NHVR
National Heavy Vehicle Regulator

NTC AUSTRALIA
National Transport Commission

Heavy Vehicle Roadworthiness Review

Phase One - Report of Current Practice

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National Transport Commission and National Heavy Vehicle Regulator

Heavy Vehicle Roadworthiness Report of Current Practice

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Report outline

Title:	Heavy Vehicle Roadworthiness Report of Current Practice
Type of report:	Information paper
Purpose:	For information
Abstract:	This paper is the first step in a program of work being undertaken by the NTC and the NHVR to develop policy to improve the national heavy vehicle roadworthiness system. It provides a survey of current practice in heavy vehicle roadworthiness assurance, including maintenance management inspections regimes and accreditation schemes. A review of available literature and international practices is provided.
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For more information

For more information or to contribute to the review, email: RWprogram@ntc.gov.au. Any information or comment you provide will only be used for informing the NTC and the NHVR in preparation of their report and recommendations. Your contact details will only be used for the purposes of this Review and will not be disclosed to any other third party without your consent, unless required to do so by law.

Foreword

The National Transport Commission (NTC) is an independent statutory body responsible for developing, monitoring and maintaining uniform or nationally consistent regulatory and operational reforms relating to road, rail and intermodal transport.

The National Heavy Vehicle Regulator (NHVR) is Australia's first national, independent Regulator for all vehicles over 4.5 tonnes gross vehicle mass. It is responsible for administering the Heavy Vehicle National Law and the delivery of a comprehensive range of services including managing the National Heavy Vehicle Accreditation Scheme (NHVAS).

At the request of Australia's transport and infrastructure Ministers, the two organisations are working together to develop policy and implementable measures for a national heavy vehicle roadworthiness system. This is being achieved through a joint program of work that integrates and extends two projects that were already on the work programs of the two organisations – a review of heavy vehicle roadworthiness inspections by the NTC and a review of the operation of the NHVAS by the NHVR.

This report represents the current status of the first phase of that work, a survey of the available research and practices applied in Australia and internationally to ensure the roadworthiness of heavy vehicles on the road network. The report provides an overview of the diverse approaches used to achieve this outcome, as well as the complexity of the issues that an effective system of roadworthy assurance must address. It provides a factual basis from which to identify opportunities to develop policies and practical measures that can improve the level of roadworthiness of Australia's heavy vehicle fleet.

The report is published as a working document and will be updated as further data and information on current roadworthiness practices are obtained.

Executive summary

The overall purpose of the Heavy Vehicle Roadworthiness Program is to develop policy and implementable measures for a national heavy vehicle roadworthiness regime. The roadworthiness of an operator's fleet is integral to the safety of the public as a whole. Unsafe vehicles of any kind pose serious safety risks to heavy vehicle drivers and other road users and it is therefore important to ensure community confidence in heavy vehicle roadworthiness.

This paper is the first step in a program of work being undertaken by the NTC and the NHVR to develop policy and implementable measures for an effective national heavy vehicle roadworthiness regime. This paper outlines current requirements for roadworthiness, including approaches to determining and rectifying unroadworthy vehicles. In this respect, the paper describes the roles and responsibilities of regulators and other parties in detecting and assessing the roadworthiness of vehicles, which differ across the states and territories.

While noting the findings of some previous studies by, and practices of, third parties, this phase one report does not attempt to draw any conclusion on the effectiveness or integrity of particular approaches to roadworthiness assurance. These matters will be addressed in the next report to be published under this review program.

Regulatory practices for inspecting, advising on and determining roadworthiness comprise three forms of compliance assurance activities:

- Mandatory periodic or change-of-ownership inspections of heavy vehicles by a regulator.
- Random and targeted compliance checks of heavy vehicles, including roadside checks by regulatory or authorised officers.
- Accreditation schemes, based on operators demonstrating through audit, that they are undertaking a robust system of heavy vehicle maintenance.

The type of roadworthiness assurance activities undertaken varies significantly between jurisdictions. Each jurisdiction has its own requirements for the circumstances in which a heavy vehicle must be inspected and by whom. In 2011, the NTC found that jurisdictional requirements for inspections varied in frequency, cost, delivery model, ease of compliance, inspection 'trigger', assessment methodology, and audit and control systems. Further, variation in the compliance inspection regimes was also evident when comparing Australian practices to those of some overseas countries and regions. Some of those regimes are discussed in the literature review provided in this report.

Many of the published studies reviewed concluded that a clear link between periodic vehicle inspections and specific improved road safety outcomes could not easily be established. However, a lack of evidence supporting the effectiveness of periodic inspections is not proof that they are ineffective. Some evidence from a review of light vehicle inspection regimes in New Zealand and Victoria showed a reduction in crash risk from increased vehicle inspection frequency, but this did not seem to be as significant a factor in crash risk as the age of the vehicle, or its owner. A more recent evaluation of the United States Federal Motor Carrier Safety Administration's program showed that crash rates for heavy vehicle operators who did not meet the vehicle maintenance standards were more than double the rate of those who met all standards.

The requirements for roadworthiness in the United Kingdom are intrinsically linked to their operator licensing scheme. In this respect their approach differs significantly from that in Australia. Although the fundamentals of regular and roadside inspections may be consistent, the issue of operator motivation is addressed in the United Kingdom through the link with operator risk scoring – in this respect it is in the operator's interest to ensure their vehicle is

maintained to a roadworthy standard. A poor operator risk score increases the likelihood that an operator's vehicles will be stopped for inspection.

The most frequent vehicle defects detected during roadside and periodic inspections were inadequate braking systems, deteriorations in the condition of tyres and lighting system faults. Research studies that are reviewed in the paper indicates there may be benefit in examining the development of roadworthiness assurance systems as a form of risk management in further phases of this Roadworthiness Program.

There are three systems of assuring the continual safety and roadworthiness of a vehicle, and it is these systems that will broadly underpin the discussion throughout the paper.

- *First party schemes* – the management and assurance provided by the regulated party for the roadworthiness of the heavy vehicles that they are operating.
- *Second party schemes* – assurance provided by government through inspection or other monitoring.
- *Third party schemes* – assurance provided by a third party that is authorised to exercise responsibility and make judgements, such as by way of an accreditation scheme.

Accreditation schemes (the third element of the roadworthiness framework) are described in detail in this report. The three heavy vehicle accreditation schemes of primary interest for this review are:

- *National Heavy Vehicle Accreditation Scheme (NHVAS)* – an audit-based compliance system administered by the NHVR.
- *Western Australian Heavy Vehicle* Accreditation *Scheme (WAHVAS)* – a mandatory scheme for B-doubles, road trains, restricted access vehicles and those operating on permits or concessions in Western Australia.
- *TruckSafe* – an industry scheme operated by the Australian Trucking Association primarily focused on improving road safety and business performance of operators.

The NHVAS enables operators to apply for accreditation under three modules, of which only the Maintenance Management Module is the subject of this Roadworthiness Program. Operators who are accredited to the Maintenance Management Module must be able to demonstrate their vehicles are continuously maintained in a safe and roadworthy condition.

To become accredited, operators must have a relevant maintenance management system and comply with the maintenance management standards that cover areas such as daily checks, fault reporting and fault repairs. Operators must be independently re-audited at regular intervals to demonstrate compliance with the standards to maintain accreditation. Under these conditions, operators are exempted from periodic vehicle inspections where they occur.

NHVAS is a 'third party', audit-based compliance scheme. Auditors are currently certified Exemplar Global, a body recognised by the NHVR to undertake accreditation audits of the operator's management system. The HVNL contains provisions allowing for the recognition of auditors, but provisions for the governance, accountability or liability of auditors are not included in the legislation nor the NHVAS Business Rules which set out the high level policies and process for the Scheme.

A key objective in the review of the NHVAS is to ensure the governance of any national scheme or its component elements will assure accountability, competence, capability and diligence of those involved in assuring heavy vehicle roadworthiness, and that the method of assessment actually assures roadworthiness. At this stage, data collection methods do not yield sufficient, reliable data to reach a conclusive determination about whether the NHVAS

provides an effective mechanism for achieving road safety outcomes relative to its objectives.

Phase two of the NTC/NHVR Roadworthiness Program will build from this summary of current status and develop options for an effective national approach to ensure the roadworthiness of Australia's heavy vehicle fleet.

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1. Introduction

Crashes involving heavy vehicles represent around 18 per cent of the deaths and 3 per cent of the serious injuries on Australian roads each year[1]. Collectively, these crashes are the result of a combination of factors including the decisions and actions of the people directly and indirectly involved in the crash, the physical conditions at the crash location and the mechanical condition of the vehicles involved. This paper is concerned with the mechanical condition of the heavy vehicles. It details the existing systems to ensure these vehicles are maintained in a roadworthy condition.

A roadworthy vehicle has all of its safety-related components maintained in a manner that makes it safe to drive on the road. The condition of a motor vehicle, in common with any other piece of machinery, will deteriorate through use. For this reason, the maintenance of heavy vehicles and their components is integral to ensuring safety on the roads.

This paper is the first step in a program of work being undertaken by the NTC and the NHVR to develop policy and implementable measures for an effective national heavy vehicle roadworthiness regime. This paper outlines current requirements for roadworthiness, including approaches to determining and rectifying unroadworthy vehicles. In this respect, the paper describes the roles and responsibilities of the NHVR and other regulators, vehicle registration agencies and other parties in detecting and assessing the roadworthiness of vehicles, which differ across the states and territories.

It must be noted that while this paper provides a survey of current practice in roadworthiness compliance assurance, it does not extend to assessing the relative effectiveness of different approaches.

Before a vehicle can be supplied to market on the road it must meet a minimum level of safety and environmental standards. Once the vehicle comes into service, its condition inevitably begins to decline. Wear and tear on moving parts, thermal stress and mechanical fatigue in parts, together with the corrosive effects of exposure to air and moisture all contribute to a vehicle's condition deteriorating.

To maintain a vehicle in a safe, roadworthy condition over its lifetime requires ongoing maintenance. All components of a vehicle have a finite lifespan and need to be assessed with sufficient frequency to allow for their replacement before they fail. For some components – such as tyres and brake pads – the amount of wear and likely effective lifetime remaining is readily apparent. Their decline in performance is relatively predictable and identifiable. For others – such as structural components that may be subject to stress fractures – deterioration may be difficult to observe, with no noticeable impact on vehicle performance until the point of catastrophic failure.

This paper considers schemes that are used to assure the continual safety and roadworthiness of a vehicle which are recognised under the Heavy Vehicle National Law (HVNL) and the other road laws of the states and territories. Their application comprises a focus for the Heavy Vehicle Roadworthiness Program and the review of the national heavy vehicle roadworthiness assurance system.

[1] National Road Safety Strategy 2011-2020.

2. Requirements for roadworthiness

This chapter describes the statutory requirements governing heavy vehicle roadworthiness including applicable standards and circumstances under which inspections may be undertaken. These are the current standards and regulatory practices which form the heavy vehicle roadworthiness assurance regimes in place, both under the HVNL and NHVR, and under the varying requirements of individual state and territory governments.

2.1 Heavy vehicle design and manufacture

As a prerequisite for being supplied to market, heavy vehicles in Australia must be designed and manufactured to meet the requirements of the Commonwealth *Motor Vehicle Standards Act 1998* (the MVSA), which in turn requires compliance with the Australian Design Rules (ADRs). The ADRs prescribe minimum standards for new vehicle safety and environmental performance.

The ADRs are developed for new vehicles (i.e. their design and manufacturer). They do not particularly address in-service roadworthiness matters (i.e. those relating to modification or deterioration of vehicle condition during its service life).

2.2 In-service requirements

Having met the requirements for being supplied to market, a heavy vehicle may be registered to be operated on public roads. At this point, it becomes subject to in-service roadworthiness requirements; themselves being the subject of this review. These requirements aim to ensure the vehicle continues to be maintained to a prescribed minimum standard of safety and environmental performance.

2.2.1 Vehicle registration

A current registration is a prerequisite for a heavy vehicle to operate on public roads. In turn, a condition of registration is that a vehicle continues to meet applicable roadworthiness requirements. This makes the administration of vehicle registration a tool for managing roadworthiness.

While work is underway to bring heavy vehicle registration under the HVNL and NHVR, it is currently administered by the individual states and territories under separate laws in each jurisdiction. An exception is the Federal Interstate Registration Scheme (FIRS), which is administered by the Commonwealth Government under the *Interstate Road Transport Act 1985* and administered by each state and territory on the Commonwealth's behalf.

2.2.2 Roadworthiness standards

Roadworthiness standards can be split into two categories, both of which must be met:

- The Heavy Vehicle Standards (as made under the HVVL).
- Any and all other aspects of a heavy vehicle's mechanical condition which may impact upon its safe use.

The first of those is prescribed in the HVNL under section 60(1), which states that:

> *'A person must not use, or permit to be used, on a road a heavy vehicle that contravenes a heavy vehicle standard applying to the vehicle.'*

The Heavy Vehicle (Vehicle Standards) Regulation 2013 (Vehicle Standards) prescribe various elements of heavy vehicle design and construction, including the types of equipment that must be fitted and a number of performance standards. They also apply, or call up, on

an ongoing (in-service) basis, those new vehicle standards (ADRs) which applied when the vehicle was first supplied to market.

However, criteria for assessing roadworthiness are not restricted to the Vehicle Standards. HVNL section 89 (Safety requirement) states that:

- A person must not use, or permit to be used, on a road a heavy vehicle that is unsafe.
- The second category describes a range of criteria for a heavy vehicle's mechanical condition which impact on its safety, but which are not addressed by the HV Standards. Examples include fuel and oil leaks, and worn suspension components. Section 89 authorises the NHVR to use judgment in developing and assessing these criteria (i.e. beyond which is prescribed in the HV Standards).

These criteria are inherently more subjective than those prescribed in the Vehicle Standards. To help clarify them, the NHVR has developed a Heavy Vehicle Inspection Manual (HVIM). It outlines consistent practical steps for a heavy vehicle inspection, establishing nationally consistent criteria for heavy vehicle roadworthiness. The manual comprises 15 sections, covering relevant parts and different types of heavy vehicles.

Notwithstanding the legal requirements that must be met, in a practical sense a roadworthy vehicle is one that has all of its safety-related components maintained in a manner that makes it safe to drive on the road. The purpose of any effective roadworthiness regime is to assure compliance with regulations, as well as manage the risks that may lead to a vehicle being used on the road when it does not meet this general definition of roadworthiness.

2.3 Threshold approach to vehicle condition deterioration and its management

Roadworthiness is defined in an absolute sense; that is all elements of a heavy vehicle must be assessed as roadworthy. In practice, components wear progressively and occasionally fail without apparent warning. Operators must ensure that components do not:

1. Wear beyond an unroadworthy threshold (for example, tyre wear, hydraulic or pneumatic leaks and worn suspension bushes).
2. Fail catastrophically[2] without practicably detectable signs of wear (for example, re-treaded tyres delaminating suddenly or suspension leaf springs fracturing.)

Any maintenance regime should be based on the first principle, which is ensuring component wear does not reach or exceed an unroadworthy threshold. However, the subjective nature of defining such a threshold may pose a challenge. The second principle is more difficult for operators to prevent. While regular inspections may reduce the incidences of such catastrophic failures, some are difficult to detect before they occur. While component age or service duration is often a risk factor, a general replacement regime is typically cost-ineffective.

Three categories or stages of unroadworthiness on a heavy vehicle are:

1. Before it reaches an unroadworthy state.
2. After it reaches that state, but before it is detected as such.
3. After it is detected as such, but before it has been rectified.

[2] *Catastrophic* here refers to the nature of component failure (i.e. suddenly), not the severity of consequences for safe operation of the vehicle. Many catastrophic failures (such as a failed light globe filament) have relatively benign implications on road safety.

These stages help illustrate the gap between views of roadworthiness in a strict compliance sense (that is, unroadworthiness of a heavy vehicle as a threshold beyond which may be assessed as evidence of wrongdoing) and that of roadworthiness as a safety management process. In the latter case, roadworthiness is supported by a maintenance process with more strategic objectives. These may ideally incorporate minimising the frequency, severity and exposure of unroadworthy components on a heavy vehicle, with a focus on minimising associated risks to safety.

2.4 Roadworthiness assurance measures

Perhaps the greatest challenge around heavy vehicle roadworthiness – and a major focus of this review – is establishing the optimum means of ensuring continued roadworthiness. This is not merely compliance with regulatory requirements, but also requires the management of the relevant risks that may cause a vehicle to become mechanically unsafe, may cause a defect to remain undetected, and may cause a vehicle to remain unsafe for an ongoing period.

The overall system of managing these risks contains many layers – daily vehicle checks, a driver's observations of vehicle performance, routine vehicle maintenance, inspections mandated by company safety management systems, accreditation schemes, registration requirements, and roadside inspections. These can all contribute to reducing the risk that a vehicle will be used on the road in an unroadworthy condition. Within the structure of a safety management system of the type described by Reason[3] each of these layers has a role to play in reducing the overall risk, despite each having limitations.

The major assurance measures and their governance are described here.

2.4.1 Institutional arrangements for inspections

Responsibility for heavy vehicle inspections may be broadly categorised in three ways.

- **First party schemes** – the management and assurance provided by the regulated party for the roadworthiness of the heavy vehicles they are operating. These schemes rely on business practices and commercial incentives, complemented or underpinned by regulations imposing legal accountabilities.
- **Second party schemes** – assurance provided directly by government officers (i.e. through inspection or other monitoring). A second party scheme may rely on outsourcing or delegation of some inspection or monitoring activities.
- **Third party scheme** – assurance provided by a third party who is authorised to exercise responsibility and make judgements on behalf of the regulating authority, such as by way of an accreditation scheme.

The responsibility for ensuring a heavy vehicle's roadworthiness principally falls on its operator – a first party model. However, this model alone does not provide sufficient assurance to the public that the responsibility is being met. The conventional and predominant model for providing the latter is under the second party model (i.e. government / regulator-appointed inspectors checking heavy vehicle roadworthiness (or that the first party model is functioning effectively).

A growing heavy vehicle fleet, combined with constraints on government resources to support the second party model and some question about its cost-effectiveness, together with demand by industry members for greater degrees of flexibility, have driven a shift towards greater use of the third party model.

[3] Reason, J. (1997) *Managing the Risks of Organisational Accidents*, Ashgate Publishing Company.

2.4.2 Parties to the roadworthiness system

A number of parties operate within the roadworthiness system, including operators and drivers.

- **Operators** are those who manage the heavy vehicles under their control. Operators are directly responsible under the HVNL for the roadworthiness of their heavy vehicles. More detail on the role of operators is provided in the next section. Operators can be:
    - Hire-and-reward owner-operators – individuals who drive and maintain a heavy vehicle they have purchased or procured. These operators offer transport services to customers for a fee.
    - Hire-and-reward, non-driving operators – individuals or organisations who are the operators of heavy vehicles, but who do not drive them. Most commonly these operators employ multiple heavy vehicles from several to hundreds.
    - Ancillary operators – operators of heavy vehicles for reasons other than hire-and-reward, such as to service a business other than transport. Ancillary operators carry their own freight and include farmers transporting primary produce.
- **Drivers** are those who drive heavy vehicles. Drivers may be owner-operators (in which case they are both the driver and the operator), or may be employed by an operator:
    - The roadworthiness of a vehicle and its potential on-road safety is a direct concern for drivers. However, where they are not the owner of the vehicle they may be limited in their influence over the maintenance regime of the vehicle they drive.

Other parties that are not necessarily directly included under the HVNL include maintenance providers and customers.

- **Maintenance providers and repairers** undertake maintenance work on heavy vehicles at the request of customers, in this case operators. While the HVNL does not cover the roles and responsibilities of maintenance providers and repairers, other laws do. However, maintenance providers and repairers should be aware of and apply the requirements of the Vehicle Standards and other applicable standards as required by the HVNL.
    - Maintenance providers and repairers may be directly employed by a transport operator (in-house) or third parties. An in-house maintenance provider may also be the owner-operator who maintains their vehicle, in which case they would be subject to the HVNL by way of their role as operator.
- **Freight customers** are those whose goods are being carried by heavy vehicles. These parties will generally rely on the operators to ensure the roadworthiness of their vehicles. Under the HVNL, freight customers may have some obligations regarding the condition of a heavy vehicle in relation to its mass, dimensions or loading, due to their role as either consignor or consignee; however, these obligations do not extend to issues of maintenance and roadworthiness.

A number of government organisations share a role in developing and applying laws relating to heavy vehicles. These include:

- **The Commonwealth Government** is responsible for regulating the technical safety standards for new vehicles through the Australian Design Rules (ADRs). The ADRs

are national standards for vehicle safety, anti-theft and emissions, and cover performance standards such as occupant protection, structures, lighting, noise, engine exhaust emissions, and braking.

- **The National Heavy Vehicle Regulator (NHVR)** develops and implements compliance and enforcement strategies, including those applicable to heavy vehicle roadworthiness, and funds the work of authorised officers ('transport inspectors') across its participating jurisdictions.

- **The state and territory road or transport agencies** are currently responsible for managing heavy vehicle registration and, in the process, determining the roadworthiness of a vehicle prior to registration. For this reason, jurisdictional roadworthiness requirements are an essential element of any future national scheme for roadworthiness. Currently, the standards required for vehicle registration vary across the jurisdictions, which require consideration going forward. These differences are outlined at section 10.2 of this report.

