COST EFFECTIVENESS

OF

PERIODIC MOTOR

VEHICLE INSPECTION

A REPORT FOR

THE FEDERAL OFFICE OF ROAD SAFETY

APRIL 1999

KEATSDALE PTY. LTD.

PO BOX 264 TUGUN

QLD 4224

0416-201498

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EXECUTIVE SUMMARY

The Federal Office of Road Safety (FORS) commissioned Keatsdale Pty. Ltd. to prepare a report on the cost effectiveness of periodic motor vehicle inspection (PMVI). A summary of the Keatsdale report follows.

PMVI is a controversial topic both internationally and within Australia. PMVI was not endorsed in the US by NHTSA (1989) but their conclusions were rejected by the GAO (1990). Less than half the States in the US operate PMVI programs.

In contrast the ECE members have agreed to the introduction of PMVI programs at least at a minimum level by 1998 following commissioned research (Rompe and Seul 1985). Japan maintains a stringent PMVI program although substantially revised in 1995.

In Australia opinion is divided. In the last decade major parliamentary and government reviews have not endorsed PMVI (Tasmania (1995), South Australia (1995), Australian Capital Territory (1994), Queensland (1990)). The RACV, RACQ, and the RAA are opposed to PMVI and its value is questioned by the ACA. However PMVI programs operate in New South Wales and the Northern Territory and PMVI is supported by the NRMA and FCAI.

The objectives set for PMVI programs are primarily road safety related - ie., to reduce the number of vehicle crashes through the reduction of the number of defective vehicles in the fleet, ie., through the improved mechanical condition of the vehicle fleet. Two questions arise - firstly, does PMVI lead to an improved condition of the fleet and secondly, is PMVI associated with reduced crashes.

Improved condition of the fleet The mechanical condition of a motor vehicle at any time during its operating life involves the interaction of a complex set of factors reflecting design/manufacturing philosophy including design life of components, owner/operator attitudes and behaviour, the behaviour of the maintenance providers and other elements of the automotive industry and the regulatory and enforcement environments established by governments. Australian laws place the onus on vehicle owners to maintain their vehicles in a "roadworthy" ie, in a mechanical condition which complies with specified requirements. Hence Government mandated PMVI is only one of a number of factors which may influence the mechanical condition of the vehicle.

The assumptions which underpin PMVI are complex and are rarely recognised and subject to scrutiny. Belief in the effectiveness of PMVI *presumes* that defects present in a manner which is amenable to identification at inspection, but this is not necessarily so; *presumes* that defects will be present at the time of inspection, but defects are highly likely to develop during the interval between inspections; and *assumes* PMVI inspection systems are reliable and produce consistent outcomes, but this is not necessarily so.

Research worldwide including definitive studies (Fosser 1992 Norway, NHTSA 1989 US) lead to the conclusion that PMVI does not result in an improvement of the mechanical condition of the vehicle fleet. While much of the body of research is methodologically flawed, it also suggests that not all defects are identified during PMVI and that the effect of PMVI is not enduring - research suggests that six months after inspection the defect rate in the vehicle fleet has increased significantly and for vehicles inspected at an interval of three years, the defect rate is comparable with vehicles which have not been subject to mandated inspection.

Reduced crashes Opinion is divided as to whether PMVI is associated with reduced crash rates. NHTSA (1989) in reviewing the extensive body of research found there was no conclusive evidence that PMVI was or was not effective in reducing crashes. GAO (1990) rejected these findings concluding that the issue was one of estimating the quantum of the reduction. ECE accepted the review by Rompe and Seul (1985) of European and US research which concluded there was a quantifiable association. Yet the most comprehensive and methodologically sound large scale experiment (Fosser 1992) was unable to demonstrate a link between vehicle inspection and crash rates. Similarly using FORS Fatal File (1992) Keatsdale was unable to demonstrate an association between PMVI and reduced fatal crash rates in Australian jurisdictions.

Keatsdale has undertaken a hypothetical benefit cost analysis, in the event that an association between PMVI and crash reduction may be established. The hypothetical benefit cost analysis has incorporated a range of vehicle defect related accident rates and a range of effectiveness levels of PMVI in identifying defects which would have caused or contributed to accidents.

A range of benefits from PMVI programs have been claimed including those relating to road safety, reduced emissions, increased vehicle productivity, reductions in vehicle theft and potential industry assistance.

For benefit cost calculations road safety benefits have been developed from BTCE (1994) estimates. FORS (1996) have estimated savings in emissions from a better maintained fleet of some $200m annually. Testing of vehicle emissions is not currently included in PMVI programs and the cost of inspections remain unknown. Furthermore FORS estimated that 80 percent of the benefits were related to 20 percent of the fleet, primarily older vehicles which will eventually be retired, ie. only 20 percent of the benefits if realisable are sustainable in the medium to longer term. For these reasons potential reductions in emissions have not been included in the hypothetical benefit cost calculations. While vehicle theft constitutes a major issue in Australian costing over $650m annually (NRMA 1995) recent analysis (Keatsdale 1997) for the National Motor Vehicle Theft Task Force demonstrated PMVI to be ineffective in countering motor vehicle theft for profit. Other claimed benefits are not readily quantifiable or have been considered to be of a lower order.

In the benefit cost equation the costs attributed to PMVI include not only direct costs associated with vehicle inspection but also the significant indirect costs including social time costs, operating costs and the costs of unwarranted repairs.

