge.

- Directorate-General of Highways implemented the "Taiwan Bridge Management System" to inquire the capacity of bridges, and control the aggregated weight of passing-by vehicles.

Do you capture and analyse data to inform policy development to mitigate overloading or incorrectly or unsafely restrained loads on heavy vehicles? If yes, what methods do you use to measure the impact?

- Highway sector: None. According to the preliminary research for road's pavement, if the loading is heavy-duty or incorrectly, it may increase 10% of axle weight and decrease the life span of road by 18%. If it increases 20% of axle weight, the life span of road will decrease 31%.

- Freeway and Expressway sector: Based on the statistics for freeway traffic accidents, Taiwan Area National Freeway Bureau (TANFB) makes some suggestions to Ministry of Transportation and Communications (MOTC). After drawing up the policy, TANFB continuously analyses whether the large cargo vehicles' overloading problems has been improved or not.

- Maritime Port area sector: In order to solve the problems of overload imported containers in Taichung Port, a report titled "Planning of setting the public weigh bridge within Taichung Harbor" was finished in 2015. The above mentioned report revealed that there was only 1.85% of overloaded container and the cost was too high. Maritime Port Bureau (MPB) then sets the "container weight query system" for the container haulage company to inquire container weight in advance, so they are able to arrange appropriate vehicles to reduce the overloaded container problems.

Do you use technology to measure the problem (or example, weigh stations, weigh-in-motion facilities and other pavement detectors)?

- Highway sector:

    - Fixed weighing stations: As the mobility of manpower isn't efficient and the fee is very high, it is easy for the drivers to bypass other roads to dodge weighting. Therefore, it's merely set up on the road for dump trucks, and steel factories.

    - Weigh-in-motion facilities: It takes a long time to calculate after weighing loads of each axle, and it is inaccuracy. Because the road surface is uneven, the weigh-in-motion facilities can be damaged easily by the overloaded vehicles.

- Freeway and Expressway sector: There are 44 weight stations on the freeways. The large cargo vehicles should follow the signs to weigh, if overloading is detected, they have to pay the penalties.

- Maritime Port area sector: According to the report “Planning of setting the public weigh bridge within Taichung Harbor ", the best solution is to set up dynamic weigh bridge. However, it does not worth because the cost is too high. Maritime Port Bureau (MPB) sets the "container weight query system" for the container haulage company to inquire container weight in advance, so they are able to arrange appropriate vehicles to reduce the overloaded container problems.

What, if any, measures do you take to educate transport department officials and those working in the transport industry on their responsibilities to reduce the incidence of overloading and poorly loaded heavy vehicles?

- Highway sector:
    - According to the Highway Act, the Regulations for Automobile Transportation Operators and the Motor Vehicle Business Operation: Regulations for Review and Approval to regulate Automobile Cargo Transportation Business, Automobile Cargo Transportation within Designated Route(s) Enterprise" and "Container Truck Transportation Enterprise". Each area of Motor Vehicles Office which belongs to Directorate General of Highways dominate management and assistance of relevant companies, monitoring companies. They manage vehicles, drivers and employees to take their responsibilities. If the performance is bad, and they interrupt the public interest or traffic safety, they have to modify based on above regulation in a specific period. If it can’t work out before the due date, the government can cease part of its business immediately. If they still not modify yet in 1 year, the government could revoke the license of Automobile Transportation Operators.
    - “Improving Highway Traffic Order and Safety Projects” was launched to process with “Supervise Plan for Dump Truck Cargo Transportation Business”. “Strengthening Nationwide Road Safety Action Plan” was processed to implement inspection for all categories vehicles and strengthen educational training on drivers.
    - Drivers who don’t conform to the regulations will get a ticket, and be asked for modifying in a specific period of time. In case the heavy-duty vehicles are still incorrect or unsafe, the owners could be fined and charged with violation by police according to the Road Traffic Management and Penalty Act, Article 29-2.
- Freeway and Expressway sector: TANFB endeavour on safety educations a lot, and requests for the freight association to require their drivers to load safely. When the police inspect in the weight stations, they also check the goods loading and teach them how to load safely.
- Maritime Port area sector: Maritime Port Bureau (MPB) sets the "container weight query system" for the container haulage company to inquire container weight in advance, so they can arrange appropriate vehicles to reduce overloaded container problems. Moreover, they deliberate on the feasibility of enforcement to set up dynamic weigh bridge before laden truck departure from port area and reduce the impact of road safe by the overloaded container effectively.

Have you evaluated any of the above measures (regulatory, enforcement, educational)?

- Highway sector: Each regional Motor Vehicles Office which belongs to Directorate General of Highways is in charge of the management and assistance of relevant companies, and

monitoring companies. They have to manage vehicles, drivers and employee to take their responsibilities. They invite all variety of unions in his area to hold an administrative affairs and driving safety seminar every half year. In addition to assigning employees to participate in a variety of congress, directors and supervisors meeting of unions, it's important to promote every traffic policy and safety traffic education.