- The HVNL authorises state and territory police officers to manage compliance and enforcement of heavy vehicle roadworthiness. In conjunction with the NHVR's authorised officers, police undertake roadworthiness inspections, such as at the roadside or sometimes at off-road sites.

2.4.2.1 The role of heavy vehicle operators

It is the role of heavy vehicle operators to undertake maintenance of their vehicles in order to achieve commercial objectives and meet their compliance obligations under the HVNL and other relevant road transport laws. In this respect, the roadworthiness of a heavy vehicle is the legal responsibility of the operator.

It is also in the operator's interest to maintain the roadworthiness of their heavy vehicles to ensure their continued commercial operations. This may be independent to any consideration of their obligations under roadworthiness provisions of the HVNL. However, the same commercial objectives can, at times, lead to non-compliance with roadworthiness requirements. This is due to the perceived gap between the concept of roadworthiness as a standard necessary to support business operations and one as a standard mandated by law; the latter as defined in the HVNL.

Heavy vehicle operators may approach vehicle maintenance in a number of ways. They may outsource maintenance tasks to third party providers, either in its entirety or outsourcing elements of the maintenance task only. Or they may undertake in-house maintenance of heavy vehicles, which may be more economically viable for an operator with a larger fleet of vehicles.

In developing national policy settings for heavy vehicle roadworthiness, including inspection regimes and accreditation, consideration must be given to how these settings may impact the various types of operators within the industry.

2.4.2.2 Interaction with drivers

Although they may not be directly responsible for heavy vehicle maintenance under the HVNL, drivers have relevant insight into a heavy vehicle's condition and roadworthiness. Potential roadworthiness issues can be identified during driving, and therefore operators should account for driver feedback as a source of information on vehicle condition.

Daily checks of vehicle roadworthiness are a requirement for vehicles operating under the maintenance module of NHVAS, and are often carried out by the driver. Any relevant information is passed on to the service manager or third party repairer as appropriate.

Addressing maintenance issues that may arise on-road may be more problematic, as drivers may be lacking in authorisation or funds to make these improvements. Other factors may also influence a driver's ability to address issues on-route, such as scheduling and fatigue requirements.

In these respects, the driver is the party most likely to be directly impacted by roadworthiness and any associated issues. Where roadworthiness, or lack thereof, is attributed as a cause of a crash, the driver is the most likely victim.

In theory, a driver may refuse to drive a heavy vehicle they believe to be unroadworthy. However, in practice there may be pressure on the driver from their employer or contractor to continue driving the vehicle, placing their job security or contract at risk. Some drivers have reported difficulties in gaining the support of their employers or contractor in attending to issues of roadworthiness.

2.4.3 Maintenance scheduling by operators

While not required by the legislation, the scheduling of maintenance in accordance with advice from heavy vehicle manufacturers provides a common model for operators for maintaining roadworthiness. Although it cannot be guaranteed, an operator that adheres to the recommended service schedule will often be well prepared when its vehicle is required for inspection under the law.

These schedules are prescribed in the paperwork issued by manufacturers, such as service manuals accompanying the sale of a new vehicle. They reflect the manufacturer's assessment of the frequency with which various components of a given model should be inspected and/or replaced, and are typically grouped into periodic service schedules, per classes A to C in the list below.

- **Class A** – minor service every 20,000 km (with every second service undertaken as a class B).
- **Class B** – intermediate service every 40,000 km.
- **Class C** – major service every 100,000 km.

As they are not a statutory requirement, the extent to which these schedules are followed may vary. Where the warranty of a new vehicle is conditional upon a specified maintenance regime the operator may be encouraged to follow that regime more strictly. Alternatively, an operator's competitive advantage may derive from having very precise management of their service intervals, which may depart from manufacturers' recommendations while still maintaining the vehicle in a roadworthy condition. It is also worth noting that the rate at which various components will require maintenance is dependent on three factors – usage, environment, and distance driven. For example, brakes on a heavy vehicle that is stopping frequently are going to require maintenance at more regular intervals than on a vehicle that is travelling longer distances (such as line haul) and not stopping as frequently.

The frequency of A, B and C maintenance varies depending upon the severity of service and according to the operator's experience and preferences. Some operators enter into programmed maintenance agreements with the original equipment suppliers or their agents. Consequently vehicles can be maintained routinely and at regular intervals by service workshops that are affiliated with the OEM manufacturer. Service records are kept by the third-party workshop.

There are evidently different approaches to maintenance and repairs as follows:

- *Programmed maintenance conducted by third party workshops* – maintenance is carried out according to a distance-based schedule that has been agreed by the service provider and the fleet operator.

- *Regular maintenance conducted in-house* – maintenance can be carried out according to a distance-based or a time-based schedule developed by the operator.
- *Occasional maintenance conducted by third-party workshops or in-house* – maintenance is carried out when it is convenient to have the vehicle off the road.
- *Repair-driven maintenance conducted either in-house or by a third party workshop* – maintenance is carried out when a failure or repair imperative causes the vehicle to be in the workshop.
- *Basic lubrication maintenance conducted in-house* – simple maintenance involving greasing and oil-changes is routinely conducted. More significant maintenance, which cannot be done conveniently at the operators premises, is done when a need to have repairs done by a third-party workshop.

2.4.4 Inspection types

Broadly, these have been categorised by the circumstances in which roadworthiness inspections may be required:

- upon change in ownership of the vehicle
- at specified periods of time
- at random or targeted roadside inspections
- at targeted off-road inspections.

Additionally, roadworthiness inspections may be required in the following situations:

- clearing of defect notices
- where a vehicle registered (garaged) address has been transferred interstate
- where a vehicle's registration has expired.

2.4.4.1 Inspections at change in vehicle ownership

Some states and territories require roadworthiness inspections of heavy vehicles upon change of ownership. These serve as a form of consumer protection for the new owner, who may be assured of their newly acquired vehicle's roadworthiness. They also serve as a general form of quality control (or assurance) for roadworthiness of the heavy vehicle fleet. A heavy vehicle which does not change hands during its service life would never be subject to this type of inspection.

2.4.4.2 Roadside inspections

Roadside inspections are conducted by authorised officers and police, who intercept heavy vehicles being operated on-road. Broadly, intercepts are made in two ways:

- establishing a (temporary or fixed) checking station at a given location and diverting all or some heavy vehicles that happen to drive past
- intercepting individual heavy vehicles in moving traffic, where the inspector is also moving with traffic.

Roadside roadworthiness inspections tend to be predominantly visual checks, due to time pressures that apply in a roadside environment, and limits to available resources (human and technical). Some standards relevant to roadworthiness may require specialist knowledge to assess, while others may require particular testing equipment.

However, some enforcement agencies have access to mechanical testing equipment in roadside environments and are able to select a proportion of intercepted vehicles for this more rigorous testing.

2.4.4.3 Periodic inspections

A periodic inspection is one which a (heavy) vehicle is required under law to be submitted by its operator for on a regular, periodic basis. The inspection must be undertaken by a *second party* (an officer of the Regulator such as a vehicle inspector employed by the Regulator) or an authorised officer (a party authorised by the Regulator to undertake such inspections on its behalf (such as a licensed vehicle tester). It is typically undertaken in a controlled, off-road environment which allows for a more comprehensive inspection than a roadside inspection.

Typically, for the vehicle to be eligible for continued use on public roads, it must pass the roadworthiness inspection. The criteria for a pass, including the requirements for rectifying identified defects (such as whether a period of grace is granted, during which the vehicle may continue to be driver) may vary between different schemes.

A periodic inspection excludes regular inspections by the operator of a heavy vehicle undertaken in the course of their general maintenance program. While an integral part of general (first party) roadworthiness practice, the latter is not subject to the independent oversight as applies under a second party inspection regime.

There are two major objectives of periodic inspections:

- To ensure vehicles are certified as being in a roadworthy state at given points in time and will remain roadworthy for at least a period afterwards.
- To encourage operators to maintain a vehicle on an ongoing basis – knowing that maintenance could only ever be deferred until such time as the next periodic inspection.

The majority of Australian jurisdictions require periodic roadworthiness inspections, but the requirements are not consistent[4]:

- New South Wales, Queensland and the Northern Territory require annual inspections as part of the registration process, but grant exemptions to vehicles in an approved accreditation scheme with maintenance management.
- The Australian Capital Territory requires inspection every 2 years after a vehicle is 3 years of age.
- South Australia requires annual inspection only of restricted access vehicles, and only of those that are not in an approved accreditation scheme with maintenance management.

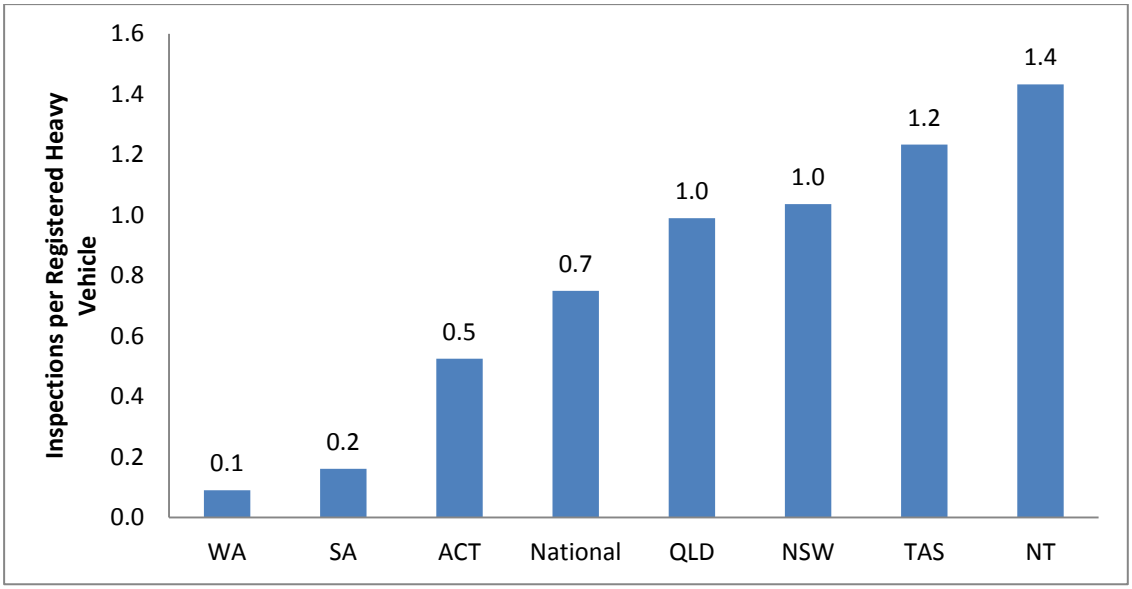
[4] The name given to the documentation for heavy vehicle roadworthiness varies between jurisdictions. For example:

- in New South Wales documentation is called a ‘heavy vehicle inspection report’
- in Victoria it is called a ‘certificate of roadworthiness’ and in Queensland, ‘a certificate of inspection’
- In South Australia and the Northern Territory, ‘vehicle inspection report’ is used and in Tasmania, ‘inspection report’.
- In the Australian Capital Territory and Western Australia, roadworthiness documents are called a ‘certificate of inspection’.

Victoria does not require periodic inspections, but does require an inspection be carried out when ownership is changed. Western Australia and Tasmania have no periodic inspection requirements applicable to trucks. Details of when each of the jurisdictions requires inspections are provided at Appendix A: Summary of heavy vehicle inspection arrangements in each jurisdiction.

Figure 1 compares the average number of periodic inspections that occur for every registered heavy vehicle (including trailers) per state and territory. However, differences in inspection regimes means the results differ across the jurisdictions.

Figure 1: Periodic inspections per heavy vehicle, per jurisdiction, 2007[5]



As Figure 1 demonstrates, a heavy vehicle in Western Australia would be, on average, be subjected to an annual inspection once every 10 years. This is due to the fact that only a subset of all (i.e. restricted access) heavy vehicles are required to participate in the Western Australian Heavy Vehicle Accreditation scheme[6] (WAHVA) and it is only those heavy vehicles which are subject to a minimum of one inspection every 3 years (i.e. more regularly than the broader Western Australia fleet-weighted average of 0.1 inspections per year).

By contrast and due to the mandatory periodic inspection regime in the Northern Territory, a vehicle registered there may be inspected more than once every year[7].

2.4.4.4 Targeted, off-road inspections

Under the HVNL authorised officers may request entry to premises for the purposes of inspecting an operator's heavy vehicles. They may also, including when such entry is refused, direct an operator to present a heavy vehicle(s) at a designated location for inspection. This type of inspection is most likely undertaken when there is probable cause to suspect a heavy vehicle may be unroadworthy.

[5] http://www.ntc.gov.au/filemedia/Reports/HVNatLawRISFINAL.pdf

[6] A detailed description of the Western Australian HVA is provided in section 3.2 Western Australia Heavy Vehicle Accreditation Scheme of this report.

[7] No data was available for the number of inspections conducted in Victoria.

2.4.5 Who may undertake second party inspections

The survey revealed that training received by authorised officers (including police) ranges from on-the-job training to formal TAFE courses. Qualified mechanics support police and authorised officers in certain road side operations. The range of training varies from on-the-job training in the Northern Territory to more involved training regimes. For example Tasmania's transport Inspectors are required to successfully complete in-house training modules that are associated with vehicle compliance within 6 months of appointment. Additionally, 18 Transport Inspectors are Certificate III trade-qualified (4-year training qualification) within a designated light vehicle or heavy vehicle automotive trade. Two Transport Inspectors are qualified in Certificate II Automotive Mechanical (AUR20705) which is a 340-hour training course with TasTAFE.

Accredited inspectors are subjected to audits that monitor the quality of the work done, and any accredited inspector may be audited if there are complaints or requests from ministerial offices. Audits focus on compliance against the relevant inspection manual and thoroughness of work through observation and quality documentation. In Western Australia, accredited inspectors are checked by the AIS quality team and in Victoria, by VicRoads under the Victorian licensed vehicle testers' scheme.

Adverse findings from audits generally act as a trigger for authorised officers to be required to undertake refresher training. For accredited inspectors, the ramifications can be more significant, ranging from sanctions to cancellation of licence.

Tasmania	Transport Inspectors are required to successfully complete 10 in-house training modules associated with vehicle compliance. This is completed within 6 months of appointment. Additionally, 18 Transport Inspectors are Certificate III trade-qualified (4-year training qualification) within a designated light vehicle or heavy vehicle automotive trade 2 Transport Inspectors are qualified in Certificate II Automotive Mechanical (AUR20705) which is a 340-hour training course with TasTAFE.
Western Australia	Road Transport Compliance Officers – Initial training over 6 months involving theory and hands on. Some inspectors originate from a mechanical background other trained to 'initial response' level. Six months covers all aspects of the inspector role. Training provided covers on road inspections only. Department of Transport Vehicle Inspectors – One week of training plus ongoing supervision for an extended period, until deemed competent by supervising staff. Authorised Vehicle Inspector – A trade certificate in Heavy Vehicle Mechanics, Mobile Plant or the vehicle class equivalent is required before entering the training program. The program involves one week of training, including four days of theory and one day in the workshop. A further week of training is undertaken at the worksite supervised by an experienced Department of Transport Vehicle Inspector.
Victoria	Four-week TAFE Qualification.
Northern Territory	On-the-job training for transport inspectors and police.

New South Wales, Australian Capital Territory, Queensland, South Australia	No information currently available.

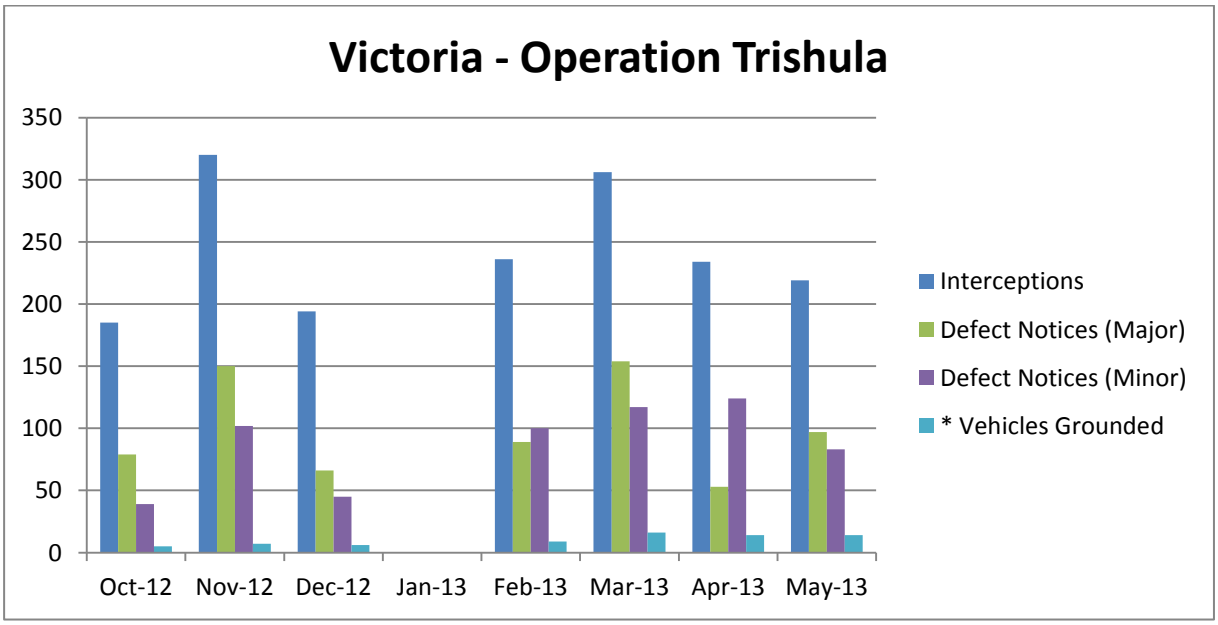
Across the states and territories, second party inspections are delegated between government and (licensed) private institutions, such as:

- Victoria delegating the entire second party (heavy) vehicle inspection regime to licensed private inspection providers (mechanical workshops).
- New South Wales delegating some of the inspection task for predominantly smaller heavy vehicles (nominally those under 12 tonnes Gross Vehicle Mass) to private inspection providers, with larger heavy vehicles required to be inspected by and at government inspection facilities.
- South Australia delegating the entire heavy vehicle inspection task to government inspectors.
- Western Australia currently only operates a single government Vehicle Examination Centre with a limited capacity for mobile inspections. The majority of vehicle examinations are completed by the private sector at Approved Inspection Stations. The Department of Transport oversees the quality of inspections with regular data audits and annual on-site audits.

These differing approaches to second party inspections impact on governments and operators in different ways. A significant impact on governments of operating their own inspection facilities is the demand on resources. This includes the cost of owning and operating them and also the diversion of human resources (skilled inspectors) away from other potential roles (such as roadside inspections). A factor in why governments have, to varying degrees, elected to retain direct control of heavy vehicle second party inspections is the need for them to exert influence over their quality and integrity.

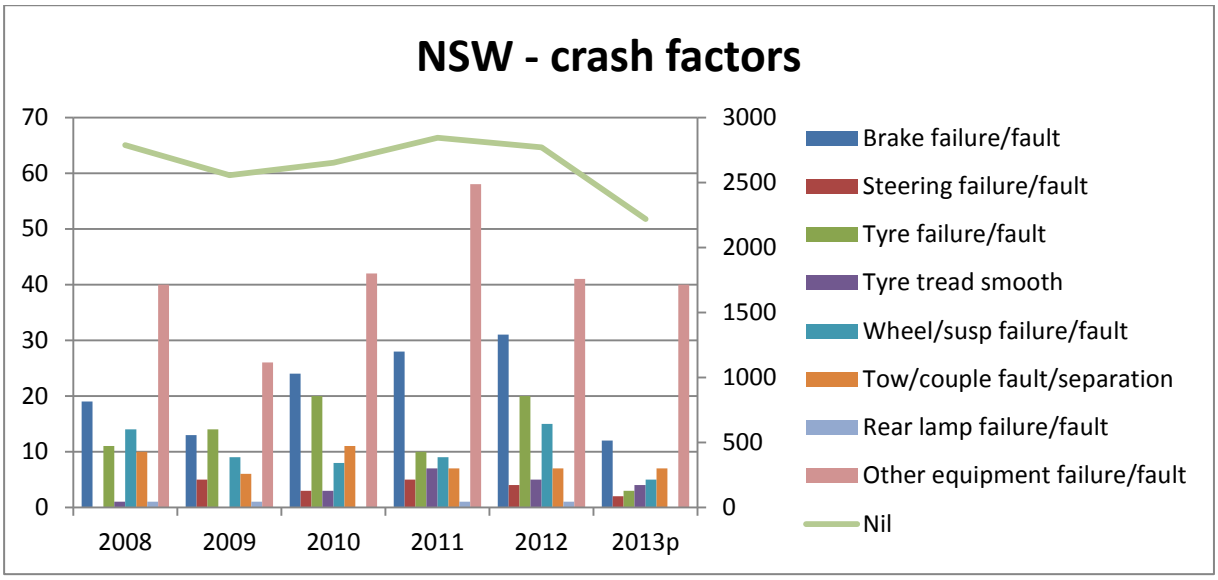
2.4.6 Inspection results and defect patterns

Figure 2: Operation Trishula – Victoria



* Vehicles Grounded (Mechanical Condition only). Does not include vehicles grounded for being Unregistered or Driver being unlicensed, disqualified, etc

Figure 3: Crash factors by type – Victoria



- Other equipment failure/fault includes overloading and incorrect loading.
- 'Nil' indicates that the accident was not caused by the criteria listed.