The hypothetical benefit cost ratios for a national PMVI program based on current NSW arrangements were calculated as 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) ie. *a national PMVI program with annual vehicle inspections commencing for vehicles at 4 years of age is unlikely to provide cost effective*. A range of other models was briefly examined but the benefit cost ratios were considered unlikely to change markedly.

An alternative to current PMVI programs based on integrating vehicle "screening" inspections with police RBT and speed enforcement operations offers the prospect of reducing the cost side of the benefit cost equation and hence improving the cost effectiveness of PMVI. This may require changes to legislation and would require changes to police operations.

It should however be noted that achievement of benefits from periodic motor vehicle inspection programs depend on their ability to eliminate defects which may cause or contribute to crashes. If the most comprehensive and methodologically robust studies ever conducted (Fosser 1992 Norway, or NHTSA 1989 US) are to be believed and the analyses of the FORS Fatal File (1992) for Australia is to be believed a relationship between PMVI and reduced crash rates has yet to be demonstrated.

1. INTRODUCTION

This is a report on the cost effectiveness of periodic motor vehicle inspection (PMVI) for light vehicles prepared by Keatsdale Pty Ltd for the Federal Office of Road Safety (FORS).

The term PMVI refers to government mandated requirements for motor vehicle inspection, usually associated with motor vehicle registration. The age at which vehicles are required to be inspected and the intervals between inspection may vary according to jurisdiction. The inspections may be undertaken by authorised private or public sector organisations.

Light vehicles are defined as passenger vehicles (including derivatives), vans, four wheel drives and trucks less than 4.5 tonnes.

1.1 Background

The utility of motor vehicle inspection programs is a controversial topic. Discussion is often polarised and is frequently driven by anecdotal information, limited personal experience and the perspectives of particular stakeholders. The assumptions which underpin PMVI are complex and are rarely recognised and subjected to careful scrutiny. A lack of reliable data together with research leading to conflicting outcomes (often as a result of methodological limitations) further hampers informed debate.

As governments seek to formulate optimal road safety investment programs this situation is unfortunate.

1.2 Terms of Reference

The Federal Office of Road Safety (FORS) commissioned Keatsdale to "*determine the cost effectiveness of Australian periodic motor vehicle inspection schemes, providing a rigorous evidentiary basis for conclusions through citation and the use of established analytical techniques.*"

The method specified by FORS included the following components:

- *review of current data sources and seminal literature, summarising key findings and tracing the development of thinking on the issue;*

- *a brief review and summary of the contribution of vehicle defects to crashes in Australia;*

- *the adoption of a holistic approach to the consideration of costs and benefits, including provision of soundly based estimates;*

- *a brief review of alternative vehicle assessment schemes;*

- *development of recommendations.*

1.3 The Keatsdale Team

The Keatsdale consultant team included Douglas Taylor B.E.(Civil), M.Eng.Sci., M.Admin., MIE, and Anna Hobday B.Sc., B.Ed.(Counselling), M.Clin.Psych. MAPS. As Head of the ACT Traffic and Transport Branch and Registrar of Motor Vehicles from 1980 to 1984 Douglas' responsibilities included management of the periodic motor vehicle inspection program.

1.4 Acknowledgments

Keatsdale wishes to express its appreciation of assistance provided by Government departments with responsibilities for road safety and vehicle inspection programs, police services and motoring associations. Keatsdale also wishes to record its appreciation of the assistance provided by FORS.

2.

OVERVIEW OF THE DEBATE

Diversity in policy on motor vehicle inspection programs is apparent both internationally and within Australia. Differing opinions are also apparent between and within stakeholder groups including government agencies, consumers and their representatives (including motoring organisations) and the motor industry. Discussion of the topic is also hampered by economic analyses which have produced differing outcomes.

2.1 International authorities

The US Federal Government has adopted markedly different policies on PMVI to the ECE and Japan. The US Government does not endorse PMVI and less than half of the US states operate PMVI programs. In contrast the ECE has endorsed PMVI and Japan continues to operate a PMVI program which was heavily modified in 1995.

In the US PMVI has been the subject of two major and comparatively recent reviews conducted by the National Highway Traffic Safety Administration (NHTSA) (1989), and Government Accounting Office (GAO) (1990). These reviews draw on the more pertinent of an extensive range of studies undertaken in the US over the past 20 years.

NHTSA reviewed existing research and data but was unable to establish a correlation between the reduction in motor vehicle defects arising from PMVI and a reduction in vehicle crashes. However, GAO revisited the NHTSA investigations and concluded that there was an association between PMVI and a reduction in crash rates, but that the *magnitude* of the crash reduction could not be determined.

Unlike the US, the ECE have endorsed a minimum PMVI program for introduction by Member States by 1 January 1998 at the latest. The endorsement followed the major ECE commissioned review in 1985 (Rompe and Seul) which supported its introduction in economic and social terms. Yet a major Norwegian study (Fosser, 1992) based on a large scale controlled experiment involving analysis of crash rates concluded there was no statistically significant difference in crash rates between vehicles subjected to PMVI and those which were not inspected. That report remains the most comprehensive examination of the issue to date.

A number of the larger ECE members already have PMVI programs in place which exceed the minimum standard. PMVI is undertaken in the UK, with the Ministry of Transport (MOT) (1994) concluding that the MOT testing scheme was achieving its objective.

In 1995 Japan modified its PMVI requirements including effectively doubling the interval between mandatory “maintenance” inspections (now annual) and doubling the interval between pre-registration inspections for vehicles over 11 years old.

Detailed discussion of these and other reviews are provided later in this report.