- Freeway and Expressway sector: TANFB continues to collect data on overloading of large cargo vehicles and watch whether the safety problems is improved or not.

Provide documentation that assesses the impact of measures and initiatives to reduce overloading or incorrectly or unsafely loaded heavy vehicles. It would be particularly useful if sections within the documentation relating to overloading or incorrectly or unsafely restrained loads on heavy vehicles were highlighted or identified in some manner. Please provide these as email attachments or with links to websites.

- According to Road Traffic Safety Regulations, Subparagraph 4, Paragraph 2, Article 83-1, THB shouldn't give permission if the carrying goods vehicles could damage roads and bridges.

Provide challenges, success stories and lessons learned on the regulation of heavy vehicles in your economy.

- Sand, stone or soil must carried by designated vehicle according to Road Traffic Management and Penalty Act, Paragraph 1, Article 29.
- According to Road Traffic Management and Penalty Act, Paragraph 2, Article 29, the provisions are listed below.
    - If the loads exceed the weight limit by no more than 10 tons, a fine of NTD1,000(USD33) should be charged for each exceeded ton.
    - If the loads exceed the weight limit by 10 to 20 tons, a fine of NTD2,000 (USD67) should be charged for each exceeded ton.
    - If the loads exceed the weight limit by 20 to 30 tons, a fine of NTD3,000(USD100) should be charged for each exceeded ton.
    - If the loads exceed the weight limit by over 30 tons, a fine of NTD5,000(USD167) should be charged for each exceeded. Fractions of 1 ton should be rounded up to 1 ton.

Economy: Hong Kong, China

Provide a broad summary of your economy's heavy vehicle industry.

- market size: Approximately 43,000 vehicles
- the role and importance of heavy vehicle road transport in your economy: Mainly for ground handling of air cargo and container freight
- the roles of responsible agencies: Vehicle licences issued by Transport Department

Describe the agencies responsible for controlling overloading of heavy vehicles in your economy (road authority, traffic police, others).

- Traffic Police carries out road enforcement

Provide legislation relating to regulation of heavy vehicles, particularly for overloading or incorrectly or unsafely restrained loads.

- regulations and regulatory instruments: Road Traffic (Traffic Control) Regulations
- documentation outlining compliance and enforcement penalties: "Code of Practice for the Loading of Vehicles" issued

What are the regulations to control load distribution on vehicles in your economy?

- General requirement in Road Traffic (Traffic Control) Regulations to ensure no danger is caused by distribution and adjustment of the load

Provide any documentation, such as codes of practice or industry guidelines that assist in the interpretation of, and compliance with, the above legislation.

- "Code of Practice for the Loading of Vehicles" http://www.td.gov.hk/en/publications_and_press_releases/publications/free_publications/code_of_practice_for_loading_of_vehicles/index.html

What is the maximum permissible single axle load of heavy vehicles in your economy in tonnes?

- 10 tonnes

What is your economy's maximum gross vehicle mass (GVM) in tonnes?

- 38 tonnes rigid; 44 tonnes articulated

What are the maximum permissible dimensions of heavy vehicles in your economy in terms of:

- maximum height of vehicles: 4.6m
- maximum width of vehicles: 2.5m
- overall length of rigid vehicles: 12m
- overall length of articulated vehicles: 16m
- overall length of combination vehicles: 16m

How are these maximum permissible dimensions regulated, controlled and monitored?

- Type approval; annual examination; road enforcement

Describe the measures for penalties and remedies for vehicle overloading. Who is responsible for compliance (driver, vehicle owner, transport company, others)?

- fine of $5,000 and on second or subsequent conviction to a fine of $10,000 and 6 months imprisonment; driver and owner may be liable

Do you use on-road enforcement to reduce the incidence of overloading and poorly loaded heavy vehicles? Please describe these operations.

- Carried out by traffic police. Vehicle may be directed to weighing stations

Do you have controls or limits in place to restrict heavy vehicle access to certain roads? If yes, please provide a brief description of these measures.

- By means of traffic signs

Do you collect and analyse information on the status of bridge infrastructure and have a program in place to monitor bridge loading capacity? Please describe these technologies and their use.

- (Under the purview of the Highways Department.)

Do you capture and analyse data to inform policy development to mitigate overloading or incorrectly or unsafely restrained loads on heavy vehicles? If yes, what methods do you use to measure the impact?

- Through analysis of traffic accidents, as required

What, if any, measures do you take to educate transport department officials and those working in the transport industry on their responsibilities to reduce the incidence of overloading and poorly loaded heavy vehicles?

- Industry newsletters