The data received from jurisdictions broadly corresponds with the findings from the literature survey in attributing faulty brakes, tyres and wheels as common factors in vehicle crashes. There are no standards for data collection and not all of the data collected can provide detail on individual crash factors. As Figure 3 shows, New South Wales has comprehensive data in regards to crash factors.

Data from other jurisdictions is presented in the appendix, showing the number or crashes and the main crash factor (mechanical). The data indicates that heavy vehicle crashes attributed to mechanical failure are below 5 per cent.

2.4.7 Issuing and managing vehicle defects

Defect notices are issued to heavy vehicles assessed by officers as unroadworthy. The HVNL authorises officers to issue major or minor defect notices, with:

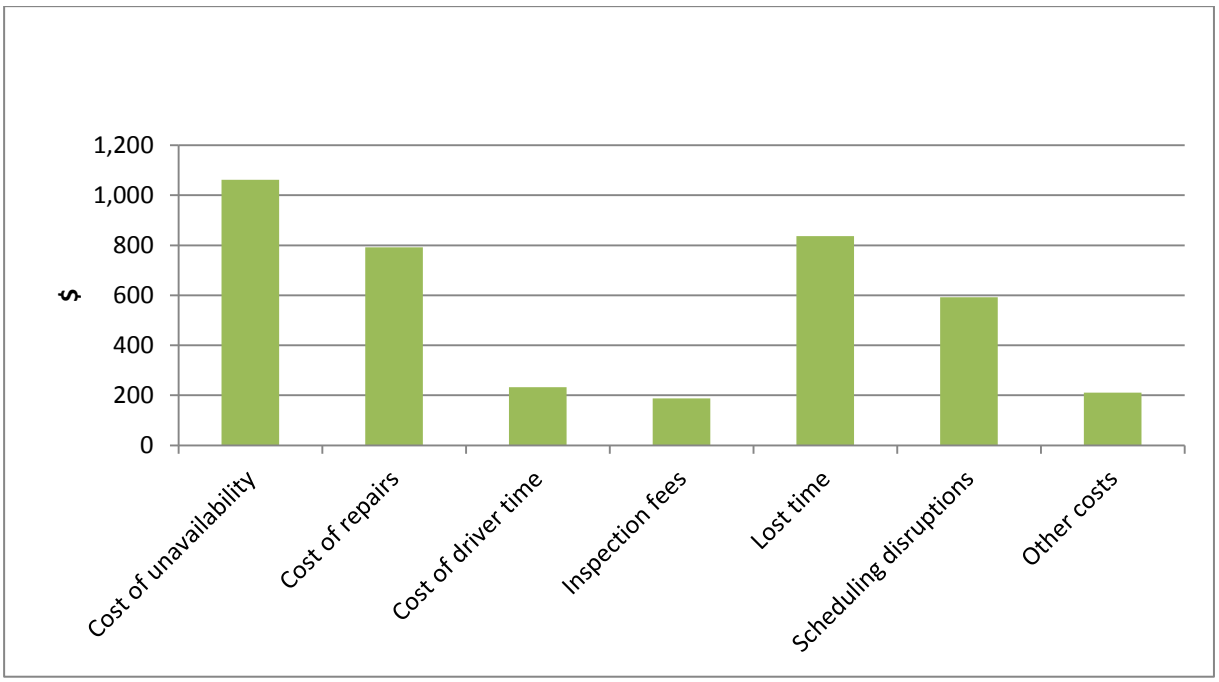
- **Major defects** deemed as those posing 'an imminent and serious safety risk' and resulting in the vehicle being prohibited from further use, other than as permitted by the issuing officer (such as for transport to a repairer).
- **Minor defects** deemed as those not constituting major defects and with a period of time granted to the operator to rectify the defect, during which the vehicle may continue to be operated.

Consultation suggests that determining criteria for distinguishing between major and minor defects is principally the responsibility of the individual officer. Industry members have expressed concerns over reported inconsistencies in how these (subjective) criteria are applied.

2.4.8 Second party inspections costs

A survey of heavy vehicle operators found the costs of the driver and vehicle unavailability represent the largest reported regulatory burden from regulatory required inspections (see Figure 4).

Figure 4: Costs per vehicle of an inspection for regulator required inspection ($)



- The average costs are reported as $1,062 (90 responses).

2.4.9 Accreditation

Accreditation and particularly that under the National Heavy Vehicle Accreditation Scheme (NHVAS) was conceived as a means of providing heavy vehicle operators with a means of demonstrating compliance with elements of heavy vehicle law, including vehicle roadworthiness / maintenance. Accreditation is granted to operators who have demonstrated that they have implemented a management system considered capable of effectively maintaining their heavy vehicles.

Chapter 8 of the HVNL prescribes requirements for heavy vehicle accreditation. It is under this framework the various accreditation modules, including for NHVAS maintenance management and the associated business rules for granting, maintaining and auditing an operator's accreditation are made.

A more detailed description of accreditation, under the NHVAS and other schemes, is included in Chapter 3 (

Heavy Vehicle accreditation schemes) of this report.

2.4.10 Heavy vehicle modifications and crash repairs

While much attention on heavy vehicle roadworthiness has focused on matters of general deterioration (such as worn tyres and brakes) the roadworthiness of modified and crash-repaired heavy vehicles also requires oversight. All states and territories administer schemes under which modifications or repairs beyond a given threshold are required to be

inspected. The purpose of the inspection is to certify the quality and safety (roadworthiness) of the modification / repair.

These schemes are relevant to a general roadworthiness regime in that (second party) inspections serve as a means of assuring that an operator has submitted their vehicle for certification of a modification / repair. The schemes also serve an important role in providing evidence to inspectors that a modification or repair has been undertaken to a sufficient standard.
The specific design details of each state and territory scheme vary. They may be summarised as varying to different degrees. While the development of a national code for heavy vehicle modifications[8] has supported greater harmonisation, the administration of (what are commonly known as engineering signatory) schemes continues to vary.

2.4.11 Compliance and enforcement powers under the heavy vehicle law

Division 6 of Part 9.3 of the HVNL provides authorised officers and police with the power to issue defect notices for vehicles:

- that contravene the Vehicle Standards
- that do not perform as prescribed
- that have deteriorated to the extent that their function cannot be reasonably relied on
- whose use poses a road safety risk.

Division 6 lists a number of offences applicable to the use of a defected vehicle, and also provides the NHVR with the power to clear a defect notice.

Section 731 of the HVNL provides for the development of national regulations applicable to approved vehicle examiners. These would permit the approval of classes of vehicle examiners permitted to inspect vehicles for the purposes of the HVNL. These would also define the roles and responsibilities applicable to such parties.

Additionally, section 522 of the HVNL permits the power to order presentation of a heavy vehicle for inspection purposes. This may be exercised where the authorised officer believes the vehicle has not complied with the law or is defective.

2.5 Comparison of Australian roadworthiness assurance regimes

While the HVNL and NHVR have commenced, heavy vehicle roadworthiness assurance regimes are still predominantly managed under (pre-existing) individual state and territory arrangements.

All states and territories have implemented assurance regimes under which second party inspections feature as a major element. However, the structure and emphasis on different types of second party inspections varies considerably:

- New South Wales, the Northern Territory, and Queensland require annual, second party roadworthiness inspections for trucks and trailers.
- The Australian Capital Territory requires biennial inspections of trucks and trailers once they have reached 3 years of age.
- South Australia requires annual, second party roadworthiness inspections for restricted access heavy vehicles (B-doubles and road trains) only.

[8] *Vehicle Standards Bulletin 6: Heavy Vehicle Modifications*, available at http://www.infrastructure.gov.au/roads/vehicle_regulation/bulletin/vsb_06.aspx.

- Victoria and Tasmania do not require any periodic inspections for trucks and trailers.

Where periodic inspections are not required, states and territories (Victoria and Tasmania) require roadworthiness inspections to be undertaken on change of ownership of a heavy vehicle. In most cases, due to the period of heavy vehicle ownership tending to be measured in years, this results in less frequent inspections than under an annual periodic regime. The benefit of requiring a roadworthiness inspection on change of ownership is principally to provide a form of quality (safety) assurance to the new owner. While the prescriptive requirements (as discussed here) are the most visible elements of second party heavy vehicle inspections to be compared, other aspects of how they operate potentially have just as much impact on their effectiveness and efficiency. These include:

- Who may undertake inspections (including whether by government or licensed private inspectors, and their necessary qualifications).
- The standards of such inspections (or lack thereof), particularly those undertaken at the roadside where constraints on available time, necessary equipment and skilled inspectors are more likely to impact.
- Procedures for clearing identified defects (whether and where an operator must subsequently present their vehicle for inspection).

All states and territories undertake roadside inspections of heavy vehicles. Data on the volume and other elements of inspections undertaken by state and territory governments was unavailable for inclusion in this report.

3. Heavy Vehicle accreditation schemes

Accreditation is a formal process for recognising operators who implement management systems to achieve specified standards. Those management systems may include vehicle maintenance, mass management, driver health and fatigue management, driver training and vehicle loading, as well as other factors that can affect the safe operation of a heavy vehicle fleet.

Operators may be accredited under a range of schemes, each of which has its own requirements.

Government agencies use accreditation as an additional compliance assurance mechanism. The government schemes are linked to regulatory road access and may or may not be voluntary. Industry accreditation schemes are voluntary for operators who join where they see benefits and are most likely to attract operators within industry associations[9].

There are a number of industry accreditation schemes operating in Australia. In 1996 the Australian Trucking Association (ATA) introduced TruckSafe as a means of raising the profile and safety of the trucking industry.

There are also a number of sector specific schemes in Australia that are worthy of note, but are not included in this review. Examples are PACIA (Plastics and Chemicals industries Association) and Truckcare (Australian Livestock and Rural Transporters Association).

The Australian Logistics Council's (ALC) National Logistics Safety Code of Practice (NLSC) enables supply chain participants to manage their Chain of Responsibility obligations. Variants of the Code are available in the retail, steel, gas, and electronics sector and ALC has announced extension to the fuel supply sector, through a 'tanker code'.

The NLSC applies to the wide range of activities within the supply chain including legal compliance and Chain of Responsibility, safe loads, speed and fatigue management. Two tools accompany the NLSC:

- 'iAppraise' which is the ALC's Electronic Compliance Platform and Audit Tool and assists conducting an internal review in preparation for an external audit.

- 'Reasonable Enquiry' which is a due diligence questionnaire mechanism to enable ALC signatories to evaluate if a supply chain partner has the required systems in place to manage their Chain-of-Responsibility legal obligations.

The NHVAS was first approved by the Australian Transport Council (comprising transport Ministers of all jurisdictions) in 1997 as a voluntary means for operators to demonstrate compliance with certain aspects of the law. It has since evolved as a formal, audit-based process for recognising and granting entitlements and commercial benefits to operators who have implemented auditable vehicle maintenance, mass management or fatigue management systems[10].

The NHVR is responsible for and is the single point of contact for the NHVAS.

The Western Australian Heavy Vehicle Accreditation scheme (WAHVA) was introduced in 2002. All restricted access vehicles and those operating on permits or concessions in

[9] For a discussion of voluntary and mandatory schemes in Australia and a mandatory scheme in Canada, see *Analysis of the Safety Benefits of Heavy Vehicle Accreditation Schemes, Austroads* 2008.

[10] The evolution of the NHVAS through policy decisions by governments is described in detail in the report, *Accreditation Policy Review,* NTC, June 2009.

Western Australia must participate in the WAHVA. This scheme incorporates the NHVAS maintenance management module.

Bus operators are accredited in Australia through government regulators in state and territory transport departments. All jurisdictions have a bus operator accreditation system in some form. They each have common features, but there are differences in the detail between each jurisdiction. The systems are not included within this review program, however, a comprehensive report is provided in the NTC Report *'Improving Safety Management in Australia's Bus Industry'* (2008).

The three heavy vehicle accreditation schemes of primary interest for this review are:

- **National Heavy Vehicle Accreditation Scheme (NHVAS)** – administered by the state jurisdictions and linked to the granting of regulatory concessions.
- **Western Australian Heavy Vehicle Accreditation scheme (WAHVA)** – available to all operators and mandatory for Restricted Access Vehicles in Western Australia.
- **TruckSafe** – owned by the Australian Trucking Association and primarily focused on improving road safety and business performance of operators.

3.1 National Heavy Vehicle Accreditation Scheme

The NHVAS is an audit-based scheme. To become accredited, operators must have a relevant maintenance management system that complies with the standards underpinning each of three accreditation modules (Maintenance Management, Mass Management and Basic or Advanced Fatigue Management). Operators must be independently audited and re-audited at regular intervals by certified auditors. Those who demonstrate compliance with the accreditation standards are exempted from periodic vehicle inspections where they occur.

The objectives of the NHVAS are to:

- improve efficiency for scheme members by reducing the impact of conventional regulatory enforcement
- raise levels of compliance for non-accredited operators through more effective deployment of enforcement resources
- improve road safety
- increase the productivity of the transport industry through adoption of good management by responsible operators.

3.1.1 Regulatory and operator benefits

NHVAS is a completely voluntary scheme, providing few barriers of entry for prospective operators and, in relation to roadworthiness, the benefit of exemption from some regulatory inspections.

A 'general access' approach to regulating road transport involves setting normal operating conditions that apply to all for general access. This approach encompasses all the road transport laws that apply to operating a vehicle on public roads.

An 'above-general access' approach to regulating road transport provides additional compliance outcomes. For example, the NHVAS requires that operators must:

- develop and maintain an in-house safety management system
- document the procedures that staff must follow to achieve compliance

- produce (and keep for audit) documents and other evidence that prove compliance
- undergo independent audits at designated intervals.

These requirements mean that government transport agencies can gain more information about the compliance of that operator's business than if the operator only used general access conditions. Under general access, the only information about compliance would come from roadside inspections or electronic means (such as speed cameras). Therefore, government agencies benefit from the NHVAS as a compliance-assurance tool in return for allowing operators meeting the requirements to run at above-general access conditions.

The NHVAS audits enable vehicle operators to demonstrate their systems comply with certain standards, which themselves are intended to provide assurance that an operator is meeting the objectives and requirements of the HVNL. In return, the operators may gain flexibility entitlements as shown in **Table 1**.

Table 1: Available flexibility for operators in the NHVAS

Standard	Available flexibility
Maintenance	Exemption from annual or other periodic vehicle inspections by the vehicle registration agency.
Mass	Concessional mass limits: vehicles can carry additional mass compared to general access.
	Higher mass limits: vehicles can carry additional mass compared to general access. Vehicles must also comply with other requirements outside NHVAS.
Fatigue	Basic fatigue management: more flexible work and rest regime compared to standard driving hours.
	Advanced fatigue management: most flexible work and rest regime compared to standard driving hours.

Source: Accreditation Policy Review, NTC, June 2009

Recommendations for broadening the scope of the NHVAS to mandate accreditation in certain circumstances to improve safety have arisen from some coronial inquiries relating to fatal truck crashes. For example, the Coroner's report on the *Coronial Investigation of Twenty Six Rail Crossing Deaths (at Kerang) in Victoria* included the recommendation the NHVR ensure the NHVAS is expanded to include all Victorian heavy vehicle operators who perform their own maintenance in-house, and they be required to inspect brakes pads and push rods every week or fortnight. The findings of other Coronial inquiries were cited to support this view.

In Western Australia, operator licensing is compulsory for all 'individuals and organisations that perform any transport task for hire or reward within Western Australia, including interstate operators and operators of a Restricted Access Vehicle (RAV)'[11]. This Western Australian operator licensing is called the Heavy Vehicle Accreditation Scheme.

3.1.2 Regulatory efficiencies

An objective of an audit-based compliance scheme is to reduce the cost of administering road transport laws. The potential for achieving regulatory efficiencies through the NHVAS stems from a model that utilises third-party auditors for monitoring operator compliance with regulatory requirements.

[11] Guidelines For Audit Providers, Main Roads Western Australia, November 2010.

When the scheme was first proposed in 1997, an expected key benefit was that inspection and enforcement resources could be refocused to concentrate on those operators' vehicles not in the NHVAS.

At this stage data collection methods have been unable to yield sufficient, reliable data to enable an evaluation of whether the NHVAS has reduced administration costs of road transport laws, or whether it has contributed to better targeting of enforcement resources. Those enforcement agencies who use intelligence-based targeting of their resources are understood to rely solely on offence histories and other enforcement data, and do not appear to be making use of the available NHVAS membership data. Differences in practices and data from inspection regimes mean that direct comparisons between the jurisdictions regarding regulatory efficiencies cannot be easily made, and benefits to one jurisdiction may be offset by the regulatory practices in others.

3.1.3 NHVAS Business Rules

The *NHVAS Business Rules* (February 2014) provide a framework for the administration of the NHVAS. It is a high-level document that sets out policies and procedures and the manner in which the NHVR should interact with jurisdictional authorities and with accredited operators. The following matters are covered:

- structural arrangements between accrediting authorities, including information exchange
- conditions and processes for entry, renewal
- entry, renewal and maintenance of accreditation
- audit processes and identification labelling
- investigation of complaints, random compliance checks, sanctions and review of decisions and exit from the NHVAS.

The *NHVAS Business Rules* are intended to be used by the NHVR offering the Scheme to operators as well as by any person offering management, consultant or audit services to operators. The rules are silent on matters relating to the governance of consultants or auditors.

3.1.4 Maintenance Management accreditation modules

Heavy vehicle operators can apply for accreditation under three NHVAS accreditation modules: Maintenance, Mass and Basic or Advanced Fatigue Management[12].

Operators who are accredited to the Maintenance Management Module must be able to demonstrate their vehicles are maintained correctly so they always comply with standards and are in a roadworthy condition.

To become accredited, the operator must have a relevant Maintenance Management System in place and provide evidence from an independent audit that the operation is complying with the maintenance management standards[13].

[12] As stated in the Introduction to this section, the Mass management and Fatigue management Modules are outside the scope of this review program.

[13] The Maintenance Management Accreditation Guide advises operators to 'Remember, accreditation does not exempt you from the law. You can be audited at any time and your vehicles are subject to on-road checks to make sure you conform to the performance standards'.

3.1.5 NHVAS accreditation standards and tools

A number of guidance tools have been developed to support the NHVAS that are intended for use by the state and territory transport agencies, auditors and the operators who are members or wish to become members of the Scheme. These are reviewed below.

Most of the documents were developed in the early stages of the NHVAS and with the exception of the NHVAS Business Rules, have not been recently reviewed. Nor can evidence be found the tools have been evaluated by any jurisdictional agency for their usefulness in contributing to the roadworthiness of heavy vehicles.

A draft review of the NHVAS was published by NTC in 2006 and this was substantially updated as a final document in 2009, but neither version included an assessment of the supporting standards or guidelines for the Scheme[14]. Phase 2 of this Roadworthiness Program will assess the supporting NHVAS standards and guidelines.

3.1.6 Maintenance management standards

To be eligible for accreditation under NHVAS, operators must agree to abide by the *NHVAS Business Rules* and provide documentary and audit evidence that they comply with the standards contained in the four NHVAS modules. Vehicles maintained in accordance the standards are considered to be likely to comply with the HV Regulations and the relevant ADRs.

The standards have their basis in Chapter 3 of the HVNL – *Vehicle operations—standards and safety*. Under the Maintenance Management Module, the operator's Maintenance Management System (MMS) must include measures to ensure each heavy vehicle conforms to eight standards[15]:

- Standard 1 – Daily check
- Standard 2 – Fault recording and reporting
- Standard 3 – Fault repair
- Standard 4 – Maintenance schedules and methods
- Standard 5 – Records and documentation
- Standard 6 – Responsibilities
- Standard 7 – Internal review
- Standard 8 – Training and education.

An operator's compliance with these standards is a prerequisite to an 'above general access' approach to using the roads and must be demonstrated to qualify and/or retain the Maintenance Management accreditation.

3.1.7 Roadworthiness Guideline

A *Roadworthiness Guideline* (NTC 1995) provides operators with advice for achieving the Maintenance Management standards and meeting the requirements of the Maintenance

[14] Policy Review of Road Transport Heavy Vehicle Accreditation Discussion Paper, NTC, October 2006 and Accreditation Policy Review, NTC June 2009.

[15] A ninth standard refers to fuel tax credit available under the scheme and does not relate to inspection for road worthiness of a vehicle.

Management System (MMS). It also serves as the basis for state and territory road agencies and auditors to assess the suitability of elements of an operator's MMS.

The *Roadworthiness Guideline* is primarily a technical document. A number of technical principles are listed that should be applied in the development of the MMS. These cover:

- requirements for an operator to ensure that equipment required by the Heavy Vehicle Standards to be on a vehicle is present and working properly
- that where it is essential for the safe operation of a vehicle and the control of its emissions, it is kept in good condition and that manufacturers' recommendations relevant to the safety of particular parts or the control of emissions are considered.

They do not require:

- the specification of test methods except where they are necessary to determine whether criteria are met
- the inclusion of parts of a vehicle that deteriorate if they have no direct safety or emission implications or if deterioration cannot readily be determined.

Similarly, the contents comprise a list of practical information covering: steering and suspension; structure and body work; brakes, braking equipment and braking system operation; wheels and tyres; lights and reflectors; tow couplings; seats and seat belts; mirrors, windscreen and glazing; engine, drive line and exhaust.

Neither the principles nor the contents include guidance for establishing a complete safety management system, an approach that uses hazard identification, risk assessment and risk management and is proven to achieve improved safety outcomes[16]. Likewise, the content of the *Roadworthiness Guideline* has not been organised within a structured plan-do-check-act (PDCA) framework that is commonly used to advise business on the control and continuous improvement of operational processes and products[17].