2.2 Australian authorities

Australian authorities are similarly divided on the merits of motor vehicle inspection. In the context of developing national road transport priorities the National Road Transport Commission advised that it had categorised PMVI for vehicles with Gross Vehicle Mass (GVM) less than 4.5 tonnes as Tier 3 - ie., not of national significance but rather of lower priority; constituting an issue on which States and Territories could choose to set their own policies and priorities.

Major reviews conducted in recent years in four Australian jurisdictions have not supported PMVI programs:

- Tasmania (1995) following an in-depth review decided not to introduce annual vehicle inspections or inspections at change of ownership. Policies to upgrade random inspection have been introduced.

- South Australia Parliamentary Committee (1995) concluded that "the claimed benefit (of PMVI) has not been proven" and there was "little evidence to suggest that substantial benefits would be derived from its introduction". Initiatives to significantly upgrade random inspections have been introduced.

- ACT accepted the recommendations of a lengthy in-depth review (Solomon et al 1994) and abolished its annual PMVI program. Greater emphasis has been placed on random inspections. The review concluded there was "widespread scepticism of the road safety benefits of wholesale vehicle testing programs".

- Queensland Parliamentary Travelsafe Committee (1990) reported that it was "not convinced that mechanical defects are a significant causal factor in road crashes to warrant the introduction of PMVI annual inspection."

Yet motor vehicle inspection programs of one form or another are operated in the three Australian states with the largest vehicle populations, and the NT.

NSW and the NT operate PMVI programs. In 1995 the NSW RTA commissioned a study to assess the level of roadworthiness of vehicles which were involved in crashes. The study includes passenger vehicles and light commercial vehicles. The results are awaited.

Vehicle inspection at change of ownership is also undertaken in Victoria and Queensland reportedly to meet consumer protection objectives.

In the context of the recent public debate over abolition of PMVI in the ACT, FORS (1996) observed in correspondence to the NRMA "annual roadworthiness inspection of cars has been one of the big disappointments in road safety".

2.3 Consumer representatives

A marked diversity of views is also reflected in the position of organisations purporting to represent the views of motorists.

The Royal Automobile Club of Queensland (RACQ 1996) reported "it had long advocated a system of random vehicle inspections (in preference to annual inspections)". "RACQ believes that high profile random roadside inspections offer the best option for reducing the number of unroadworthy vehicles on Queensland roads."

In evidence to the South Australian Parliamentary Committee Inquiry (1995), that State's motoring organisation, the Royal Automobile Association (RAA) indicated that it believed PMVI whether annual or at change of ownership, would not have any effect on road safety.

Similarly, the Royal Automobile Club of Victoria (RACV) (1994) acknowledged that annual PMVI "might" reduce crash costs but were opposed to it because it was not considered "cost effective".

By contrast when the ACT Government decided to abolish its annual PMVI program, the NRMA engaged in public debate, strongly opposing proposals to replace annual PMVI with random inspections, recommending a compromise instead that PMVI be conducted after three years and at intervals of two years until the eighth year when it recommended annual inspections be instituted.

The NRMA (1991) acknowledged fundamental problems within the NSW annual inspection system, but strongly supported the concept of PMVI being conducted in specialised large testing stations. The NRMA is thus a firm supporter of a centralised system of regular vehicle inspection.

Choice (1994), the magazine of the Australian Consumer Association questioned "Are consumers benefiting from these (PMVI) schemes or are they just being taken for a ride". They concluded that "In-depth studies don't exist to guide us in either direction" and commented that "with limited resources at our disposal and lives at stake, it is important to know what our money is buying".

Opinion amongst Australian consumer representatives thus remains polarised.

2.4

Motor Industry

Press reports and evidence to parliamentary inquiries suggest that sections of the Australian motor industry regard PMVI programs as, amongst other things, a potential industry assistance measure.

In discussing Australia's "ageing vehicle fleet" the President of the Federal Chamber of Automotive Industries (FCAI) was reported (Grennan, The Bulletin 1996) as commenting "our market has been shrinking and the Government needs to do something to put some impact into domestic sales". In this article the Chief Executive FCAI was reported as including PMVI along with sales tax reduction, accelerated depreciation and increased price differential between leaded and unleaded fuel in a "multi-pronged" response to the problem. PMVI was also considered to offer improved fuel economy and safety as well as benefits to the community.

An indication of the position of sections of the motor repair industry is also illustrated in evidence to recent parliamentary inquiries. The South Australian Motor Trades Association in its submission to the 1995 Parliamentary Inquiry reportedly indicated that inspection at change of ownership would only make a "small contribution to road safety" and suggested it should be accompanied by annual inspection of vehicles over five years of age.

The Queensland Motor Trades Association, in evidence to the 1990 Parliamentary Travelsafe Inquiry reportedly stated "This association refuses to accept the premise that vehicle condition is not a major factor in road accidents" and that PMVI "must be considered useful and effective". It recommended passenger vehicles over three years old be subjected to annual inspection.

It can be concluded that the Australian motor industry thus generally supports the concept of regular vehicle inspection for older vehicles. It should be noted that the industry would benefit from the introduction of PMVI through increased turnover including revenue from inspection fees, the value of consequent repair work and potentially accelerated scrappage rates for older vehicles.

2.5 Community Attitudes

Limited information is available on community beliefs concerning PMVI including its perceived benefits, consumers willingness to pay for mandatory inspections, and the behaviour of vehicle owners regarding maintenance and servicing of vehicles.

Anecdotal information available to the author suggests many Australian drivers believe vehicle inspection programs reduce crashes. It also suggests widespread community ignorance of the extent to which vehicle defects contribute to fatal and serious crashes and to the further question of whether PMVI is cost effective.