While the MMSs are based on a safety management system approach and reflect the PDCA cycle, they are not supported by more practical 'how-to' guidance as the approaches are not elaborated in the *Roadworthiness Guideline.*

From this perspective, the *Roadworthiness Guideline* differs from many industry guidelines with similar objectives.

3.1.8 NHVAS National Independent Audit Framework

A *National Independent Audit Framework* (NTC 2000) provides auditors with extensive guidance about the audit processes that apply in relation to all accreditation modules. It includes (in Chapter 6):

- The principles an auditor will apply in assessing evidence (frequency of like incidents, seriousness, corrective actions taken).
- Evidence to be collected and the style and accessibility of reports.
- Required working papers for a comprehensive audit methodology.

[16] Reason, J. (1997) *Managing the Risks of Organisational Accidents*, Ashgate Publishing Company.

[17] The PDCA cycle underpins a number of comparable industry standards and accompanying guidance for the establishment of management systems with quality or safety related objective. These include the ISO Quality series and AS/NZ Standards such as for AS/NZ 4360 (Risk Management) or AS/NZ 4801 (OHS Management).

The types of independent audits that are performed on an operator's MMS are described as:

- **System Accreditation Audits** – to confirm the operator's MMS conforms to the required standards for the relevant NHVAS module.
- **Compliance Audits** – to periodically demonstrate the operator's MMS continues to maintain compliance with the 5 types of compliance audits being:
    - *Compliance audit* – a precondition of entry to the scheme to certify that a MMS for accreditation is in place, is being used and adheres to the scheme standards.
    - *Six-month compliance audit* – must be undertaken within the first 6 months of operation in the scheme, otherwise initial accreditation is automatically suspended.
    - *Renewal compliance audit* – upon applying for renewal of accreditation (which has a life of 2 years. When an auditor has carried out two consecutive audits on an operator, a different auditor must conduct the next audit. This requirement may be waived by the Regulator in extenuating circumstances, such as in remote areas. Accreditation expires after 2 years if a renewal application is not received (or approved).
    - *Regulatory audit* – triggered audits are initiated by the NHVR if non-conformance is identified via an on-road breach, intercept report, serious crash or other means.
    - *Random audit* – random audits, like triggered audits, may be conducted at the discretion of the NHVR.

The *National Independent Audit Framework* has not been reviewed since its publication in 2000.

3.1.9 Maintenance Management Audit Matrix

Audit criteria and evidence against which compliance with the MMS are assessed are provided in the *NHVAS Maintenance Management Audit Matrix.*

The Audit Matrix is a check list to be used by the auditor. Its purpose is to help ensure completeness and consistency in audit practice and it comprises a standardised framework for each standard to check:

- that a system is in place for the selected standard
- whether there is any relevant evidence to show compliance with the system in place
- that the relevant staff responsible for the standard is aware of their responsibilities
- they are qualified to perform their assigned task.

3.1.10 Auditor Governance, Administration and Certification Requirements

Exemplar Global[18] is the body responsible for administering the certification of heavy vehicle accreditation auditors in all jurisdictions, under all schemes relevant to this review: NHVAS, WAHVAS and TruckSafe. A certified auditor may offer their services to operators under any or all of these schemes[19].

[18] Formally known as RABQSA International until rebadged in late 2013

[19] Separate audits and reports must be undertaken for each.

Exemplar Global is accredited by JAS-ANZ[20] as meeting the requirements of the international standard for personnel certification bodies and it aligns its processes to the *International Standard ISO/IEC 17024:2003 (17024)*[21]*.* This establishes the sequence of examinations, skills assessments and payment of fees (and offers the potential to auditors of recognition by other international personnel certification bodies).

To be recognised by the NHVR as an NHVAS auditor, the auditors must be certified by Exemplar Global. The NHVR has no active role in certification of the private sector auditors and under present arrangements, has no power to sanction or remove an auditor from the NHVAS.

The Exemplar Global certification processes are laid out in the *RAB-QSA Heavy Vehicle Accreditation (HVA) Auditor Accreditation Requirements* (2011). Applicants for certification as a heavy vehicle auditor must have successfully completed both a 'RABQSA-HV e-based examination' and examinations for the applicable competency units that are conducted by an Exemplar Global certified Training Provider.

As the certification body, Exemplar Global has a role to audit or investigate auditor performance. There is no written or anecdotal record of Exemplar Global having sanctioned or excluded an auditor for any reason during the current life of NHVAS, TruckSafe or WAHVA.

Table 2: Certification applications received by Exemplar Global – Feb 2013 to Feb 2014

Total applications received	25
Applications approved	13
Currently in progress	9
Closed / denied	3

Source: Exemplar Global Feb. 2014

3.1.11 Training providers

There are 14 certified training providers for auditors that are distributed across all jurisdictions. All training providers must be certified under Exemplar Global's *Training Provider and Examiner Certification Scheme* (TPECS). Certification to the TPECS certification requirements ensures training is competency-based, is designed to meet the ISO standards underpinning the process and requires a Training Provider to:

- establish an examination for each [Exemplar Global] defined knowledge competency, with an examiner's guide that provides sufficient detail to ensure examination is fair, valid, reliable and impartial and delivers consistency in examination outcomes
- utilise competent examiners
- maintain effective supporting administrative processes.

Only some of these training providers are registered training organisations (RTOs) that meet the delivery requirements of the Australian Quality Training Framework (AQTF) and competency requirements of the Australian Qualifications Framework (AQF).

[20] Joint Accreditation System of Australia and New Zealand.

[21] Conformity assessment - General Requirements for Bodies operating Certification of Persons.

The heavy vehicle auditor competency standards have been set with reference to the *ISO19011:2002 (ISO 19011)—Guidelines for quality and/or environmental management systems auditing.* Completion of the following units is required:

- Management Systems Auditing: RABQSA-AU
- Auditing Quality Management Systems: RABQSA-QM
- Heavy Vehicle Operations: RABQSA-HV.

There are currently no prior industry-relevant qualifications or competency skills sets required for certification as an auditor under the Maintenance Management module, such as those relating to heavy vehicle mechanical maintenance or diesel fitting[22].

Higher entry standards for auditor training than currently apply have been proposed by jurisdictions. For example, specific engineering expertise recognised by an independent professional or licensing organisation such as Engineers Australia has been suggested, or in the case of diesel mechanics, AQF Certificate III and 2+ years of on-the-job training or AQF Certificate IV (ANZSCO Skill Level 3).

3.1.12 Auditor performance and accountability

The relationship of certified auditors to the NHVAS in relation to auditor governance, including selection, accountability, performance and liability are not addressed by the *NHVAS Business Rules,* nor by the HVNL. Some issues associated with these matters that have been identified are:

- *Auditor selection* – Current practice is for operators to select and purchase their HV auditor, selecting from a list provided by Exemplar Global or industry association. This commercial relationship between operator and auditor creates an inherent potential for the auditor to provide 'what the purchaser wants, not what is required by the issue identified'.
- *Consultancy* – Certified auditors are not precluded from providing consultancy services to heavy vehicle operators or from grouping together to create a single pool from which operators may select. This also creates a high risk for a conflict of interest as auditors are able to provide scheme entry advice and support and then take on an auditing role.
- *Remote regions* – HV auditors are not readily available in remote areas. For example, comments from the regulatory authority indicate the Northern Territory as only two auditors, one implication being that the same auditors may be undertaking consecutive audits.
- *Auditor Liability and Insurance Obligations* – The *Road Transport Reform (National Compliance and Enforcement Bill) Regulation* in 2003 features the Chain of Responsibility (CoR) concept – meaning all those with responsibility for activities that affect compliance with the road transport laws (initially in relation to dangerous goods and driving hours), can be held legally accountable if they do not meet their responsibilities.

  A wide range of responsible parties come within the ambit of the CoR law, but certified NHVAS auditors are not included. Currently, auditors do not automatically carry any direct liability for their audit outcome. In some schemes, auditors are held liable for remediation of defects where an operator is discovered to continue to run

[22] A minimum of 2 years of industry experience in transport and logistics is a pre-requisite for entry to the HVA Auditor Certification - Fatigue Management (FM).

defective vehicles in a business or undertaking to which the auditor has issued a favourable audit opinion. In such schemes, the auditors are required to hold substantial insurances.

- *Penalties for Auditors* – The HVNL legislative framework from which the NHVAS is administered imposes penalties in relation to auditors for certain offences. Section 475 imposes a penalty of up to $10,000 on persons who make false or misleading statements to auditors, while s478 of the HVNL provides offences relating to mis-representation by or about auditors.

  Neither the HVNL nor the *NHVAS Business Rules* contain provisions concerning the removal of auditors from the scheme, or the management of poor performance.

- *Management of NCRs* – NHVAS auditors issue minor or major non-compliance reports (NCRs) where an operator is found to be not complying with one or more of the Maintenance Management standards. If an operator fails to close out the corrective actions contained in the NCR, the auditor has no statutory powers of enforcement, therefore the operator may continue to enjoy the regulatory benefits with no sanctions.

3.2 Western Australia Heavy Vehicle Accreditation Scheme

Western Australia did not adopt the NHVAS in 1999, but introduced its own heavy vehicle accreditation scheme (WAHVA) in 2002. It is a hybrid scheme that recognises the NHVAS Maintenance Management module (and Fatigue Management module) and standards, and draws on some features of TruckSafe.

An essential, distinguishing feature of WAHVA is that it is mandatory for all restricted access vehicles and those operating on permits or concessions. Operators mandated are:

- B-doubles or road trains
- Truck and trailers with a GCM exceeding 42.5 tonnes
- Vehicles on all other concessional loading schemes
- All oversize vehicles on annual permits or notice.

Accreditation does not apply to:

- vehicles such as buses, special purpose vehicles (SPVs) and agricultural equipment
- vehicles which have a Gross Vehicle Mass (GVM) of 8 tonnes or less.

The objectives of the WAHVA are to:

- improve road safety
- increase the productivity of the transport industry through adoption of good management by responsible operators
- provide consistent standards
- improve community confidence.

There were 4460 accredited operators in the WAHVA, as of February 2014[23].

[23] Main Roads WA.

3.2.1 WAHVA Business Rules and Guidelines

***WAHVA Business Rules* (2013)** – these establish the framework for the administration of the scheme. They contain a similar scope to the *NHVAS Business Rules* and set out the current policies and procedures that must be used by any operators and persons offering management, consultant or audit services to operators.

Entry audits are undertaken to determine the operator's eligibility to be accredited. Once accepted, the operator is subjected to annual compliance audits for 2 years to ensure the operator continues to meet the requirements of accreditation.

Re-entry audits are conducted on expiry of the Accreditation Certificate every 36 months. These audits should be treated in the same way as entry audits. If the audit is not submitted to Main Roads WA before or on the due date, the operator's accreditation lapses and no extension of time is given. Main Roads WA also undertakes random audits of 5 per cent of their operators each year and triggered audits where there is a breach of the standards

Accredited operators are required to complete a 6-monthly compliance statement if they have completed a systems audit. The statements must contain a record of compliance with the key outcomes required for each module offered under accreditation.

***WAHVA Guidelines for Auditors* (2010)** – explain the processes for individuals to become recognised by Main Roads WA as an auditor and for providing audit services to heavy vehicle operators.

Maintenance Management standards – the standards which operators are required to incorporate the standards into their daily work practices, are the 'identical to those required under the nationally endorsed NHVAS'. They cover daily vehicle checks, fault recording, maintenance management record keeping, education and training, non-compliance management, and external audits[24]. Additionally, all vehicles must have a signed roadworthiness certificate presented at every entry or re-entry audit (every 3 years).

3.3 TruckSafe

3.3.1 Scheme structure

The TruckSafe Accreditation Program is a voluntary program established in 1996 by the Australian Trucking Association (ATA). It is administered by TruckSafe Pty Ltd, a wholly-owned subsidiary company of the ATA and managed by a Board of Directors that sit under the ATA Board.

The scheme structure includes a number of 'Core Providers' who are member organisations of the ATA and whose role is to promote TruckSafe. As 'Endorsed Service Providers', these industry associations may provide fee for service implementation assistance to operators where required, however, they are not certified to conduct audits.

One of several distinguishing features of TruckSafe is the inclusion of the TruckSafe Industry Accreditation Council (TIAC) in the governance arrangements. TIAC is a body that comprises members drawn from industry, government and the community and is independent of TruckSafe's Board of Directors. TruckSafe Accreditation is verified through the external audit process leading to certification by TIAC. It meets regularly for the purposes of:

- approving applications for accreditation of operators
- reviewing and approving audit reports undertaken of the operator's systems

[24] The module does not include a 9th fuel tax credit standard.

- assist in the reviewing of policy and principles of the TruckSafe Program to maintain and enhance the rigor and credibility of the program.

TIAC also has a role in granting 'conditional' accreditation where TIAC has concerns about an operator's ability to meet the ongoing requirements of the TruckSafe Standards or acceptance criteria. In these circumstances, TIAC can place the operator under the surveillance for nominated time frame, of random compliance checks, random audits, compliance audits and/or triggered audits.

3.3.2 TruckSafe Business Rules

TruckSafe Operator Business Rules set out the rules and requirements for operating under the TruckSafe Accreditation Program and specify the requirements for the scheme, including:

- applying to participate in the TruckSafe Industry Accreditation Program
- terms and conditions for participation in the TruckSafe Program
- key principles of 'Safety' and 'Professionalism'; and a Code of Conduct.

TruckSafe rules require that:

- following a mandatory entry audit, audits are undertaken every 2 years by auditors selected and allocated by TruckSafe
- the auditor is changed after two audits by the same auditor
- operators who fail the audits can have their accreditation removed.

TruckSafe is not able to offer the regulatory concessions that are available to those accredited to the NHVAS accreditation scheme.

3.3.3 Accreditation modules and standards

TruckSafe has four accreditation modules that contain the minimum standards a trucking business should meet for it to be a safe, responsible operation. They are:

- *Management* – aimed at ensuring that a trucking operator has a documented business system which covers each of the standards.
- *Maintenance* – aimed at ensuring vehicles and trailers are kept in a safe and roadworthy condition. This standard covers the requirements for daily checks, fault reporting and recording, fault repair, scheduled maintenance, maintenance records and documentation, maintenance responsibilities, internal review, and maintenance training and education. TruckSafe maintenance also complies with NHVAS maintenance standards.
- *Workplace and Driver Health* – aimed at ensuring that drivers are fit and healthy and Occupational Health and Safety requirements are met. This standard covers requirements for Workplace Health and Safety, Driver Health Screening (including medicals), the role of the medical practitioner, rehabilitation and fatigue management.
- *Training* – aimed at ensuring that drivers are licensed, authorised and trained for the tasks which they are undertaking.

Ongoing compliance to these standards is required to maintain accreditation. This is achieved by operators conducting internal reviews, quarterly compliance statements as well as successful completion of ongoing external audits.

TruckSafe views its modules as being the minimum a trucking business should meet to be a safe, responsible operation. Operators must participate in all four modules to gain membership of TruckSafe.

For operators, accreditation shows they are meeting due diligence and can verify to customers and regulatory agencies they are operating within an audited and structured business management system. This includes ensuring trucks are correctly maintained and roadworthy, driver and employee health management systems are in place and general OH&S and workplace regulatory compliance and responsibilities are followed.

Table 3: Number of Operators Accredited to TruckSafe as of Feb. 2014

Jurisdiction	Number accredited
Australian Capital Territory	4
New South Wales	112
Northern Territory	9
Queensland	96
South Australia	19
Tasmania	9
Victoria	20
Western Australia	7
Total	274

Source: TruckSafe Website Feb 2014

3.4 Benefits of accreditation

The 2009 Austroads research study *Analysis of the Safety Benefits of Heavy Vehicle Accreditation Schemes* identified that operators who are in an accreditation scheme tend to have better safety records. However due to current methodological limitations to the availability of reliable data, the report was unable authoritatively to conclude whether accreditation was the cause of these outcomes.

The Queensland transport authority reports it has collected data showing that vehicles within NHVAS are generally more compliant on road than other (non-NHVAS) vehicles inspected by the department (comments received). However, this observation is acknowledged to be based on a small sample pool that has not been extensively tested against other criteria.

A full review of the benefits of accreditation based on the views and experience of scheme managers, operators, regulators and stakeholders is yet to be undertaken as a component of this review. The Austroads Report provides a discussion of anecdotal evidence gathered in 2008 including the following:

- Operators report choosing NHVAS accreditation rather than TruckSafe to gain the regulatory concessions.
- WAHVA is mandatory for certain classes of vehicles, but very few operators of other vehicle classes join voluntarily although there is the provision for them to become accredited.

- Purchasers of transport services reported that for them, accreditation provided a means of managing risk, especially the legal burdens associated with the chain of responsibility, duty of care, food safety, animal welfare, dangerous goods and other provisions.
- Insurance providers reported that benefits to them were in managing potential losses and by providing a form of market differentiation.

4. Literature review

A literature review was undertaken to consider expert analysis of matters relevant to heavy vehicle roadworthiness policy and practice. Reviewed studies extended to those undertaken in Australia and overseas, and including those authored by independent experts, government and parliamentary bodies.

It was found there are few studies which have directly examined heavy vehicle roadworthiness. The great majority of studies available either focused solely upon light vehicles or an intermix light and heavy vehicle data into an assessment of roadworthiness issues affecting all vehicles.

Studies considered in this literature review have drawn varying and contradictory findings on the relative effectiveness of different approaches to managing and regulating roadworthiness.

4.1 Scope and limitations of reviewed studies

Most of the studies reviewed in this chapter were based on statistical / regression analysis of data linking various approaches to managing roadworthiness assurance (such as mandatory periodic inspections) with outcomes (vehicle roadworthiness levels, mechanical defect and crash rates).

As with all such analysis, the reliability and meaningfulness of their conclusions is constrained by the quality of available data. This is particularly the case for studies on the efficacy of roadworthiness assurance measures. Data limitations include:

- inclusion of studies on light and heavy vehicle roadworthiness regimes
- the quality and quantity of data collected
- difficulty in accurately identifying contributory factors
- a lack of recent studies on roadworthiness assurance regimes.

Before discussing the conclusions drawn from the reviewed studies, the following sections address the limitations listed above.

4.1.1 Inclusion of studies on light and heavy vehicle roadworthiness regimes

Most of the studies reviewed addressed light as well as heavy vehicle roadworthiness. The application of studies on light vehicle roadworthiness to heavy vehicles must, however, be treated with caution, notwithstanding the similarities between them.

An obvious distinction is that most heavy vehicles are operated for business purposes and their roadworthiness is managed (or mismanaged) in a commercial context. This is quite different to the context for most light vehicle operators.

Another, well-understood distinction is the significantly different usage patterns between light and heavy vehicles. While light passenger vehicles are driven for an average of around 13,000 km per annum, the figure for all articulated trucks (including farm vehicles) is 83,000 km, with much higher travel for vehicles engaged in long-haul freight operations[25].

This has significant implications for the rate of deterioration of mechanical components over time and therefore on roadworthiness levels. The average annual usage of a light vehicle is

[25] Australian Bureau of Statistics, Survey of Motor Vehicle Use,12 months ended 30 June 2012 9208.0, (2013)

of the same order of magnitude as common service intervals, making an annual inspection a reasonable period of time with which to monitor some (but not all) aspects of its deterioration.

By contrast, a heavy vehicle is likely to wear out critical components much more quickly. Critical components such as tyres and brake linings are likely to be inspected and replaced on multiple occasions over a year, rendering annual inspections a less reliable indicator of its condition over the intervening period.

This does not necessarily mean that periodic inspections of heavy vehicles are less effective or important than for light vehicles. Arguably, the higher rate of deterioration experienced by heavy vehicles makes roadworthiness assurance measures more important (even if not wholly effective).

4.1.2 Quality and quantity of data

Crash data is predominantly generated by police reports. Police reports usually only contain a detailed assessment of a vehicles roadworthiness when the vehicle's condition is believed to have contributed to the crash, or where the severity of the crash warranted a detailed investigation to support a coronial inquiry or a prosecution.

A recent study by the Monash University Accident Research Centre (MUARC)[26] summarised a major shortcoming of using crash and defect data to assess the effectiveness of different roadworthiness assurance regimes by stating:

> *'It is difficult to conduct good analyses of the safety effects of vehicle inspection regimes as safety effects, based on defect rates, are likely to be small and confounding factors complicate the interpretation of any safety effects inferred.'*

Where studies have been based on mass crash data, the accuracy or integrity of associated conclusions may be compromised.

4.1.3 Difficulty in accurately identifying contributing factors

When a defect has been detected in a vehicle involved in a crash, it is still necessary to determine whether or not this was a contributing factor. The presence of a vehicle defect does not necessarily mean it contributed to a crash involving the vehicle. This was discussed by MUARC, who noted that:

> *'A complicating factor can also be that a given individual driver may have a low level of risk-averseness together with a high tolerance of vehicle faults, or may compensate for known vehicle faults by driving conservatively. Thus behavioural and attitudinal factors can confound estimates of crash risk associated with vehicle faults.'*[27]

A simple example is a vehicle found to have been operated with worn tyres, but which crashed for entirely – but not obviously – independent reasons. Another example may be a vehicle with a worn (scratched) windscreen that resulted in diffused light entering the cabin. The compromised driver vision may have contributed to increased hazard perception time, and combined with other factors (such as driver inattention) resulted in a crash. In this example, such a defect could prove very difficult to identify as a contributing factor in a post-crash investigation.

4.1.4 Lack of recent studies

The review identified few recent studies on roadworthiness assurance regimes. This may be partly as most jurisdictions (local and international) have long-established policies and

[26] Keall et al., 2012, Road Safety Benefits of Vehicle Road Worthiness Inspections in New Zealand and Victoria, MUARC, Clayton, Victoria.

[27] Keall ,et al. op.cit.

procedures in place. Many of the studies of these regimes were undertaken at the time when policy was developed.

The age of a study is a factor in assessing its relevance to current circumstances. All things being equal, the more recent a study, the more relevant it may be.

There are several key factors, changes to which over time would most influence the efficacy of roadworthiness assurance regimes:

- the reliability and crashworthiness of light and heavy vehicles
- usage patterns (such as distance driven over a given period of time)
- economic factors (such as vehicle maintenance affordability)
- means of obtaining assurance (such as changes to how inspections are undertaken)
- the number and type of road crashes.

The design and construction of light and heavy vehicles and their reliability have all improved over time. There has been a clear trend towards improved reliability of modern vehicles and the adoption of technologies which may assist operators in monitoring roadworthiness (such as in-vehicle electronic sensors and alerts). However, many key elements which determine a vehicle's roadworthiness (for example, the need for effective brakes and the level of tyre wear) remain fundamentally unchanged.

There is some evidence the purchasing power of Australian vehicle operators (such as for maintenance and repair parts and services) has increased due to facts including the rise in the currency exchange rate over recent years. However, it is unclear to what extent this has flowed to heavy vehicle operators. Operations are subject to intense industry competition, making them notoriously subject to downward pressure on freight rates they are able to charge. This tends to maintain a form of economic equilibrium which ensures profit margins remain perennially small.

In more simple terms, competition for how an operator's working capital is spent on their business remains high and along with that, a continuing incentive to minimise other expenditure such as heavy vehicle maintenance.

The relevance of dated studies is potentially impacted by changes over time to how roadworthiness assurance is undertaken. The fundamental means of obtaining such assurance have changed little over time (they are essentially constrained to physical / mechanical inspections of vehicles, with the advent of accreditation schemes being a partial exception).

However, perhaps the more significant factor is how roadworthiness assurance schemes are targeted, be it on a uniform periodic, or random and targeted basis. This factor does not have a strong correlation with time (or age of a given study). Rather, it is an important consideration of this broader review.

4.2 Reviewed material

The most recent study of roadworthiness assurance regimes is a 2012 study by MUARC on the impacts of regimes as administered in New Zealand and Victoria. This study was based on regression analysis of light vehicle defect and crash involvement rates, as a function of roadworthiness inspection approaches.

Other studies were also reviewed:

- A cost-benefit analysis undertaken by Keatsdale in 1999 on the New South Wales periodic motor vehicle inspection (PMVI) program. The study assessed its impact on

vehicle crashes, emissions, vehicle productivity, reductions in vehicle theft and potentially industry assistance.

- A 2001 report on an inquiry by the Victorian Parliamentary Committee on Road Safety into the Victorian roadworthiness system.
- A 1985 report by the University of Michigan Transport Research Institute on the cost-effectiveness of periodic motor vehicle inspections in the United States.
- A 2011 evaluation of the Compliance Safety Accountability (CSA) program in the United States, by the same Institute.
- A 1992 study on the effectiveness of PMVI programs by the Institute of Transport Economics in Norway.
- The 2006 Large *Truck Crash Causation Study* (LTCCS) in the United States investigated 967 crashes from 2001 to 2003 which involved a large truck.
- A 2011 report on heavy vehicle roadworthiness and crash involvement by the Commercial Truck and bust Safety Synthesis Program (CTBSSP) in the United States.

4.3 MUARC study findings on the New Zealand and Victorian roadworthiness regimes

The 2012 MUARC study[28] of New Zealand and Victorian roadworthiness regimes assessed data for light vehicles only. However, as it is a very recent report and gave consideration to several of the methodological challenges that arise in understanding how individual factors and measures impacted on roadworthiness outcomes, it usefully illustrates the difficulties in reaching robust conclusions that are applicable across fleets and road users.

4.3.1 Summary of findings

The study found that for crash risk:

- Based on New Zealand data, increasing the frequency of mandatory roadworthiness inspections from every 12 to 6 months reduced the crash risk by 8 per cent, with a 95 per cent confidence interval for improvement of between 0.4 per cent and 15 per cent.
- Based on Victorian data, a maximum 4 per cent reduction in road crashes for vehicles over 5 years old could be achieved by implementing periodic inspections for that segment of the fleet.
- By considering both findings, it is likely that the true reduction in crash risk in New Zealand was less than the nominal 8 per cent value, with the Victorian data suggesting it may be less than 4 per cent.

For the impact of inspections on vehicle defects, the study found that:

- The same increased frequency of mandatory inspections in New Zealand as above reduced safety related vehicle faults by 13.5 per cent, with a 95 per cent confidence interval for a reduction of 12.8–14.2 per cent.

[28] Keall et al., 2012, *op. cit.*

4.3.2 Qualifications

The major qualification for the MUARC study and its findings is that it focused on light, rather than heavy vehicles. The findings are nevertheless useful in understanding some of the general benefits and shortcomings of vehicle inspection regimes. A key finding was that vehicle usage patterns had a significantly greater impact on vehicle defect and crash rates, than did inspection frequency.

This is relevant to the subject of heavy vehicle defects and roadworthiness, in that heavy vehicles are subject to much more intensive use than light vehicles. There is little doubt that they require correspondingly more frequent inspections and maintenance. It seems clear that heavy vehicle periodic inspections with 12 or even 6-month intervals – on their own – would be insufficient to provide any meaningful assurance of the vehicle's mechanical condition during the intervening period.

However, this is not the sole, potential benefit of periodic inspections. Others include encouraging operators to properly maintain their vehicles on an ongoing basis, as the need to pass a scheduled inspection may lead them to assess maintenance as a form of sunk cost (i.e. would be necessarily incurred sooner or later). Another is as a form of risk profiling for regulatory authorities, whereby poor performance at a periodic inspection may inform more accurate targeting of additional (such as on-road) inspections.

Unfortunately, the findings of this study did not extend to assessing these latter types of potential benefits.

4.3.3 Overview of methodology and results

The study analysed vehicle defects identified during periodic inspections in New Zealand, as a function of vehicle age. This is shown in Figure 5. Two key conclusions were drawn:

- That the rate of defects presenting at an inspection increased steadily with vehicle age.
- There is a lull in this increase as vehicles age beyond 7 years; the point at which periodic inspections in New Zealand are required biannually, instead of annually.

It was concluded that the lull referred to above was evidence that inspections had a measurable impact on reducing the rate of vehicle defects. However, it is also clear that the dominant influence is not the inspection period, but vehicle age.

Figure 6 shows a broadly similar trend as for Figure 5, but by measuring crash risk (involvement rate) instead of defect rate. The authors made two observations:

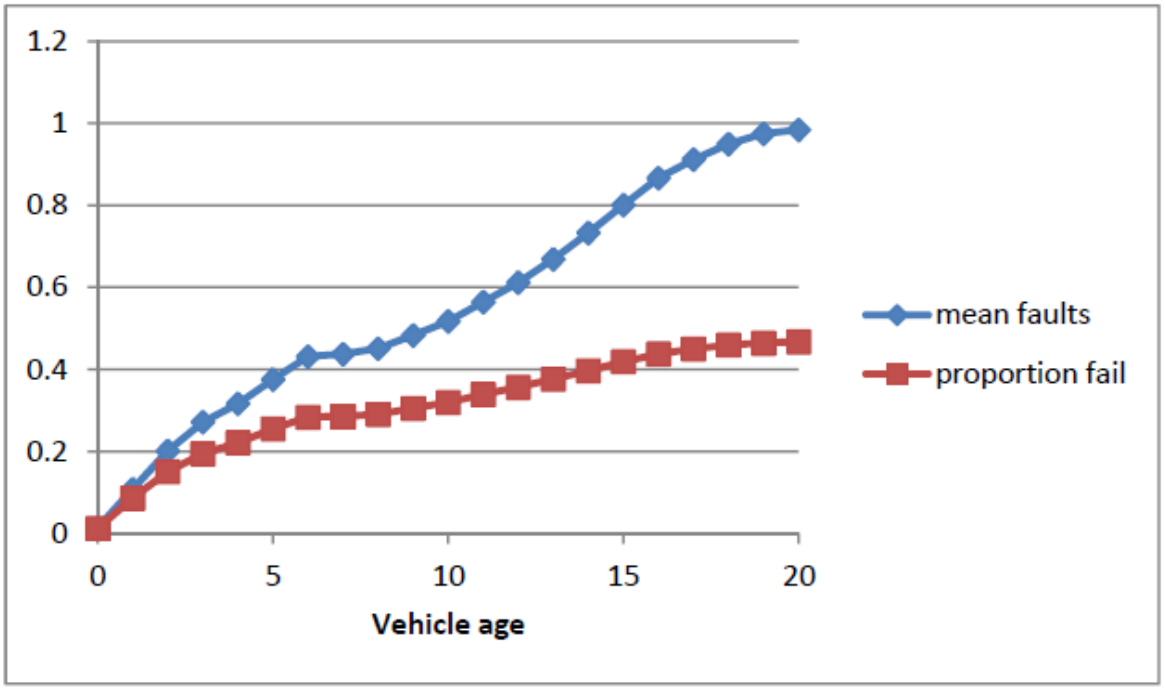
- That defect rates did not strongly influence crash risk – suggesting they may have had some, but were not a major influence on the latter.
- That the vehicle's ageing process may not have been the major causative factor in the corresponding increase in defect rates and crash risk. Rather, the authors questioned whether a correlation between vehicle and driver age and gender (such as caused by younger – and especially male – drivers perhaps tending to own older, cheaper vehicles) may mean that driver age is a stronger influence on those two measures (i.e. younger drivers tending to drive vehicles with more defects and have a higher crash risk).

The latter hypothesis was tested, with the results shown in Figure 7. These showed that driver age was a clear influencing factor on defect rate (i.e. independent of light vehicle age. It is apparent that vehicle age was also a factor).

The authors then examined the impact on crash risk for drivers of a given light vehicle, as measured against time since acquisition of the vehicle. By using Victorian data, they were

able to determine a maximum increase in crash risk (relative to the risk associated with the period of time around its acquisition) of 3.9 per cent. As Victorian vehicles are only subject to a mandatory roadworthiness inspection upon transfer of ownership, this was considered the maximum possible contribution of vehicle defects arising from owners subsequently neglecting to ensure their vehicle was effectively inspected and maintained. They considered the true contribution, in light of other factors such as changes in light vehicle use patterns, was likely to be less.

Figure 5: Light vehicle defects in New Zealand, as a function of vehicle age[29]



[29] Keall et al., 2012, *op. cit.*

Figure 6: Crash risk for New Zealand light vehicles, as a function of vehicle age[30]

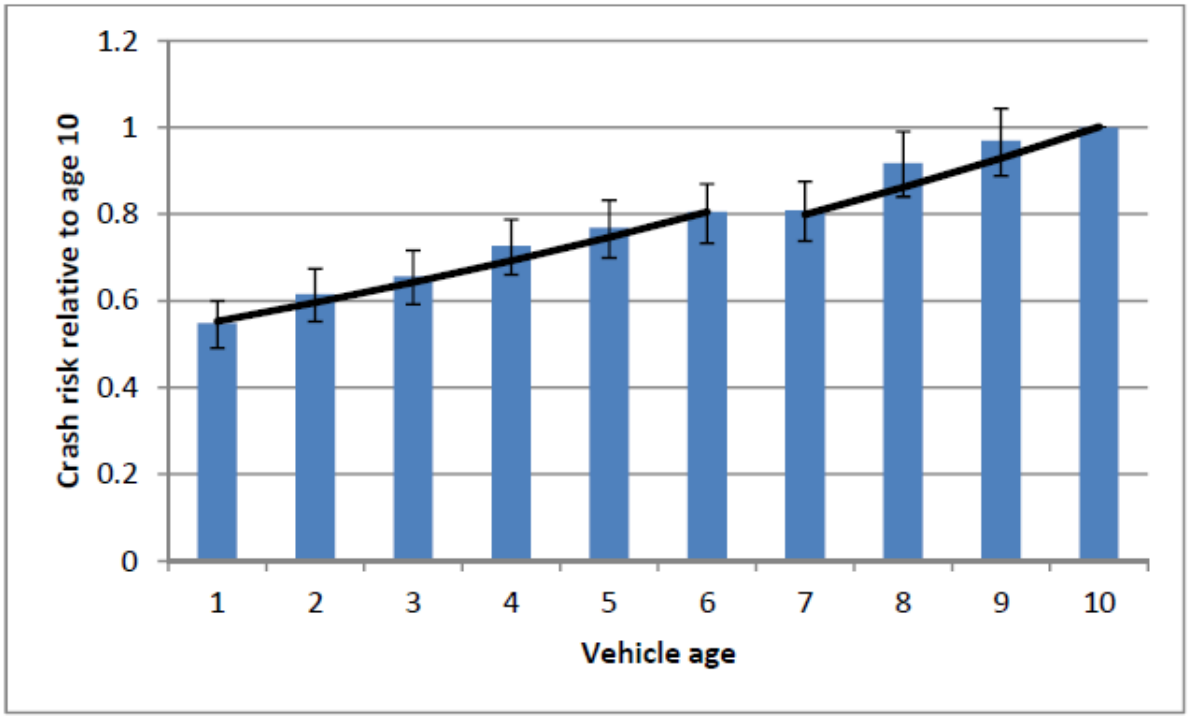
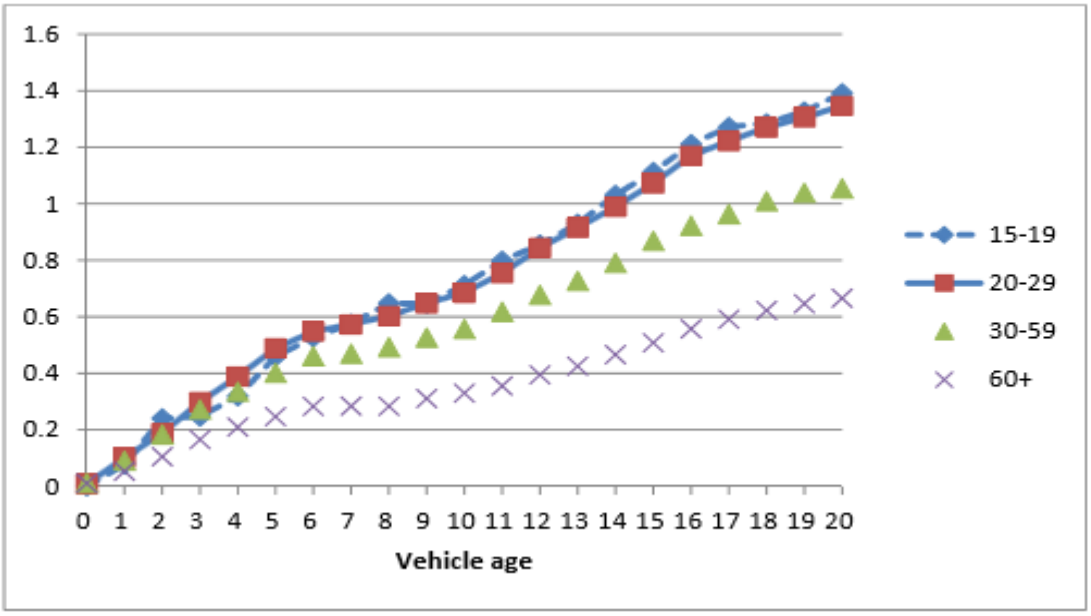


Figure 7: Mean number of light vehicle defects per inspection by vehicle age and owner's age[31]



4.4 Summary of findings from other studies

The following is an overview of finding from other relevant studies and reviews of roadworthiness and inspection regimes.

[30] Keall et al., 2012, *op. cit.*
[31] Keall et al., 2012, *op. cit.*

4.4.1 Academic and statistical-based studies

Many of the identified studies focused on assessing the efficacy of periodic vehicle inspection schemes. The prevalence of such studies perhaps reflects as much how this topic has marked debate over roadworthiness policy around the world, than necessarily their importance, relative to other compliance assurance measures (a matter which will be addressed in later reports of this review).

Studies reviewed here predominantly concluded they were unable to determine a clear link between periodic vehicle inspections and any (improved) road safety outcomes. These included the Keatsdale[32] study of 1999 and Victorian Parliamentary Inquiry into Roadworthiness[33] of 2001, both of which intermixed light and heavy vehicles.

By contrast, some studies did form that link, including a US General Accounting Office (GAO) review of an earlier US National Highway Transport Safety Administration (NHSTA) study that had found against the existence of a link[34]. The NHTSA study had concluded there was no data available reliable enough to serve as evidence that costs of requiring all motorists to have certain safety components on their vehicles inspected and repaired on a regular basis are less than the benefits grained from such inspections.

The GAO was unable to quantify the benefit, noting that police accident reports tended to understate the number of accidents to which defective vehicle components contributed. They also noted the use of fatal accidents for study was not entirely valid due to the low proportion of all accidents that were fatal. The GAO report noted that fatal accident rates were similar in the states of the United States which had inspection systems to those which did not, but total accident rates were 17 per cent lower in four states using inspection programs compared to six states that did not.

The GAO concluded that most studies it reviewed pointed to a safety benefit from inspection programs. It did not, however, provide a reliable basis for judging how much the programs affected crash rates. The report indicated a reduction in crash rates was a possible consequence from a well-conducted high-quality vehicle inspection system.

Based on the New South Wales Periodic Motor Vehicle Inspection (PMVI) program, Keatsdale undertook a cost benefit analysis on PMVIs, assessing their impact on vehicle crashes, emissions, vehicle productivity, reductions in vehicle theft and potentially industry assistance. Keatsdale calculated a cost benefit ratio in the range of 0.22 (corresponding to a set of lower bound estimates), 0.35 (corresponding to the most probable set of estimates) and 0.38 (corresponding to an upper bound set of estimates). The report concluded that such a national PMVI program, comprising annual vehicle inspections for vehicles from 4 years of age was unlikely to provide cost-effective.

The Keatsdale report further concluded – based on a review of other, relevant studies – that insufficient evidence was available to draw a link between PMVIs and reductions in mechanical defects in vehicle fleets, vehicle crashes and mechanical defects, and that even were a link able to be drawn, that their adoption would remain unjustified on the basis of a cost-benefit analysis.

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[32] Keatsdale Pty Ltd*, Cost Effectiveness of periodic motor vehicle inspections*, A report for the Federal Office of Road Safety, April 1999.

[33] Road Safety Committee, 2001, Report on the Inquiry into Victoria's Vehicle Roadworthiness System, Parliament of Victoria.

[34] Wolfe A. C. and O'Day J, *Cost-effectiveness of Periodic Motor Vehicle Inspection (PMVI): a Review of the Literature*, Report number UMTRI-85-4, University of Michigan Transportation Research Institute, for the National Highway Traffic Safety Administration, Washington, DC, 1985.

Keatsdale found that a shortfall of inspections was that not all existing defects were likely to be identified, such as when the inspection was of a primarily visual nature on the roadside. A further shortfall was identified as being that the benefits of inspections were not enduring (i.e. that after 6 months a vehicle had the same risk of developing a defect as one not inspected for 3 years).

Work undertaken for NTC in 2006 on the impact of brakes identified a case-control study undertaken in 1989 by Jones and Stein[35] in the state of Washington (United States) that found that brake defects:

- were a contributing factor in 2 to 30 per cent of (light and heavy vehicle) crashes
- increased the risk of a heavy vehicle crash by a factor of 1.6 which increased to 3.1 when a wheel or tyre defect was present with a brake defect.

Fosser[36] in a 1992 study reviewed the enduring effect of a light vehicle inspection, reporting that the crash involvement rate of a light vehicle after inspection was 9 per cent lower than before. However, after 1 year the benefits could no longer be detected. White (1986) also concluded (based on New Zealand's bi-annual inspection program) that accident rates were lowest immediately after an inspection, but that within 6 months they had increased by 15 per cent and reached their peak leading up to the next inspection.

Furthermore Elvik[37] conducted a study in Norway in which data collected on heavy vehicle inspections showed a weak statistical relationship (around 5 per cent) between the number of inspections and heavy vehicle accident rates. Based on this analysis, it was inferred that if heavy vehicle inspections were to be stopped there would be an increase between 5 to 10 per cent in accidents involving a heavy vehicle. Conversely, if such inspections were to increase by 100 per cent there would be a similar decline of 5 to 10 per cent in accidents in which a heavy vehicle was involved.

Sabow[38] describes the results of crash investigations in Germany by the Deutscher Kraftfahrzeug-Ueberwachungsverein (DEKRA). He observed that official accident statistics attribute only 2.5 per cent of crashes to vehicle defects, although in-depth studies identify a much greater contribution. About 8 per cent of car accidents and 20 per cent of heavy commercial vehicle accidents were cited as having a vehicle defect as a significant influence. Sabow also reports that routine vehicle inspections detect serious defects more frequently in older vehicles (vehicles more than 8 years old accounted for 25 per cent of the fleet but had 50 per cent of the serious defects).