Attitudes to PMVI in British Columbia were examined by KPMG (1994) who reported that 57 percent of motorists surveyed believed PMVI reduced crashes, while 37 percent were undecided. KPMG also reported that the vast majority of British Columbia motorists were *unwilling* to pay the inspection fee considered necessary by the State Ministry of Transportation and Highways for "a proper inspection at a private garage". (The estimated inspection fee was in the range C$40 to C$60. Only 16 percent and 11 percent of motorists respectively indicated a willingness to pay these fees. Some 43 percent were reportedly willing to pay only C$25.). The statistics were however drawn from a limited survey involving only 174 motorists.

Comparable information is not available for the Australian community. However the author's experience in the ACT in the early to mid 1980s indicated that motorists recognised time involvement as an explicit and important cost. Where the elapsed time for queuing, pre-inspection, inspection and payment of registration exceeded 20 minutes significant levels of complaint were registered. The majority of ACT motorists were not prepared to accept an elapsed time of 45 minutes. Furthermore motorists' opinion was marginally in favour of retention of the annual inspection system with around 20 percent of drivers undecided. A greater proportion of women than men was supportive of annual inspection. At the time opinions were surveyed the average waiting times for ACT vehicle inspections during weekdays had increased to in excess of 45 minutes due to Government imposed resource constraints. The then Government's Review of Commonwealth Functions (RCF) decision to terminate annual vehicle inspections and the low levels of customer service had polarised motorist and community attitudes.

Elliott & Shanahan (1986) reported on exploratory research in NSW into beliefs about testing in private garages and a possible centralised testing system. Participants in group discussions which formed the basis of the research were car owners in Sydney and adjacent areas. Motorists' perceptions were that the system of authorised private garages offered convenience but resulted in "massive variation" in standards. A centralised inspection model was perceived to offer reduced convenience but greater consistency. Strong opposition to government operation of inspection systems was revealed (reportedly on the basis of efficiency, cost and customer service).

In contrast to these findings, the author observed that in the early to mid 1980s a majority of ACT motorists preferred government operated testing stations to a system of authorised public garages, as government inspectors were perceived to be impartial.

Anecdotal information reported by the UK Ministry of Transport (MOT) 1994 and observations by the author suggest PMVI may influence not only motorists' attitudes but also their behaviour. MOT has reported that a "great deal of anecdotal information" indicated that motorists "use the MOT test as a means of finding out what is wrong with their vehicle". Similar sentiments were evident in the ACT community. The author also observed that it was commonplace for some motorists (more so women than men) to believe that a "pass" at inspection meant that the vehicle was "safe for another year". For these motorists PMVI engendered a false sense of security.

Choice (1994) reported that the Federal Minister for Land Transport in 1992 had speculated that "feel good" perceptions may have been the reason resources had been allocated to PMVI programs.

2.6 Economic assessments

A wide range of economic performance levels for PMVI programs have been reported internationally and within Australia. These assessments reflect varying methodologies and assumptions. On the benefit side of the equation some studies have incorporated significant *non* crash related benefits with crash related benefits. On the cost side of the equation various costs have been attributed to PMVI, reflecting differing perspectives on inspection standards, valuation of waiting times associated with queuing for inspection and the recognition or otherwise of unintended costs (eg. unwarranted repairs). Furthermore significant differences in relative cost structures are apparent between countries (eg., the relative cost of fuel).

The crucial Rompe and Seul (1985) study undertaken for the ECE included critical assumptions which given the passage of time must now be regarded as of questionable validity (in particular given changes in engine technology (computerised engine management systems and fuel injection) over the last decade, the levels of fuel savings attributed to tuning of engines failed at inspection). Further discussion is presented in Chapter 7.

Benefit-cost ratios estimated for PMVI are generally below 2.0 and typically around 1.0 or below. Examples of the economic assessments drawn from a literature survey are presented below in Table 1.

The lack of consistent outcomes as to whether PMVI is cost effective has added to the controversy.

TABLE 1 - Examples of Benefit Cost Ratios (BCR) for PMVI

Source	Assessment	Comment
RACV 1994	BCR in range 0.07 to 0.41	Based on replacing inspection at change of ownership in Victoria with annual inspection
NRMA 1991	BCR of between 1.0 and 1.2 to 1.9	Ratio of 1.0 achievable by optimising the current NSW authorised garage inspection system. Ratio of 1.2 to 1.9 based on new dedicated inspection centre program plus random inspection.
Rompe and Seul 1985 for ECE	BCR of 2.0 for a “minimum” model and 1.7 to 2.6 for an “optimum” model	Estimates for ECE Member States, minimum based on inspection beginning after seven years, optimum based on inspection beginning aft er three years.
Loeb and Gilad, 1984	BCR of 1.24	Based on assessment of New Jersey PMVI Program.
Jackson et al, 1982	BCR of 1.86	Based on assessment of New Jersey PMVI Program.
NHTSA 1989	Minimum PMVI Program would have to be 6% to 15% effective in reducing vehicle related crashes to be cost effective. *	Minimum inspection time of 10 minutes.
	Maximum PMVI Program would have to be 14% to 39% effective in reducing vehicle related crashes to be cost effective. *	Maximum inspection time of 24 minutes.

* ie. to have a BCR of 1.0

Further discussion of the RACV and NRMA studies and the ECE commissioned Report is presented in Chapter 9.