Recent evaluation of the United States FMCSA heavy vehicle Compliance Safety Accountability (CSA) program by the University of Michigan Transportation Research Institute (UMTRI)[39] found that the not only did more operators fail to meet acceptable CSA performance for the vehicle maintenance than for any other measure, but also that the level of crash involvement (per 100 vehicles) for these operators was 2.34 times higher than for those who met all performance standards.

[35] Jones, I. S., & Stein, H.S. (1989), Defective equipment and tractor-trailer crash involvement. *Accident Analysis and Prevention, 21*(5), pp. 469-481.

[36] Fosser, S, 1992, An Experimental Evaluation of the Effects of Periodic Motor Vehicle Inspection on Accident Rates, Institute of Transport Economics, Oslo, Norway.

[37] Elvik, R, 2002, The effect on accidents of technical inspections of heavy vehicles in Norway, Pergamon, Oslo, Norway.

[38] Sabow G (1994), 'The influence of technical defects on accidents', *Proceedings of VIth World Congress of the International Road Safety Organisation*, Cape Town, Oct 1994.

[39] P.E. Green & D. Blower, *Evaluation of the CSA 2010 Operational Model Test*, UMTRI , Ann Arbor Michigan, 2011.

Another report considering the roadworthiness state of heavy vehicles by the Commercial Truck and Bus Safety Synthesis Program (CTBSSP) concluded that mechanical failures are rare as a direct cause of crashes when compared with human causes, but they are still considerable[40]. This report did, however also claim a strong link in the vehicle defect potentially contributing to a truck accident in 62 per cent of single truck crashes.

By comparison, the Australian insurance company NTI estimates that 5 per cent of insurance claims are related to mechanical failures, while a senior manager at a large transport company in Australia gave a lower estimate.

The Large Truck Crash Causation Study

The *Large Truck Crash Causation Study* (LTCCS) in the United States investigated 967 crashes from 2001 to 2003, involving 1127 large trucks and 959 non-truck motor vehicles, resulting in 251 fatalities and 1,408 injuries. More than 1000 factors were collected for each crash.

The results show that driver factors are identified as the critical reason for the crash in 87 per cent of the cases, with the remaining 13 per cent split between vehicle factors, weather and roadway problems. Evaluations of data from the study investigated the frequency with which a particular factor was detected as well as the relative likelihood of a vehicle with that factor present being assigned as having the critical reason for the crash occurring[41].

Craft (2007) notes that both the number of times an associated factor is coded and its relative risk ratio are significant in interpreting the data from the LTCCS. Craft gives the example that in the study 'brake problems' is the most frequently coded factor involved in a large truck crash (29 per cent), but it has a lower relative risk ratio than 13 other factors. By comparison, pre-crash cargo shift, with the highest relative risk ratio (56.3), was reported for only 4 per cent of the large trucks involved in LTCCS crashes. Table 4 lists the most common factors assigned in the LTCCS.

Table 4: Factors assigned in large truck crashes and their relative risk importance from LTCCS[42]

Factors	% of total	Relative risk
Vehicle: Brake problems	29%	2.7
Driver: Traveling too fast for conditions	23%	7.7
Driver: Unfamiliar with roadway	22%	2.0
Environment: Roadway problems	20%	1.5
Driver: Over-the-counter drug use	17%	1.3
Driver: Inadequate surveillance	14%	9.3
Driver: Fatigue	13%	8.0

[40] Knipling, R, 2011, Safety Management in small motor carriers, A Synthesis of Safety Practice, CTBSSP, Washington D.C.

[41] Craft, R, (2007) *Large Crash Causation Study Analysis Brief*, Publication No. FMCSA-RRA-07-017, Federal Motor Carrier Safety Administration, Washington DC. Available at http://www.fmcsa.dot.gov/facts-research/research-technology/analysis/FMCSA-RRA-07-017.htm, Accessed on 13 February 2014.

[42] Craft, R., op. cit.

Driver: Felt under work pressure from carrier	10%	4.7
Driver: Made illegal manoeuvre	9%	26.4
Driver: Inattention	9%	17.1
Driver: External distraction	8%	5.1
Vehicle: Tire problems	6%	2.5
Driver: Following too close	5%	22.6
Driver: Jack-knife	5%	4.7
Vehicle: Cargo shift	4%	56.3
Driver: Illness	3%	34.0
Driver: Internal distraction	2%	5.8
Driver: Illegal drugs	2%	1.8
Driver: Alcohol	1%	5.3

The frequency of occurrence and increased risk identified for brake and tyre issues in the United States heavy vehicle crashes studied significantly influenced the priority assigned to brake and tyre issues in the FMCSA's CSA program.

4.5 Government and parliamentary reviews of roadworthiness

In its 2001 report on the Victorian light and heavy vehicle roadworthiness system, the Victorian Parliamentary Committee on Road Safety concluded there was no demonstrated link between periodic inspections and any reduction in vehicle defect-related crashes. The Committee cited evidence of similar trends between overall vehicle defect-related crashes in New South Wales and other states without mandatory periodic inspections, such as Victoria. New Zealand, with a regime of annual and bi-annual testing, was found to experience a higher rate of vehicle defect-related crashes than Australian states and territories. The Committee's report gave no special consideration to heavy vehicles.

In 2009, the New South Wales Auditor-General undertook a Performance Audit of the Roads and Traffic Authority's on-road enforcement of heavy vehicle regulation[43] of heavy vehicle compliance, which focused on measures broader than just periodic inspections. The major conclusions of the review, relevant to heavy vehicle roadworthiness, were the need for more targeted enforcement and clearer, more consistent standards for how inspections were undertaken (by authorised officers).

The report noted that on-road enforcement programs conducted by both the former New South Wales Roads and Traffic Authority and New South Wales police were predominantly of an overt nature, which drivers were able to evade with relative ease. The report recommended a mixture of more covert operations to broaden the reach of on-road enforcement (including vehicle inspections).

The recommendations extended to the need for a better response to high risk heavy vehicles, a clearer definition of visual mechanical inspections, standardised weightings for the seriousness of defects identified at checking stations, better identification of high-risk

[43] Achterstraat, P, 2009, *Auditor General's Report: Improving Road Safety – Heavy Vehicles,* Roads and Traffic Authority of NSW, Sydney, New South Wales.

vehicles, introducing a formal warning system and taking immediate action to identify drivers or operators who may have committed a safety breach.

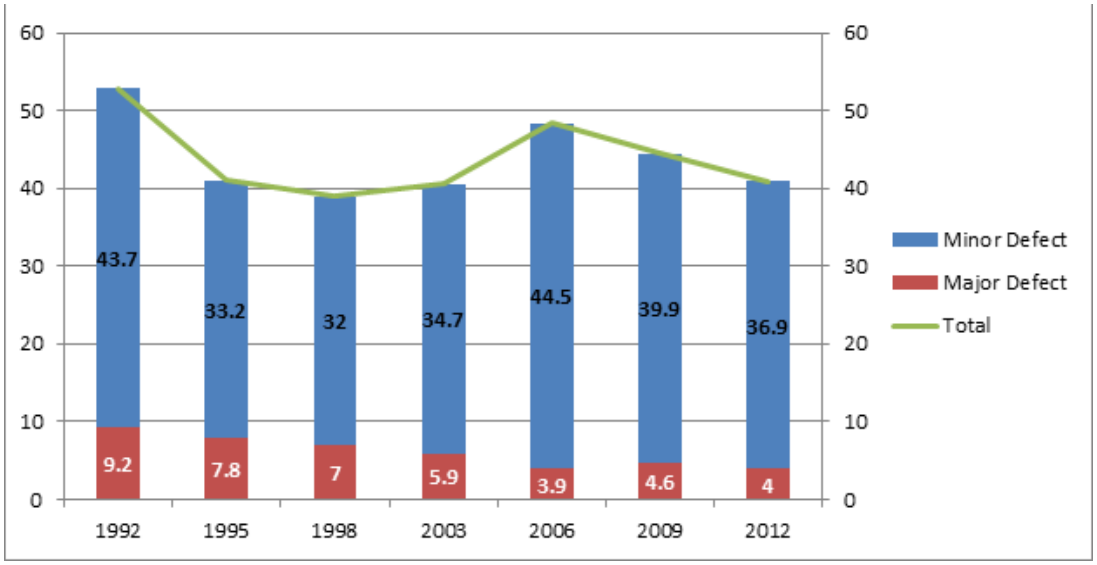
Other recommendations focused on options for better use of resources, including ensuring risk assessments were used to target high-risk areas and introducing a risk-based approach to annual inspections.

4.6 New South Wales Heavy Vehicle Compliance Survey 2012

Every 3 years, Roads and Maritime Services undertakes a survey aimed at tracking roadworthiness and compliance rates amongst heavy vehicles travelling on New South Wales roads. The most recent survey was completed in 2012 and saw 1645 vehicles randomly inspected by authorised officers.[44] The survey included inspection of 444 articulated vehicles, 293 B-doubles, 29 road trains, 507 rigid trucks, 120 plant vehicles, 147 buses, and 105 coaches at various locations across the state[45].

The survey revealed a major defect[46] rate applicable to hauling units of 4 per cent – similar to the 2009 rate of 4.6 per cent – and 6.8 per cent for vehicle combinations, the same rate as in 2009[47]. The 2012 survey saw a decrease in the overall rate of hauling unit defects to 40.9 per cent, down from the 2009 result of 44.5 per cent[48]. The defect rates for hauling units for each year are provided in Figure 8 below.

Figure 8: Default rates for hauling units 1992–2012[49]



Almost half of all freight vehicles – that is articulated b-doubles, road trains and rigid trucks – were found to have a defect in 2012, with around 5 per cent presenting with a major defect[50]. Defects were more likely to be found in truck and trailer hauling units (60.4 per cent) and road trains (58.6 per cent) than other freight vehicle types[51].

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[44] AMR for Roads and Maritime Services, September 2012, *Heavy Vehicle Compliance Survey 2012: Final Report*, p.1.
[45] Ibid, p. 5.
[46] A major defect is defined as one that presents an imminent and serious safety risk, p 8.
[47] Ibid, p.1.
[48] Ibid, p.15.
[49] Ibid, p. 9.
[50] Ibid, p. 15.
[51] Ibid, p.15.

A fault associated with brakes was the most likely cause of both major and minor[52] defects, which is consistent with previous years. Some 4.8 per cent of vehicles had at least one major brake defect, with 32 per cent having a brake defect of any kind[53]. Other commonly detected defects (in decreasing order of incidence) were: lights, reflectors, battery, horn, mirrors and number plates; chassis, body, structure, windscreen and windows; suspension; tyres, rims and hubs; and exhaust, engine, driveline and fuel system[54].

The majority of vehicles surveyed in 2012 were registered in New South Wales at 71.6 per cent[55]. Survey results indicate that New South Wales-registered hauling units were less likely to have major defects – some 3.1 per cent as opposed to 6.4 per cent for interstate registered vehicles – or any defect at all attributed to them – 37.1 per cent against 50.4 per cent for interstate vehicles for any defect[56].

A vehicle's age was likely to influence whether or not a defect would be found, with major defects issued to 2.1 per cent of hauling units under 2 years old, increasing to 6.5 per cent for those over 13 years old[57]. Similarly, 2.3 per cent of trailers under 2 years old were detected with major defects, rising to 11.7 per cent for those over 13 years[58]. The report noted that, on average, the age of vehicles surveyed in 2012 was lower than those in 2009[59].

The survey also noted that the percentage of hauling units participating in accreditation schemes had increased in 2012 to 29.9 per cent from just 16.1 per cent in 2009[60]. Scheme participation was associated with lower defect rates for vehicles registered interstate. However, a higher overall defect rate was attributed to participating than non-participating vehicles[61]. NHVAS was reported as the primary scheme of participation[62].

4.6.1 Key findings

The 2009 survey found that:

- 4.6 per cent of heavy vehicles hauling units presented with at least one major defect
- 39.9 per cent of heavy vehicles hauling units presented with at least one minor defect
- 4.3 per cent of all vehicles had defective brakes.

The 2012 survey found that:

- 4.0 per cent of heavy vehicles hauling units presented with at least one major defect
- 36.9 per cent of heavy vehicles hauling units presented with at least one minor defect
- 4.8 per cent of all vehicles had major brake defects.

Minor defects are deficiencies of the vehicle, which, if allowed to continue after the time specified (up to 28 days) may constitute a safety risk.

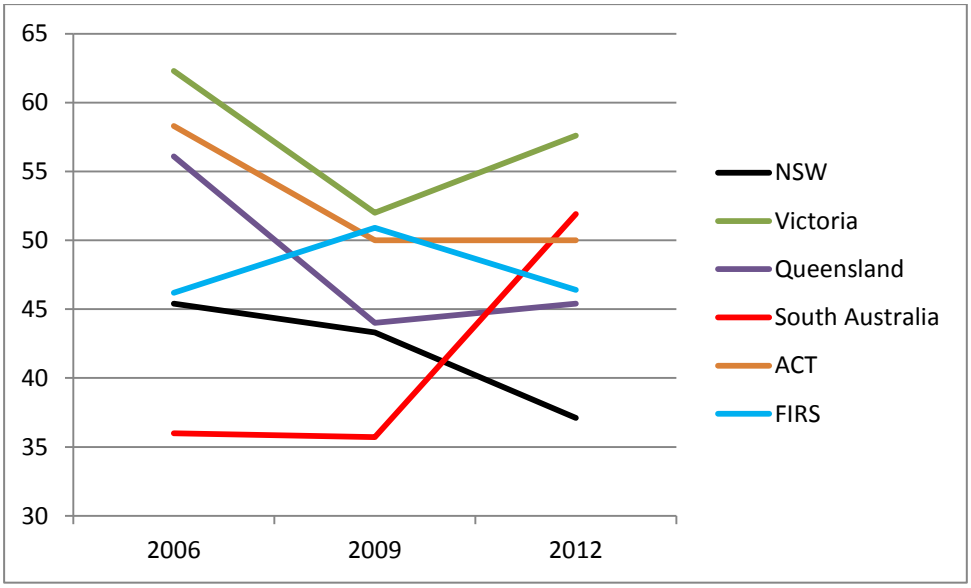
Major defects are where the inspector finds that there is an imminent and serious safety risk

[52] A minor defect is one that if allowed to continue after a specified time (up to 28 days), may constitute a safety risk, and therefore requires rectification within the period specified on the notice issued, p. 7.
[53] Ibid, p. 1.
[54] Ibid, p. 1 and pp. 11-12.
[55] Ibid, p. 17.
[56] Ibid, p. 2.
[57] Ibid.
[58] Ibid.
[59] Ibid, p. 3.
[60] Ibid, p. 2.
[61] Ibid.
[62] Ibid, p. 3.

In addition, a vehicle may be grounded if the nature of the defect is severe enough that the vehicle would constitute an imminent safety risk if it were allowed back on the road. In 2012, five of the 1645 vehicles inspected were grounded.

There is a significant difference in the rate of defects depending on where the vehicle is registered. Figure 9 shows the percentage of vehicles, by state or territory of registration, which presented with at least one defect during the survey. It should be noted there were significant differences in the types of vehicles and the number of vehicles in the samples from the different jurisdictions.

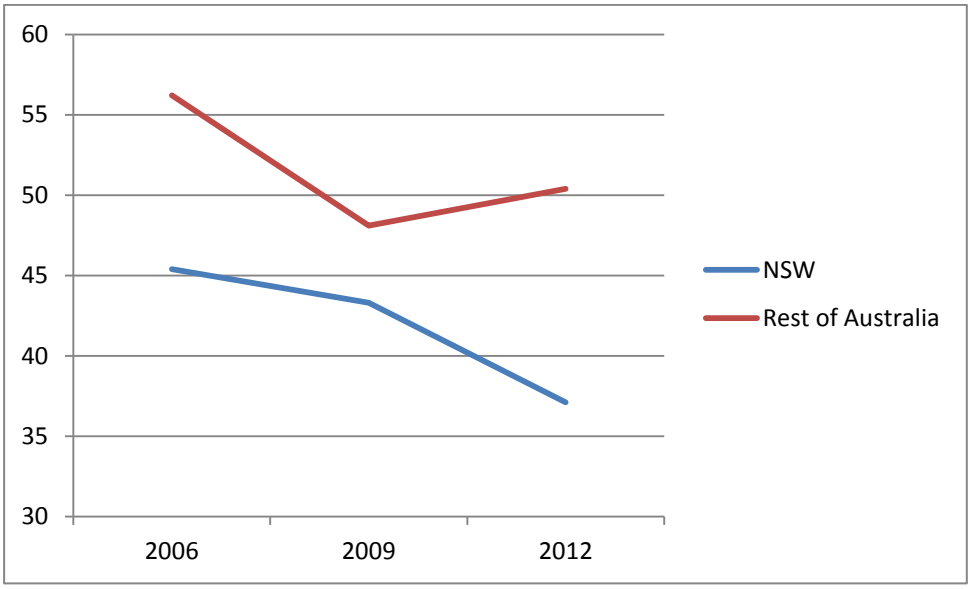
Figure 9: Vehicles with at least one defect (by state of registration) [63]



To demonstrate the comparative level of roadworthiness, Figure 10 plots New South Wales vehicles against all other vehicles for the same period:

[63] AMR for Roads and Maritime Services, September 2012, *Heavy Vehicle Compliance Survey 2012: Final Report*, p. 1.

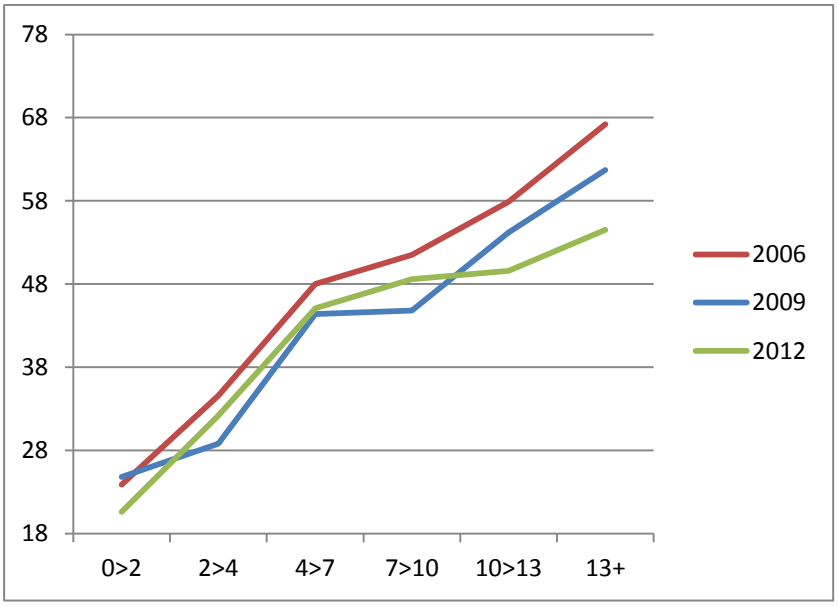
Figure 10: Comparative level of roadworthiness[64]



4.6.2 Age of heavy vehicle

Possibly the factor most relevant to the roadworthiness of heavy vehicles is the age of the vehicle. All the recent surveys indicate that vehicles are less likely to be roadworthy the older they are. Figure 11 shows the percentage of vehicles presenting with at least one defect by age and for each of the 2006, 2009 and 2012 surveys.

Figure 11: Vehicles with at least one defect (by vehicle age) [65]



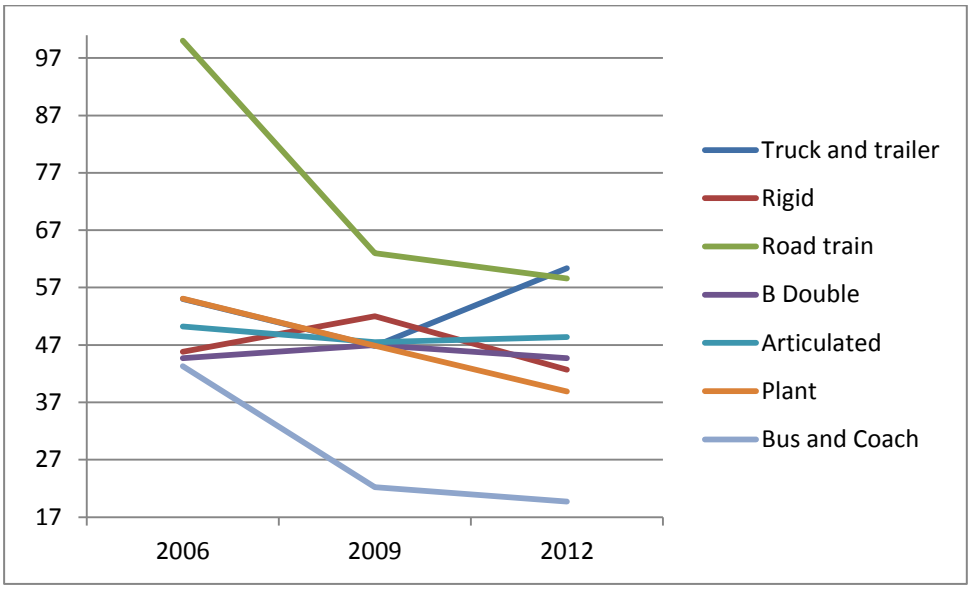
[64] AMR for Roads and Maritime Services, September 2012, *Heavy Vehicle Compliance Survey 2012: Final Report*, p. 1.

[65] AMR for Roads and Maritime Services, September 2012, *Heavy Vehicle Compliance Survey 2012: Final Report*, p. 1.