3. PMVI IN CONTEXT

3.1 A general conceptual model

Motor vehicle crashes can be attributed to the interaction of a range of factors including driver behaviour, the road and traffic environment and the mechanical condition of the vehicle. The relative importance of each of these factors in crashes is discussed in Chapter 5.

In this Chapter PMVI is examined in the context of factors affecting the mechanical condition of the vehicle. The objectives of PMVI programs are examined and comparative economic performance benchmarks identified. An overview of selected international and all Australian motor vehicle inspection programs is also presented.

PMVI is directed at addressing issues associated with the mechanical condition of the motor vehicle. It constitutes *one small element* of a wide and complex set of factors affecting the condition of a motor vehicle during its working life.

In broad terms the likely mechanical condition of a motor vehicle at any time is determined in part by the designer/manufacturer, the owner/operator, service providers and the regulatory and policy environment established by governments. The presence of a vehicle defect may be dependent on a large range of factors including:

- the intrinsic nature of the vehicle reflecting the manufacturer's design policies and standards including the *design life* of the component parts;
- warranty and servicing arrangements specified by manufacturers and/or related to consumer legislation;
- maintenance policies set by manufacturers which may reflect a preventative approach to maintenance or, alternatively, replacement of parts at failure. More particularly, whether service intervals are related to the design life of componentry;
- manufacturers' recall policies and mandatory recall programs, including their effectiveness;
- the economics of vehicle purchase and vehicle maintenance;
- vehicle age and the nature and amount of vehicle usage;
- owner/driver attitudes to vehicle maintenance, inspection;

- the nature and quality of vehicle servicing provided by motor dealers, garages, petrol stations, smash repairers etc.;

- public education activity of a road safety nature;

- legislative requirements concerning roadworthiness of vehicles and requirements for mandatory vehicle inspection; (It should be noted that conditions of operation imposed on motorists are in marked contrast to those imposed on aircraft operators where preventative maintenance regimes reflect differing risk and materiality considerations.)

- police enforcement activities.

Unfortunately the majority of research has failed to recognise the wider context. While some research of an econometric nature has sought to recognise the influence of broader factors, difficulties have been experienced in undertaking robust quantification.

Significant changes have been observed internationally and in Australia over the last 20 years in relation to many of the factors considered likely to effect the condition of the vehicle fleet.

Developments in motor vehicle technologies have led to increased service life of components. Australian Design Rules have increased the safety of vehicles having regard to their performance and crashworthiness. Manufacturers have increasingly incorporated built-in indicators which advise of the failure of key safety components (eg., brakes, headlamps). New car warranties have become longer, and extended warranties are now available for most vehicles. Mechanical reliability of vehicles has generally improved allowing servicing times to be increased. The introduction of manufacturers' recall programs has also contributed to improved vehicle condition.

The introduction by Australian governments of more onerous warranty requirements on the sale of some[1] second-hand vehicles may also have contributed to improved mechanical condition of these vehicles.

Over the last decade or so increasing investment in Australia on public education designed to reduce the road crash toll has served to increase community awareness of the importance of road safety. Increased police enforcement effort including Random breath testing (RBT) operations, speed enforcement operations and general traffic operations may also have heightened the community's perceptions of the risks of being caught driving an unroadworthy vehicle.

Rationalisation of petrol distribution and sales in Australia over the same period has led to a massive reduction in the level of driveway service (checking of inflation pressure in tyres, water, oil etc.) provided in the past by petrol stations. Depending on driver behaviour

[1] older vehicles and high use vehicles due to their low resale value are frequently excluded from second hand warranties

concerning monitoring of vehicle condition, this change may have led to an increased incidence of particular types of defects - eg., low tyre inflation.

These changes could be expected to impact on the mechanical condition of the motor vehicle fleet and must lead to the questioning of the relevance today of data used in studies in the 1970s and early 1980s.

These changes must also lead to the questioning of the relevance of overseas findings to the Australian environment.

3.2 Objectives of PMVI and criteria for assessment

Australian States and Territories require motor vehicles to comply with Australian Design Rules and responsibility is placed on vehicle owners to maintain the vehicles in a "roadworthy" condition.

While not questioning the validity of the mandatory requirement for vehicle owners to maintain their vehicles in a roadworthy condition, the question faced by regulators is what level of public intervention (in whatever form) is cost effective or can be otherwise justified.

It is significant that in each of the four recent State and Territory government reviews of motor vehicle inspection programs, the mechanical condition of the vehicle was not perceived to be an end in itself, but rather a means of achieving other objectives, primarily crash reduction. Stated objectives for PMVI have, however, often been represented as relating to the issue of roadworthiness of motor vehicles. ie. that the mechanical condition of a vehicle is equal to the standard required by law (ie. compliance). For example, the objective set for the UK scheme (MOT 1994) is "providing a means of ensuring the roadworthiness of cars on the road in a way which is acceptable to, and is not burdensome for motorists". Achievement of this objective is *assumed* to provide benefits in relation to "road safety, the environment, crime prevention and consumer protection". The MOT acknowledged that PMVI also met a broader objective for owners who were concerned about the condition of their vehicle and sought an *independent* assessment. "Very many motorists use the MOT as a means of finding out what is wrong with their vehicle".

In contrast the US GAO (1990) recognised that the primary objective of PMVI was related to crash reduction. "If periodic inspection programs are effective, they should reduce the number of accidents caused or aggravated by worn or defective vehicle equipment", ie., the GAO did not accepted roadworthiness as an end in itself.

As mentioned previously the FCAI reportedly considered PMVI as a means of achieving a further objective of assisting the motor vehicle industry at a time of a low level of activity.

If PMVI is not to be regarded as an end in itself, its objectives must presumably relate to the generation of benefits involving road safety, and/or the environment, and/or crime prevention, and/or consumer issues, and perhaps industry assistance. The case for public intervention might then be assessed in terms relevant to the chosen objective.

From an economic perspective, investment in PMVI must meet at least two basic criteria; firstly, that the benefits exceed the costs and, secondly that, in the event of capital rationing, the rates of return from investment in PMVI should exceed those available from other forms of public regulation or investment. The investment may also be required to meet other social policy objectives.

Regarding alternative road safety investment options available to government research undertaken by Monash University Accident Research Centre (MUARC) (1991) and Bureau of Transport and Communications Economics (BTCE) (1995) have revealed a range of road safety countermeasures which offer benefit cost ratios over 5.0. Examples are reported in Table 2. These projects provide a benchmark against which PMVI can be ranked.

TABLE 2 - The cost effectiveness of a range of road safety countermeasures

Countermeasure	**Specific Target**	**Community BCR**	**Net Present Value (for specified amounts of treatment)**
Rural roadside hazard management program [1]	Fixed object crashes in rural areas	18	$34m (for treatment of 350 km)
Urban roadside hazard management (poles) [1]	Crashes involving striking a pole	13	$18m (for treating 150 sites)
Roundabouts [1]	Cross-intersection crashes	7.5	$30.1m (for treating 200 sites)
Road duplication / provision of median on rural roads [1]	Undivided State highways	5	$4m (for nominal capital program of $1m)
Rural overtaking lanes [1]	Undivided State highways	5 to 10	$4m to $9m (for nominal capital program of $1m)
Rural road sealed shoulders [1]	Head-on and single vehicle crashes on rural roads	22	$147m (for treatment of 350 km)
Pedestrian facilities [1]	Crashes involving pedestrians on arterial roads	9	$19.2m (for nominal capital program of $1m)
Black Spot Program [2]	• provision of medians • traffic signal modification • roundabouts • intersection channelisation • new traffic signs	13.4 6.8 5.6 4.9 2.6	

[1] MUARC (1991)
[2] BTCE (1995)

3.3 Overview of international and Australian arrangements for vehicle inspection

A wide range of inspection regimes have been instituted internationally and in Australian States and Territories. Significant differences are apparent in the vehicle age at the time of commencement of inspections and the interval between inspections.

Annual PMVI is now only required in NSW and the Northern Territory, while inspection at change of ownership is required in Victoria and Queensland. The ACT has replaced annual PMVI with a "hybrid" form of inspection - annual inspection of vehicles 6 years of age where change of ownership *has* occurred.

All jurisdictions require some form of pre-registration identification and testing for vehicles which have been unregistered for extended periods of time or where transfer of registration between jurisdictions is being sought.

Considerable variation is also apparent amongst ECE Member States, and amongst the various States in the USA. Further information is reported in Table 3.

TABLE 3 - Overview of PMVI arrangements: Australian and selected overseas examples.

Jurisdiction	Comment
NSW	Annual testing of passenger vehicles over four years of age.
VIC	Inspection on change of ownership of vehicle.
QLD	Inspection on change of ownership of vehicle.
SA	No PMVI.
WA	No PMVI.
TAS	No PMVI.
ACT	Annual government testing of vehicles over six years recently abolished. Inspection now only required for vehicles six years of age or older when change of ownership has occurred.
NT	Annual testing of passenger vehicles over three years of age.
ECE minimum	PMVI commencing at four years, interval two years.
Germany	PMVI commencing at three years, interval two years.
UK	PMVI commencing at three years, interval annual.
Norway	PMVI but application to a 10 percent sample only (Fosser, 1992).
New Zealand	PMVI annually for first six years, then six monthly inspections thereafter.
Japan	PMVI commencing at three years, interval two years prior to registration but also requires evidence of annual maintenance inspections.
United States*	PMVI 21 States and DC Random 19 States None 10 States

* Of the 11 US States which have repealed PMVI since 1976, seven have adopted random inspection programs, (Montana also requires PMVI at four year intervals) and four have no form of PMVI or random inspections.

Marked differences are also apparent in the operation of PMVI programs.

In NSW annual PMVI testing has been privatised, while Northern Territory relies on a combination of Government testing stations and private garages (in remote locations). The ACT has retained one Government owned testing station. Change of ownership inspections in Victoria and Queensland are undertaken in private garages.

Authorisation to conduct the mandatory tests may be limited to certification of vehicle inspectors (eg., Victoria) or may include this requirement in combination with approval of vehicle testing facilities (eg., NSW).

In contrast to the US, where the majority of States rely on the use of authorised private garages and or approved vehicle inspectors, the majority of ECE Member States have adopted systems of government owned and operated testing facilities. A major exception is the UK. Further information is provided in Table 4.

TABLE 4 - Administrative arrangements for PMVI programs: Australian and selected overseas examples.