4.6.3 Type of heavy vehicle

A potential factor in the likelihood of a defect being detected is the type of vehicle. In 2012, truck and trailer combinations and road train combinations were significantly more likely to have at least one defect than other vehicle types. The fact that buses and coaches, which are the most regularly inspected heavy vehicles in almost every state and territory, are the least likely to present with a defect may indicate that heavy vehicle inspections are a factor in improving roadworthiness.

Figure 12: Vehicles with at least one defect (by vehicle type) [66]



Non-freight vehicles in the survey sample were much more likely to be New South Wales registered than interstate registered. As these types of hauling units have lower rates of defects, the higher rates among vehicles registered outside New South Wales in the survey is likely to be influenced by the profile of vehicles in the interstate sample. The rate of defects for freight hauling units, however, showed that interstate-registered vehicles had higher rates for rigid trucks, articulated trucks and B-doubles.

4.7 Discussion

The studies reviewed in this report draw various and at times contradictory findings on matters relating to vehicle inspections and their impact on defect and crash rates.

The 2012 MUARC study[67] into light vehicle data concluded that attempts to draw conclusions based on data of light vehicle defect and crash rates are fraught, as these measures are subject to confounding factors, some of which (such as vehicle use patterns) have a stronger influence than vehicle defects and roadworthiness. Findings (where able to be made) are predominantly caveated by high levels of statistical uncertainty. Logic and prior work all suggest that analysis of heavy vehicle issues face the same challenge.

A difficulty in interpreting the results of these reviewed studies is associated with the relative relevance and effectiveness of different studies and approaches to managing or regulating heavy vehicle roadworthiness (inspections).

[66] AMR for Roads and Maritime Services, September 2012, *Heavy Vehicle Compliance Survey 2012: Final Report*, p. 1.

[67] Keall, et al. op. cit.

For instance, MUARC found a benefit of reducing the light vehicles mandatory inspection period from 12 to 6 months, but the benefit was small, and less significant than the effect of light vehicle age. This makes attempting to assess roadworthiness regimes at a generic level (such as periodic inspections, rather than different approaches to the same) subject to significant error and uncertainty beyond that already present in such analyses. It seems possible the same issues will arise for heavy vehicles.

Many studies were based on data drawn from light vehicle roadworthiness and inspections. The application of findings in this context to the heavy vehicle context must be treated with great caution. One clear finding was that relevant measures were sensitive to vehicle usage patterns. This is a key point of distinction between light and heavy vehicles.

Finally, as the MUARC study observes: *'The fact that vehicle defects contribute to crash occurrence is undisputed, but the importance of the role of vehicle defects is difficult to determine'.*

4.8 Current practice of heavy vehicle roadworthiness regulation overseas

This section summarises some overseas practices relating to the regulation of heavy vehicle roadworthiness. It is useful to compare how some major overseas countries and regions have chosen to approach this regulatory task, with the Australian context. While a summary of overseas practices is given in this section, it does not extend to assessing their effectiveness.

4.8.1 European Union

European Union Member States are bound by a number of directives aimed at ensuring ongoing roadworthiness of heavy vehicles across the Union. Directive 96/96/EC denotes that Member States institute annual inspections by authorised bodies for motor vehicles and their trailers. However, it is felt that this alone is insufficient to ensure commercial vehicles are tested and maintained in roadworthy condition throughout the year[68].

For this reason, Directive 2000/30/EC requires that Member States undertake to conduct targeted roadside inspections to complement the regulated annual inspections already in place. According to the Directive, a technical roadside inspection may comprise at least one of the following:

- A visual assessment of the vehicle's condition when stationary.
- A check of the vehicles recent roadside technical report, documentation attesting to the roadworthiness of the vehicle, and proof of the vehicle having completed its mandated annual inspection where the vehicle is registered in another State.
- Inspection for irregularities of one or more of a number of components specified by the Directive – including but not limited to braking system and components, exhaust, lamps, lighting and signalling devices, wheels and tyres and suspension.

In late 2013, the Council of the European Union agreed a new roadworthiness package to further harmonise the approach to roadside inspections and periodic roadworthiness tests[69].

[68] Official Journal of the European Communities, 6 June 2000, Directive 2000/30/EC of the European Parliament and of the Council on the technical roadside inspection of the roadworthiness of commercial vehicles circulating in the Community.

[69] Council of the European Union, 19 December 2013, *Roadworthiness package agreed by the Council and the Parliament,* http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/trans/140211.pdf.

The package introduces a risk profiling mechanism via a rating system. This is intended to allow for high risk vehicles to be more easily identified and monitored more closely[70].

Article 6 of Directive 2000/30/EC also requires Member States to report to the European Commission every 2 years on the data collected over the previous 2 years concerning the number of commercial vehicles checked at the roadside. Over the 2 years from 2009 to 2010, almost 9 million commercial vehicles were subjected to roadside checks within the European Union[71]. This corresponds to 11.9 per cent of all commercial vehicles[72].

The report of the European Commission on this data suggests that figures for vehicles prohibited from continuing their journey after checking indicate that targeted roadside inspections on poorly-maintained vehicles provides better operational effectiveness and decrease administrative burden. EU Member States adopting this approach seem to have a higher capture rate of faulty vehicles with fewer checks than other Member States with a higher number of random inspections[73.]

The data found that the most common deficiencies were those relating to lighting systems (42.5 per cent), braking systems (19.8 per cent) and roadworthiness of tyres (15.9 per cent)[74]. According to the report, these areas of deficiency are consistent with those for the previous reporting period[75].

4.8.2 United Kingdom

The requirements for roadworthiness in the United Kingdom are intrinsically linked to their operator licensing scheme. In this respect its approach differs significantly from that in Australia. Although the fundamentals of regular and roadside inspections may be consistent, the issue of operator motivation is addressed in the United Kingdom through the link with operator risk scoring – in this respect it is in the operator's interest to ensure their vehicle is maintained to a roadworthy standard.

Under the *Road Traffic Act 1988* it is a requirement of operator licensing that vehicles be maintained to a roadworthy standard. This is achieved through daily and regular inspections as well as annual roadworthiness testing by the Driver and Vehicle Services Agency (VOSA). Where a vehicle fails its annual inspection it requires re-testing once the identified issues have been rectified. Some opportunity may exist to rectify minor faults on-site, which may allow a vehicle to pass the annual inspection without the requirement to return at another time.

Annual tests apply to lorries and buses, with the first test to occur 12 months after first registration of the vehicle[76]. They also apply to trailers, which require testing from 1 year after they are first sold or supplied[77]. Testing is undertaken at either a VOSA Goods Vehicle Testing Station or an Authorised Testing Facility, the latter of which is privately

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[70] Association of European Vehicle and Driver Registration Authorities, 9 September 2013, *Update EU roadworthiness package*, https://www.ereg-association.eu/actualities/archive.php?action=show_article&news_id=201.

[71] European Commission, 24 May 2013, Report from the Commission to the Council and the European Parliament on the Application by the Member States of Directive 2000/30/EC of the European Parliament and of the Council of 6 June 2000 on the Technical Roadside Inspection of the Roadworthiness of Commercial Vehicles Circulating in the Community: Reporting Period 2009-2010, p. 7.

[72] Ibid.

[73] Ibid.

[74] Ibid, p. 10.

[75] Ibid.

[76] *The annual test for lorries, buses and trailers*, https://www.gov.uk/annual-test-for-lorries-buses-and-trailers, accessed 2 February 2014.

[77] Ibid.

owned/operated[78]. Testers at all locations conform to the same test standards[79], with VOSA publishing a *Heavy Goods Inspection Manual* aimed at providing consistent testing[80].

Operators of testing locations require qualification as authorised examiners through the Ministry of Transport[81]. Similarly, their premises need to meet the approved requirements, as do the inspectors they employ[82.] Refresher training for Nominated Testers is required every 5 years.

Data from annual tests, roadside inspections and inspections undertaken at the operator's premises inform the calculation of their Operator Compliance Risk Score (OCRS). The OCRS is a point-based system calculated on a 3-year rolling basis. The aggregated score sees operators given a 'traffic light' rating of R (red) representative of high risk, A (amber) representing medium risk, or G (green) representing lowest risk[83]. The lower the score, the lower the risk and the greater likelihood of gaining a G rating.

The system accommodates 'trigger' events, which due to their severity may cause an operator to be allocated a score of R for a defined period of time. The operator may return to their base score – that prior to the occurrence of the trigger event – after the established period of time has passed[84].

A VOSA survey of heavy goods vehicles found that from 2 April 2012 to 28 March 2013, of the 2621 Great Britain registered vehicles checked for roadworthiness some 74.6 per cent were found to have no defects, while 9.9 per cent were issued with prohibition notices, and 15.5 per cent warranted inspection notices[85]. Brake system and component faults were the most common issue, accounting for 22.6 per cent of prohibition notices issued[86].

Approximately 54 per cent of vehicles surveyed were towing a trailer, of which 1370 were checked for roadworthiness – 11.8 per cent were issued with prohibition notices and 9.8 per cent warranted inspection notices[87]. The remainder were found to have no roadworthiness defects. Similarly, breaking system and component issues were the primary reason for the issue of prohibition notices to trailers accounting for 27.5 per cent[88].

In relation to vehicles and trailers registered out-of-country, 2581 heavy goods vehicles and 2502 trailers were checked for roadworthiness. Of these, 15.3 per cent of vehicles and 22.4 per cent of trailers were issued with prohibition notices, and 8.5 per cent and 56 per cent issued with inspection notices for vehicles and trailers respectively[89]. Again,

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[78] Ibid.

[79] Ibid.

[80] Vehicle & Operator Services Agency, 1 July 2013, *Heavy Vehicle Inspection Manual*, Consolidated Edition 2013, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/270467/heavy-goods-vehicle-hgv-inspection-manual-2014.pdf.

[81] *Set up an MOT test station: Overview,* https://www.gov.uk/become-an-mot-station/overview, accessed 2 February 2014.

[82] *Set up an MOT test station*, https://www.gov.uk/become-an-mot-station/approved-testing-equipment; and *Become and MOT tester,* https://www.gov.uk/become-an-mot-tester/eligibility, accessed 2 February 2014.

[83] *Operator Compliance Risk Score (OCRS): How the system works*, https://www.gov.uk/operator-compliance-risk-score/how-the-system-works, accessed 2 February 2014.

[84] *Operator Compliance Risk Score (OCRS): How your score can change,* https://www.gov.uk/operator-compliance-risk-score/how-your-score-can-change, accessed 2 February 2014.

[85] Vehicle & Operator Services Agency, *Fleet Compliance Checks 2012/13: Summary Report,* version 1.2, p3, https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/243979/fleet-compliance-checks-summary-report-2012-2013.pdf.

[86] Ibid.

[87] Ibid.

[88] Ibid.

[89] Ibid, p. 4.

brake systems and components faults were the primary reason for the issue of prohibition notices, accounting for 27.5 per cent of prohibitions for vehicles and 27.5 per cent for trailers.

4.8.3 New Zealand

The New Zealand Transport Agency's safety standards and associated policies and procedures are established in the Vehicle Inspection Requirements Manual (VIRM), its Standard Operating Procedures and Technical Bulletins, and are reflected in documents such as the Deeds and Notices of Appointment applicable to service providers.

New Zealand employs both regular and on-road inspections as part of its roadworthiness regime. The former is conducted by the Transport Agency and its approved service providers, with the latter undertaken by New Zealand Police supported by the Transport Agency's Transport Officers.

Heavy and light vehicles providing a commercial transport service are inspected every 6 months to ensure they meet safety standards, and remain compliant with their Certificate of Fitness (CoF). Heavy vehicles – those with a GVM greater than 3.5 tonnes – are subject to a CoF B, which involves a more comprehensive inspection than that applicable to light vehicles.

The certification process is part of a broader commercial vehicle safety management system, and requires vehicle owners to ensure their vehicles are:

- Maintained – involving an ongoing service and maintenance program appropriate to the vehicle, which may be achieved either in-house or through a third party provider.
- Inspected – undertaken at independent vehicle inspection organisations as approved by the Transport Agency. These are completed in accordance with the standards and requirements of the VIRM. Where the standards are met, the vehicle will be issued with a CoF.
- Repaired – where the vehicle does not meet the requirements of the VIRM, the operator is obliged to ensure the vehicle is prepared to the prescribed standard.
- Re-inspected and certified – following repair of the vehicle it is to be re-inspected and, where the vehicle meets the requirements of the VIRM, it will be issued with a CoF.

Where repairs are undertaken, these must be to the standard of the *Land Transport Rule: Vehicle Repair 1998*, which requires the system part or component to be restored within 'safe tolerance' of its original state. Where a vehicle is modified affecting safety, it must be inspected and certified under the terms of the *Heavy Vehicle Specialist VIRM for vehicles over 3,500kgs*.

Inspection organisations and individual inspectors are appointed by the Transport Agency in accordance with the requirements of the VIRM. The VIRM also contains specifics about the requirements of inspection sites and the equipment used. The Transport Agency is also responsible for the review and audit of inspectors and inspecting organisations, which is undertaken at the expense of those being audited. Through this Performance Review System, the Transport Agency is able to manage the integrity of the inspection regime.

The Transport Agency's Landata system captures all CoF inspection results. Statistics reveal that in 2012/13 New Zealand had a heavy vehicle fleet of 153,000 vehicles, with a total of 356,000 inspections undertaken in that time (including re-checks).

4.8.4 The United States of America

Federal Safety Regulations in the United States compel commercial motor vehicles (CMV) to comply with general safety requirements. Under this regulation, a CMV cannot be used on the road unless it has passed an inspection at least once in the preceding 12 months[90]. These checks may be carried out either in-house where appropriate, or by another commercial operator with the appropriate facilities and qualified inspectors.

Vehicles passing roadside or periodic inspections that meet the minimum standards required by regulation are considered to meet the requirements of an annual inspection.

The inspection requirements of commercial vehicles not engaged in interstate commerce, including school buses, are variable with few requiring periodic inspections.

The Federal Motor Carrier Safety Administration (FCMSA) within the Department of Transport is responsible for ensuring regulatory compliance with federal laws for those carriers operating interstate trade. The Commercial Vehicle Safety Alliance (CVSA) has developed North American Standard Inspection Program, which is the standard accepted across the United States and Canada[91].

In 2010, the FCMSA introduced the Compliance, Safety, Accountability (CSA) scheme, which is a compliance and enforcement model aimed at addressing risk factors before they become on-road incidents[92]. The scheme's Operational Model measures safety performance through inspection and crash information to identify risky carriers, assists the FCMSA and state agencies to modify carriers' high risk behaviour, and uses a number of interventionist tools to address compliance issues and enforce the law effectively and efficiently[93].

The CSA also encompasses the Safety Management System (SMS) which evaluates the safety of individual motor carriers through collation of various data including from roadside inspections and crash information to quantify performance via the Behaviour Analysis and Safety Information Categories (BASICs):

- **Unsafe Driving** – Operation of commercial motor vehicles by drivers in a dangerous or careless manner. *Example violations:* Speeding, reckless driving, improper lane change, and inattention.
- **Hours-of-Service (HOS) Compliance** – Operation of commercial motor vehicles by drivers who are ill, fatigued, or in non-compliance with the HOS regulations (including record keeping requirements).
- **Driver Fitness** – Operation of commercial motor vehicles by drivers who are unfit due to lack of training, experience, or medical qualifications.
- **Controlled Substances/Alcohol** – Operation of commercial motor vehicles by drivers who are impaired due to alcohol, illegal drugs, and misuse of prescription or over-the-counter medications.
- **Vehicle Maintenance** – Failure to properly maintain a commercial motor vehicle and/or properly prevent shifting loads.

[90] http://www.fmcsa.dot.gov/rules-regulations/administration/fmcsr/fmcsrruletext.aspx?reg=396.17

[91] Commercial Vehicle Safety Alliance, *North American Standard Inspection Program*, http://www.cvsa.org/programs/nas.php, accessed 25 March 2014.

[92] Federal Motor Carrier Safety Administration, *About CSA – What Is It?*, https://csa.fmcsa.dot.gov/about/, accessed 25 March 2014.

[93] Federal Motor Carrier Safety Administration, *How Does CSA Work?* https://csa.fmcsa.dot.gov/about/csa_how.aspx, accessed 25 March 2014.

- **Hazardous Materials Compliance** – Unsafe handling of **Hazardous Materials** on a commercial motor vehicle.
- **Crash Indicator** – Histories of high crash involvement, including frequency and severity, based on information from State-reported crashes.

Based on their BASICs categorisation, operators are placed into a peer group and given a percentile, where 100 is the worst-performing percentile.

The results of this analysis are used to identify carriers for targeted interventions, which may range from formal warning letters to on-site investigations under the CSA model. To assist in rectifying problems, the CSA process, motor carriers are provided with a step-by-step process that goes beyond just identifying 'what' the violation is to get at 'why' the safety performance issue is occurring. The tool is made up of six Safety Management Processes (SMPs) laid out in a specific order to address the areas of a motor carrier's operations: Policies and Procedures; Roles and Responsibilities; Qualification and Hiring; Training and Communication; Monitoring and Tracking; and Meaningful Action.

The SMPs provide a framework to identify and correct breakdowns or safety compliance issues before or after they have occurred. As part of this framework, job aids are used to assist in applying the SMP. The Vehicle Maintenance BASIC has two separate job aids: Inspection-Repair-Maintenance and Cargo-Related. These job aids provide recommended safety improvement practices, which FMCSA developed with input from enforcement personnel and the motor carrier industry.

Recent evaluation of the CSA program by the University of Michigan Transportation Research Institute[94] found that the BASICs of the CSA SMS were significantly related to underlying motor carrier safety, although the Cargo-Related and Driver Fitness BASICs show a weaker relationship to crash risk.

The study found that more operators exceeded the acceptable threshold for the vehicle maintenance BASIC than for any other BASIC, and that the level of crash involvement (per 100 vehicles) for vehicles operated by motor carriers who exceeded the vehicle maintenance threshold was 2.34 times higher than for vehicles operated by motor carriers which did not exceed any BASIC threshold.

4.8.5 Canada

The Canadian Government manages the regulation of heavy vehicles, however, under the Motor Vehicle Transport Act, it permits each province to manage and regulate heavy vehicles independently.

In 1987, Ministers agreed to develop and implement the National Safety Code (NSC) to encourage safer heavy vehicles and provide consistency across the many provinces. The NSC standards were developed in conjunction with the federal and the provincial representatives under the Canadian Council of Motor Transport Administrators.

The NSC provides four levels of standards with each standard differing in the frequency of the inspections.

Table 5: Four levels of National Safety Code heavy vehicle inspection standards[95]

	NSC Standard 11A Maintenance	NSC Standard 11B PMVI	NSC Standard 12 CVSA	NSC Standard 13 Inspection

[94] P.E. Green & D. Blower, op. cit.

[95] CCMTA, 2006.

Frequency	Regular (monthly)	Annual/semi-annual	Random	Daily
Inspection conducted by	Carrier/Operator	Inspectors (government)	Inspectors (govt. / Police)	Driver
Number of Vehicle Systems and Parts Inspected	10 systems 100 components	10 systems 100 components	14 critical safety systems	20 items
Compliance verification	Audit of Carrier Facility	On-road and Audit	On-road	On-road and audit

The CVSA inspection scheme which is used in the United States also extends to Canada and Mexico, and the NSC also provides a specific standard to address CVSA inspection requirements.

As each Canadian province still has the authority to independently manage inspections schemes, five provinces are not subject to the requirements under the NSC but have established their own procedures regarding inspections.

4.8.6 Comparison of Australian and international inspection regimes

There is significant variation in the approaches to heavy vehicle inspection regimes across the jurisdictions sampled as part of this review.

In terms of roadside inspections, all regulators undertook in these in at least some form. However, the administration of these varied, with some jurisdictions seeing transport or road agency staff conducting these, and others using the resources of police forces. As a result, the rate of roadside inspections varies from jurisdiction to jurisdiction.

Almost all of the sampled jurisdictions administered a scheme of mandatory, periodic heavy vehicle inspections. These included the United States, the United Kingdom, the European Union, New Zealand, Canada and most Australian states and territories. Victoria is a significant exception with no such requirement, while Western Australia and Tasmania only require periodic inspections for buses.

There is also evidence of variation in the scope and nature of periodic inspection schemes. For example, in the United States the scheme only applies to heavy vehicles engaged in interstate commerce (traveling between state borders), while in other locations such as the United Kingdom it applies regardless of country of origin.

Most jurisdictions specified 1 year as the maximum period between inspections, however New Zealand requires inspections be undertaken on a 6-monthly basis, and interestingly the ACT only requires inspections biennially (every 2 years) and then only for vehicles over 3 years of age.

Another significant point of difference between the Australian approach (despite internal differences between states and territories) and those implemented internationally is the way in which heavy vehicle inspection regimes may be linked to operator licensing schemes. A regime that is lined to operator licensing may be more practically administered and monitored, and provide assurances to both regulators and industry's customers. The United States, United Kingdom and New Zealand have each taken an operator licensing approach to managing roadworthiness.

Further, given the rating system linked to the United Kingdom's operator licensing scheme and roadworthiness assessment system for example, this approach may serve as motivation for operators to maintain their vehicles in an ongoing state of roadworthiness. In turn, a risk management approach to roadworthiness may allow regulators and enforcement agencies to better allocate their resources to those higher risk heavy vehicles both on-road and as part of their regular inspection regimes.

With the partial exception of mandatory accreditation for restricted access vehicles in Western Australia, Australia does not license heavy vehicle operators and has no comparable, formal national operator rating scheme.

5. Conclusions

This paper has provided an overview of current practice in heavy vehicle roadworthiness and accreditation, from the perspectives of both industry members and government regulators.

Effectively managing roadworthiness has been described as a form of risk management system; one which acknowledges the presence of multiple risks, with varying probability / frequency of incidences and severity of outcome. There are also multiple layers of defence against those risks which can complement one another to achieve a safe outcome. Roadworthiness compliance requires not only willingness, but also sufficient competence and resources.

Accounting for these various factors, heavy vehicle regulators (prior to commencement of the NHVR) have implemented roadworthiness assurance regimes, incorporating measures which include:

- Mandatory periodic or change-of-ownership inspections of heavy vehicles by independent (second or third) parties.
- Random and targeted inspections of heavy vehicles (such as on the roadside by regulatory officers).
- Accreditation schemes, based on operators demonstrating their having developed and undertaking a robust system of heavy vehicle maintenance.

Implementation of these compliance assurance measures varies significantly between Australian states and territories, and with those of some overseas countries and regions whose roadworthiness regimes were reviewed.

Previous studies and inquiries into roadworthiness have highlighted the major challenges in measuring the precise nature and degree to which roadworthiness impacts on vehicle defects and road safety outcomes. Most available studies relate to the roadworthiness of light vehicles. It cannot be assumed these are authoritative in determining an appropriate response to heavy vehicle roadworthiness issues. Many published studies reviewed concluded that a clear link between periodic vehicle inspections and specific improved road safety outcomes could not easily be established. However, evidence from a review of light vehicle inspection regimes in New Zealand and Victoria showed a reduction in crash risk from increased vehicle inspection frequency, but this did not seem to be as significant a factor in crash risk as the age of the vehicle, or its owner. The evaluation of the United States Federal Motor Carrier Safety Administration's CSA program showed that crash rates for heavy vehicle operators who did not meet the vehicle maintenance standards were more than double the rate of those who met all standards. A report of the European Commission that targeted roadside inspections on poorly maintained vehicles provided better operational effectiveness and decrease administrative burden. The age of a vehicle also emerged as a significant factor in roadworthiness and crash risk.

Given the current limitations of data collection methods that have been discussed in this paper, a review of the systemic integrity of accreditation, with consultation from the former scheme managers, transport operators, ang government and industry stakeholders is to be undertaken as a component of further phases of this review.

This paper was prepared to bring together the available information on current knowledge and activities that aim to ensure the roadworthiness of the heavy vehicle fleet. It does not make any recommendations for change, but provides a basis for a dialogue with stakeholders to identify options for improvements. The next stage of the NTC/NHVR Roadworthiness Program will build from this summary of current status to develop options for

an effective national approach to ensure the roadworthiness of Australia's heavy vehicle fleet. Input from stakeholders and compliance data will be essential to the effective development of these options.

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7. Abbreviations

Acronym	Expanded term
ACT	Australian Capital Territory
ADR	Australian Design rules
AIS	Authorised Inspection Station
AQTF	Australian Quality Training Framework
ATA	Australian Trucking Association
AVSR	Australian Vehicle Standards Regulation
COAG	Council of Australian Governments
CoR	Chain of Responsibility
CSA	Compliance, Safety, Accountability (Operational Model)
DVSA	Driver and Vehicle Services Agency (UK)
EC	European Commission
GVM	Gross vehicle mass
HML	Higher Mass Limits
HoS	Hours of Service
HVNL	National Heavy Vehicle Law
Jurisdictions	the States, Australian Capital Territory and the Northern Territory (the Commonwealth is separately referred to as „the Commonwealth")
MCRT	Ministerial Council for Road Transport
MDL	Mass Dimension loading
MMA Guide	Roadworthiness Guideline (NTC)
MMS	Maintenance Management System
MUARC	Monash University Accident and Research Centre
NHVAS	National Heavy Vehicle Accreditation Scheme
NHVIM	National Heavy Vehicle Inspection Manual
NHVR	National Heavy Vehicle Regulator
NOC	Notice of Claim

NOV	Notice of Violation
NSW	New South Wales
NT	Northern Territory
NTC	National Transport Commission
OEMs	Original Equipment Manufacturers
OH&S	Occupational health and Safety
OOS	Operations Out of Service Order
PBS	Performance Based Standards
Qld	Queensland
RAV	Restricted Access Vehicle
RIS	Regulatory Impact Statement
RMS	Roads and Maritime Services NSW
RTO	Registered Training Organisation
SA	South Australia
SMS	Safety Measurement System
SPV	Special purpose vehicles
Tas	Tasmania
TfNSW	Transport for New South Wales
TIAC	TruckSafe Industry Accreditation Council
TISOC	Transport and Infrastructure Senior Officials' Committee
Vic	Victoria
WA	Western Australia
WAHVAS	Western Australia Heavy Vehicle Accreditation Scheme

8. Key terms

Approved Vehicle Examiner	**A** person authorised by RMS **to conduct inspections and tests of registrable vehicles at authorised inspection stations and to issue inspection reports relating to those inspections (NSW) definition**)
Authorised Officer	As per s.80 of the *Heavy Vehicle National Law*: (a) a police officer declared by a law of a participating jurisdiction to be an authorised officer for the purpose of this Law; or (b) a person who holds office under this Law as an authorised officer.
Inspections	Activities performed by authorised officers or Authorised examiners for the purpose (within context of roadworthiness) to determine compliance with the HNVL ss. 69 and 80.
Roadworthy	A vehicle that complies with legislated vehicle standards

9. Appendix A: Summary of heavy vehicle inspection arrangements in each jurisdiction

Table 6 summarises the broad arrangements for heavy vehicle inspections in each Australian state and territory, including the circumstances under which a formal inspection is required and who may undertake the inspections.

Table 6: Summary of heavy vehicle inspection arrangements in each jurisdiction

State or territory	Name of document	Roadworthy requirements	Triggers for needing a roadworthy inspection	Roadworthy checks can be performed by:	Defect / Compliance notices can be issued by:
Victoria (Vic)	Certificate of Roadworthiness	• No periodic inspections •	• Interstate transfers96 • Ownership change • If registration expired for > 3 months	• Authorised licenced vehicle testers	• Police • VicRoads (and equivalent interstate) inspectors • Environmental Protection Authority •
New South Wales (NSW)	Heavy Vehicle inspection report	• Annual for truck trailer and biannual for buses	• Registration renewal • Interstate transfers • Ownership change	• Government inspection stations • Authorised licensed vehicle testers	• Police • RMS authorised officers • Authorised examiners cannot issue defect notices. If an authorised examiner detects a breach, they report it to RMS. RMS then chooses

[96] Except when no change of ownership (including spouse)

State or territory	Name of document	Roadworthy requirements	Triggers for needing a roadworthy inspection	Roadworthy checks can be performed by:	Defect / Compliance notices can be issued by:
			• If registration expired for > 3 months		whether to issue a defect notice.
Queensland	Certificate of Inspection[97]	• Annual for truck and trailer • biannual for buses	• Registration renewal • Interstate transfers • Ownership change • If registration expired for > 3 months	• Government inspection stations • Authorised licensed vehicle testers in limited circumstances98	Police and authorised officers Clearance of defects – For major defects: • Police • Authorised officers For minor defects: • Authorised examiners • Depending of the nature of the minor defect the driver can clear the defect (i.e. – tail light cover)
South Australia (SA)	Vehicle Inspection Report	• Annual periodic inspections for restricted access vehicles (B	• Registration renewal • Interstate transfers • Ownership	• Government inspectors. These officers are a mobile force and conduct vehicle inspections across SA	• Police • Transport Safety Officers • Vehicle Inspectors

[97] For motor vehicles exceeding 4.5 tonnes GVM and trailers exceeding 3.5 tonnes GVM.

[98] Authorised license testers can issue Certificates of Inspections for unregistered vehicles above 16t (GVM) and trailers over 16t (ATM) in remote areas or under natural disaster circumstances.

State or territory	Name of document	Roadworthy requirements	Triggers for needing a roadworthy inspection	Roadworthy checks can be performed by:	Defect / Compliance notices can be issued by:
		doubles and road trains[99]	change • To clear a defect notice[100]		
Western Australia (WA)	Certificate of Inspection	• No periodic inspections required for trucks but annual inspections for buses	• Registration renewal • Interstate transfers if owned for < 12 months • If registration expired for > 3 months • To clear compliance notice 101	• Government Inspection Stations (Perth) • Authorised Inspection Stations (Perth and rural)[102]	• Police Officer • Licensing Vehicle Examiner • Authorised Vehicle Examiner • Wardens operating with the Dealer Compliance Unit • Wardens operating with Omnibus Section of Licensing • Authorised school bus inspectors • Wardens operating with the Road Transport Compliance Section • Authorised Regional Coordinators operating in rural areas
Tasmania (Tas)	Application for Registration of a Heavy Vehicle (for unregistered	• No periodic inspections generally but Accredited	• Interstate transfers • Initial registration	• Approved outsourced inspection stations	• Police • Authorised officers

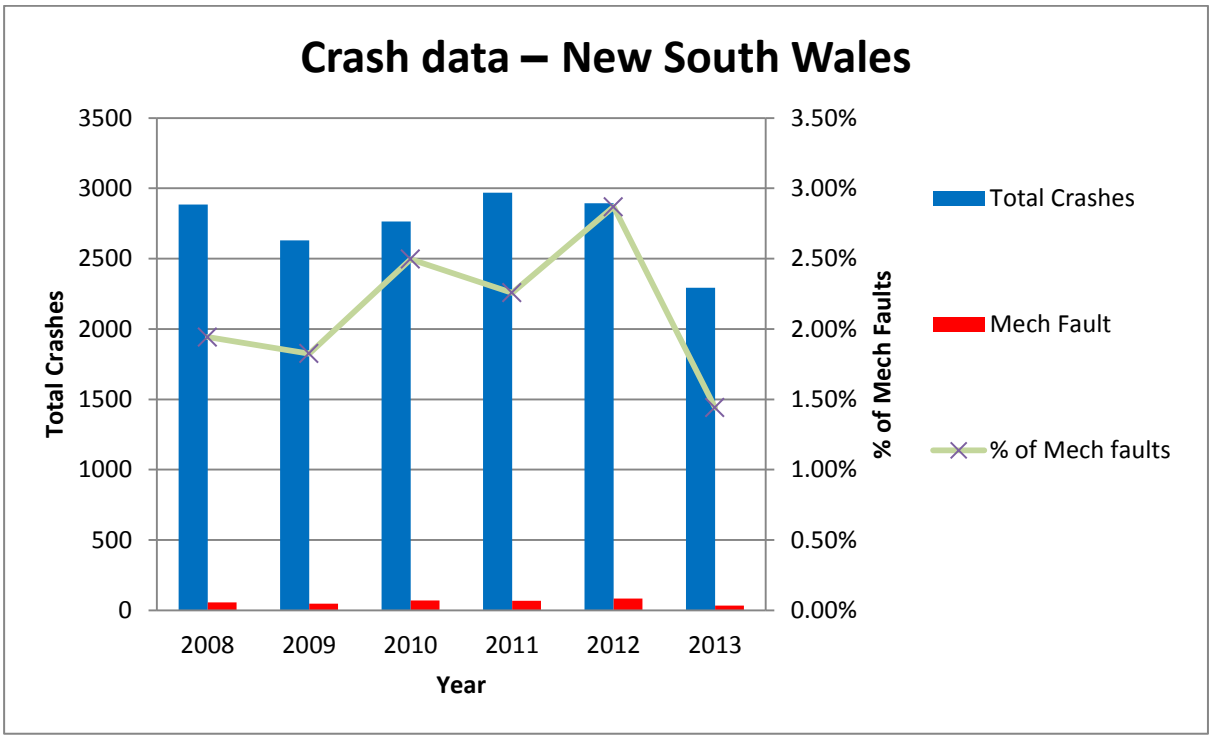
[99] Required if not in an approved accreditation scheme with Maintenance Management Module.
[100] Not all defect notices require a roadworthiness check.
[101] Compliance notice is the term used in Western Australia
[102] 80 stations as at 27/02/14.

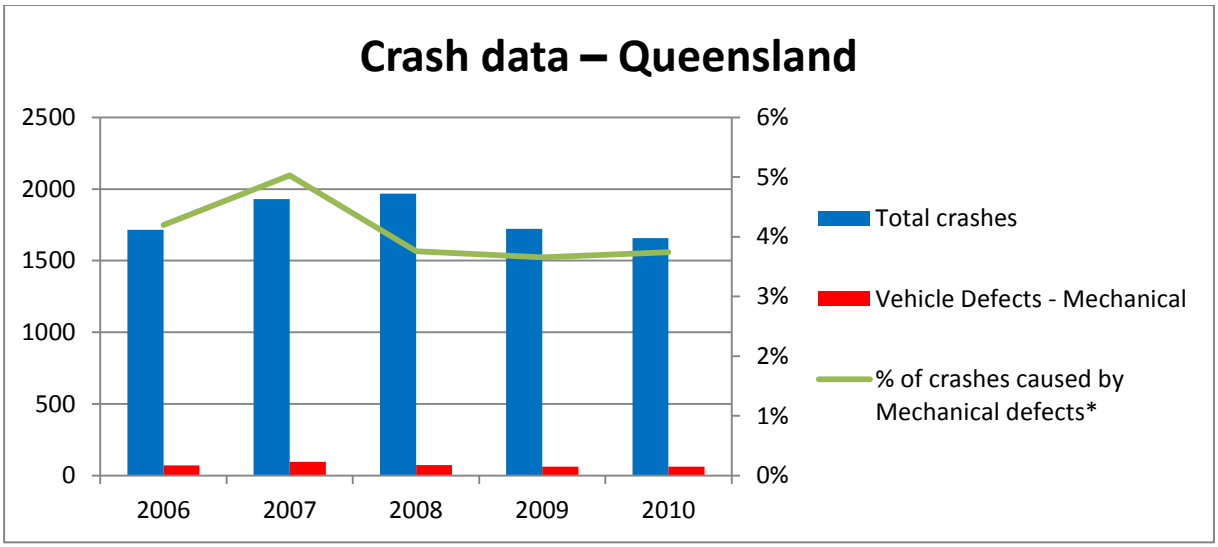
State or territory	Name of document	Roadworthy requirements	Triggers for needing a roadworthy inspection	Roadworthy checks can be performed by:	Defect / Compliance notices can be issued by:
	vehicles, General Inspection Report for currently registered vehicles)	Public Passenger Vehicles (PPV) 6-monthly or 12-monthly depending on vehicle age	• As required by a defect notice* • Call in notice		
Northern Territory (NT)	Vehicle Inspection Report In addition to a roadworthy, HVs are also required to pass a compliance check	• Annual	• Interstate transfers • Defect notices • Call-in Notice and verification of the vehicle condition is required103 •	• Government Inspection Stations • Authorised vehicle inspection stations • The compliance check may only be performed by a Transport Inspector operating from a Vehicle Standards Centre	• Police • Authorised officers •
Australian Capital Territory	Certificate of Inspection	• Any vehicle over 6 years old requiring a transfer of ownership	• Interstate transfers	• Government Inspection Stations	• Police • Authorised officer

[103] Call-in notices are generally issued by Transport Inspectors and generally cleared by Transport Inspectors following a full inspection of the vehicle.

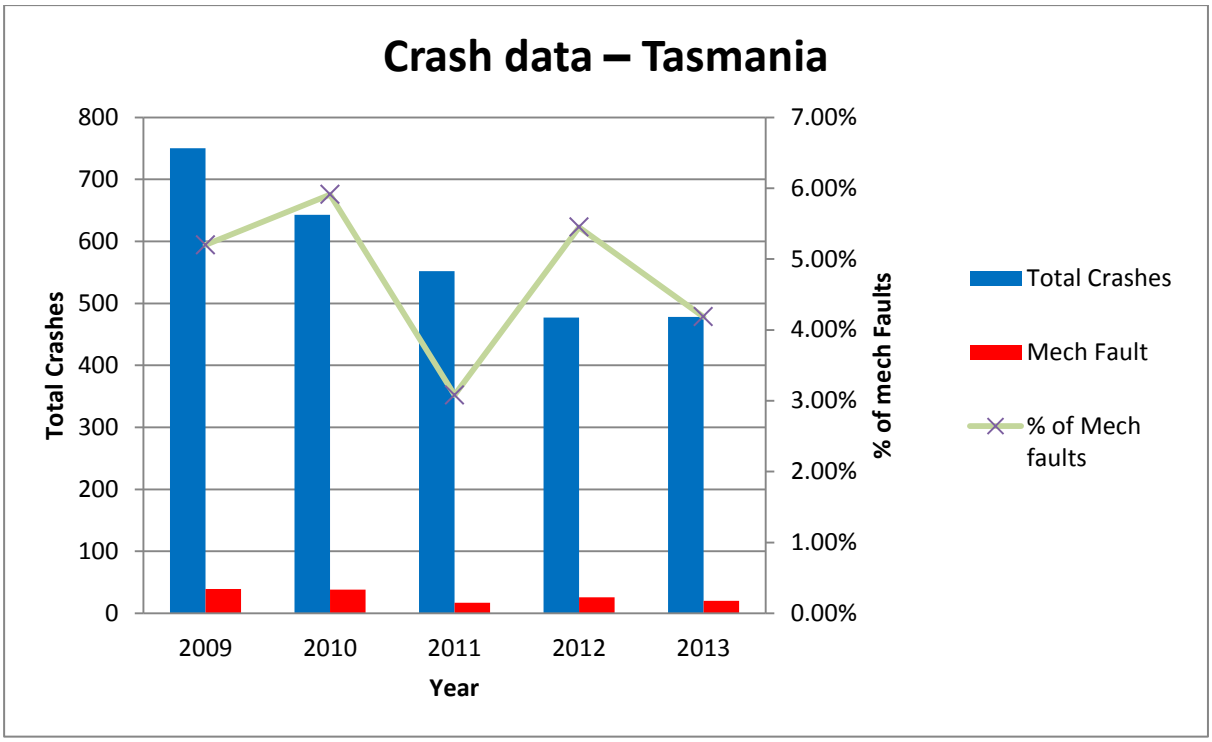
State or territory	Name of document	Roadworthy requirements	Triggers for needing a roadworthy inspection	Roadworthy checks can be performed by:	Defect / Compliance notices can be issued by:
		• When registration has expired by more than 12 months • Every 2 years after the vehicle is 3 years of age			

10. Appendix B: Crash data due to attributable mechanical faults

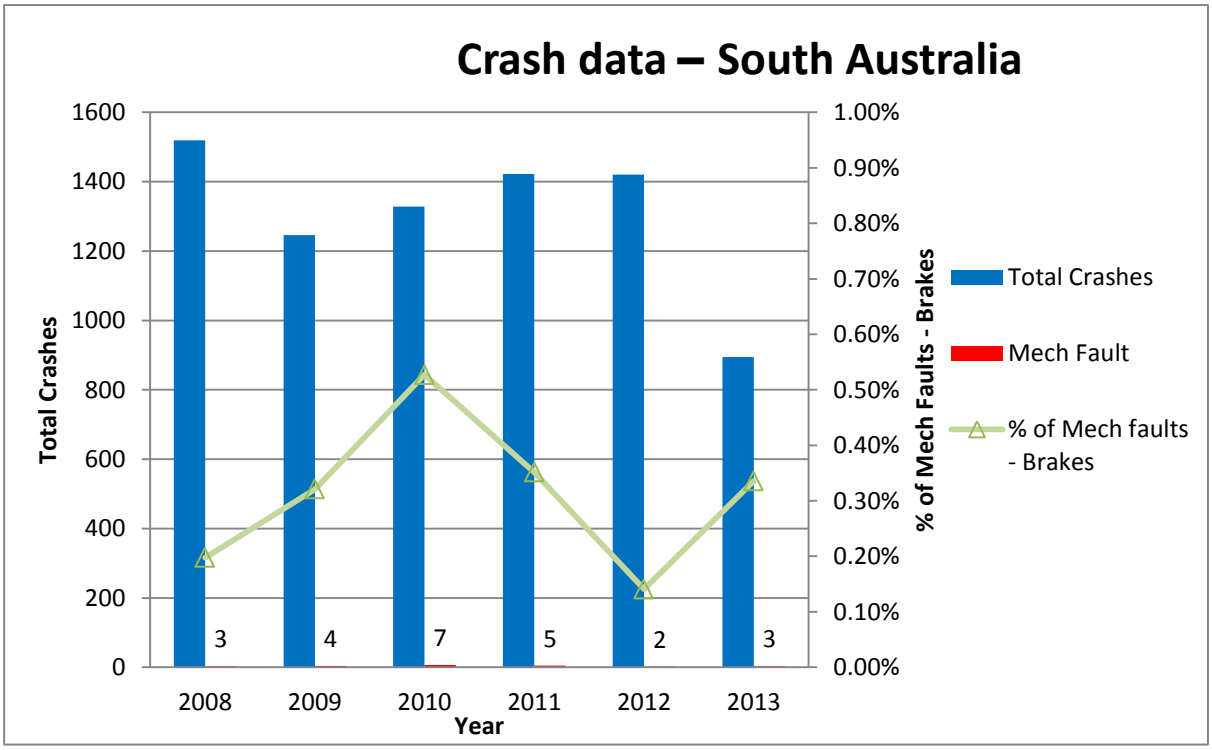




* No data available on defect types



*No data available for vehicle defect types



*No data available for other types of mechanical factors