Jurisdiction	**Primary responsibility for conducting inspections**	**Comment**
NSW	The RTA approves Inspection Stations (AIS) ie., authorises private garages and licenses testers.	6,114 AIS and 12,462 examiners (1987). The system was reportedly overhauled in 1992/93 by the RTA. Fees are set by the RTA.
VIC	VicRoads authorises Licensed Vehicle Testers (LVT).	Around 2,500 LVT (1996). The test fee is not regulated and market rates apply. The Roadworthiness Certificate is valid for 30 days.
QLD	Department of Transport (DOT) authorises Approved Inspection Stations (AIS) (private garages).	2,264 AIS and 3,711 examiners (1996). Fee set by DOT. Certificate is valid for 30 days.
ACT	One Government owned and operated testing station is used to check vehicles found from random inspection to be defective and some other inspections.	The former ACT system was based on use of two Government owned and operated testing stations, and authorised inspection stations (private garages) for retest of failed vehicles.
NT	Government owned and operated testing stations.	Some use is made of authorised private garages in isolated areas.
ECE	16 of the 19 Member States with PMVI use government owned and operated testing stations.	Three Member States use authorised private garages.
UK	Uses Authorised Examiners (AEs) and Nominated Testers (NTs) (ie., use of private garages and inspectors).	The UK system includes some 18,000 AEs and 55,000 NTs. (MOT, 1993)
Norway	PMVI on around 10 percent of the population of passenger vehicles and vans conducted by Department of Motor Vehicles (Fosser, 1992).	Roadside inspection is conducted on around 18 percent of the fleet (Fosser, 1992).
New Zealand Japan	Predominantly government authorised private garages. Ministry of Transport authorise repairers who have the required automated equipment, plus government owned and operated testing stations.	Around 30 percent of vehicles were tested in government owned and operated testing stations. (White, 1988) Around 20,.000 authorised repairers, 91 government test stations (1995).
United States	19 of the 21 States (including DC) use authorised private garages and	Nine States have government owned but contractor operated emission testing

	inspectors.	facilities.

4. PMVI AND VEHICLE DEFECTS

4.1 Assumptions underlying PMVI

The efficacy of PMVI programs is frequently accepted at face value and the assumptions and logic which underpin PMVI are rarely recognised and subjected to scrutiny.

The hypothesis that PMVI leads to a reduction in crashes involves two propositions, ie., firstly that PMVI leads to a reduction motor vehicle defects; and secondly that the consequent reduction in motor vehicle defects results in fewer road crashes.

The first proposition that PMVI leads to a reduction in motor vehicle defects is based on a range of beliefs and implies a sequence of causal relationships. These include that:

- motor vehicles commonly contain defects which render them unsafe;
- vehicle defects increase with the age of the vehicle;
- vehicle defects are amenable to identification;
- vehicle defects can be identified with certainty and consistency through inspection arrangements;
- the nature of inspections and the interval between inspections have been set to provide confidence that vehicle defects will not occur between inspections.

These factors are discussed in this Chapter.

The second proposition that the consequent reduction in motor vehicle defects arising from PMVI leads to a reduction in motor vehicle crashes is discussed in Chapter 5.

4.2 In-service condition of the Australian motor vehicle fleet

Comprehensive reliable information on the “in-service” condition of the Australian motor vehicle fleet is not readily available. A range of data is available from random inspections, PMVI programs and surveys but these data sets have serious limitations.

Random road inspection data potentially provides some useful insights into the condition of passenger vehicles. It is typically available from police records, but must be treated with caution. While much vehicle inspection activity may be perceived as “random”, the samples are not uncommonly selected on the basis of vehicles exhibiting visual signs of deterioration (ie., a targeted sampling). They may also be derived from other self-selecting samples, eg., speeding vehicles.

In some respects ACT data collected in 1995 and 1996 provides an insight into the in-service condition of the vehicle fleet. The reported data samples were generally randomly selected. They arose from inspections undertaken by Licensed Vehicle Inspectors in two open public car parks and while accompanying police undertaking RBT inspections. The samples were of significant size; some 680 vehicles inspected in car parks and some 3,600 vehicles inspected in four separate RBT operations. Unlike vehicles presented for annual vehicle inspection or roadworthiness inspection, these vehicles could not have been "prepared" for inspection.

The data revealed that on average 1.3 percent of vehicles inspected had defects considered sufficiently serious that the vehicle could not be driven. An average of 11.5 percent of vehicles were assessed has having defects which required repair within 14 days and an average of 11 percent of vehicles were issued with "cautionary advice".

Details of the inspections are reported in Table 5.

TABLE 5 - Incidence of vehicle defects - ACT random inspections

Date	Type	Number of vehicles inspected	Defects (A)	Defects (B)	Caution advice only
Sept '95	R	1,462	12%	3%	13%
Feb '95	R	466	12%	1%	13%
Mar '95	R	1,006	10%	0%	12%
Apr '95	R	680	13%	0%	15%
Jan '96	P1	490	9.6%	0%	0%
Jan '96	P2	190	13%	3%	2%

ACT Department of Urban Services (1996)

(A) Defect to be rectified within 14 days and vehicle to be presented for inspection at Testing Station.
(B) Vehicle not to be driven.
R Roadside inspections undertaken by ACT vehicle inspectors.
P Inspections of vehicles in car parks (1) Civic (2) Belconnen undertaken by ACT vehicle inspectors.

The testing undertaken in each instance was varied in scope and this part explains the differences in the incidence of defects identified. Exhaust/noise defects were not identified during vehicle inspections undertaken in car parks. It is also reasonable to expect other defects including those associated with lights, steering and brakes would be *understated* compared with comprehensive inspections undertaken at ACT testing stations. Foremost amongst defects were defective tyres (tread less than 1.5mm) ranging between 7 percent and 14 percent of vehicles inspected. This assessment is probably a fair reflection of the extent of tyre defects in the vehicle fleet, as the means of defect identification are the same whether undertaken in a testing station or in the field. Further details are provided in Table 6.

TABLE 6 - Nature of vehicle defects - ACT random inspections

	Defect Category					
Date	**Worn tyres**	**Exhaust defects/ noise**	**Unapproved modifications**	**Cracked broken windscreens**	**Head/ tail lights**	**Other**
Sept '95	10.8%	1.2%	0.6%	1.8%	1.8%	1.5%
Feb '95	9.4%	1.3%	2.0%	1.3%	1.7%	1.7%
Mar '95	7.0%	1.3%	0.4%	1.6%	0.9%	0.8%
Apr '95	7.4%	0.7%	0.9%	2.4%	1.1%	1.9%
Jan '96	9%	-	-	1.2%	0.6%	-
Jan '96	14%	-	-	3.7%	1.0%	0.5%

ACT Department of Urban Services (1996)

A further source of data on the in-service condition of vehicle tyres is provided by the NRMA (1993) Tyre Survey involving a random sample of vehicles (701) selected in Sydney car parks. The NRMA concluded the results were "disturbing". "Only 17 percent of the 3,012 tyres surveyed were of the correct pressure and had no other fault". NRMA also reported "12 percent (of vehicles) had tyres that were in a poor overall condition".

NRMA concluded "the results show little evidence of improvement in the general *attitude* of motorists to tyre care" (comparison drawn with 1987 NRMA Tyre Survey). It should be noted that the NRMA applied standards generally higher than required by law, eg., 3mm tread depth and ± 10 percent in recommended tyre pressure. Spare tyres in over 200 vehicles were also included in the sample. NRMA reported that the major cause of uneven tyre wear was poor wheel alignment.

Under inflation of tyres by more than 50 kpa (ie., around 30 percent of the manufacturers recommended tyre pressure) was reported in 9 percent of tyres. From a road safety viewpoint this observation is significant. Fluctuations in tyre pressures can occur in a relatively short period of time and hence are not readily amenable to identification through annual or two yearly PMVI.

Tread depth of 3mm or less was reported on 19 percent of tyres. Again tyre wear may occur over a relatively short period of time with high vehicle use and PMVI is unlikely to be highly effective in identifying the problem in a timely manner.

These findings were observed in a jurisdiction which has compulsory *annual* motor vehicle inspection reinforcing the point that PMVI is not effective in identifying some important vehicle defects.

Limited data is also available from annual PMVI programs. Although dated published ACT (1973) data for government testing stations 1968/69 to 1970/71 revealed a failure rate between 23.9 percent and 26.4 percent. Between 5.3 percent and 5.8 percent of vehicles were failed due to tyre defects - around half the level reported above. The failure rate at inspection due to brake defects was between 9.0 percent and 9.8 percent. Steering and suspension defects were the single largest cause of failure at inspection in the range of 10.2 percent to 17.1 percent. It should be noted that the failure rate at inspection due to defects in steering and suspension declined some 40 percent over the three years reported. In the early 1980s the rate had declined even further. Further details are reported in Table 7.

TABLE 7 - The main safety related defects detected in inspection in ACT 1968-71

	1968/69	1969/70	1970/71
Vehicles Inspected	72,204	80,791	85,506
Vehicles Rejected	19,054	18,933	20,405
Percentage Rejected	26.4	23.4	23.8
Reasons for Rejection (percentage)			
• Brakes incl. hand brake	2.2%	9.0%	9.8%
• Headlamps	5.8%	6.0%	6.9%
• Tyres	17.1%	5.8%	5.3%
• Steering or Suspension	13.6%	11.7%	10.2%
• Other faults *		12.3%	14.3%

ACT (1973) Department of Capital Territory
* Includes parking lights, stop lights, signal lights, rust and sub-frame cracking, exhaust, leaks, etc.

More recent data on the vehicle failure rate in the NSW inspection system has been published by the RTA (1996). The average failure rate at Authorised Inspection Stations (AIS) in 1995 was 19.9 percent for registered vehicles (first inspection) and 29.1 percent for unregistered vehicles (first inspection). Information was not available on the incidence of defects. There is no basis for determining whether these failure rates are indicative of the overall condition of the vehicle fleet.

As mentioned previously motorists' responses to PMVI programs are unknown, in particular the percentage of vehicles "prepared" for inspection, and those vehicles where servicing/maintenance would normally have been undertaken but has been deferred pending annual testing. Anecdotal information suggests it is not uncommon for NSW AIS to advise motorists of defects, obtain approval to repairs and subsequently record a "pass" of inspection. Other factors associated with inspection standards and procedures may also directly affect "pass rates". These are discussed later in this Chapter.

Statistical information on vehicle defects at time of inspection is provided by the Swedish Motor Vehicle Inspection Company (A. B. Svensk Bilprovning 1992). Of the 3.3 million vehicles aged two years and over inspected in 1991, 46 percent did not have a defect while 31 percent were observed to have minor defects and were "passed". Of the quarter of vehicles which failed inspection only 2 percent were "prohibited from traffic", ie., only 0.5 percent of the total vehicle population inspected were in such poor condition as to be prohibited from road use.

Of reported defects, the most commonly observed were parking brake (11.2 percent), headlamps (7.9 percent), brakes, (rear 8.1 percent, front 7.6 percent). Exhaust defects accounted for 5.3 percent while tyre defects accounted for only 4.8 percent. A. B. Svensk Bilprovning also reported increased incidence of vehicle defects with age. For vehicles which were failed, the failure rate was 5 percent for two year old vehicles increasing to 40 percent for 14 year old ones. For vehicles "passed" at inspection but with observed defects, 16 percent of two year old vehicles had at least one defect increasing to 77 percent for 14 year old vehicles, ie. the incidence of defects increased with age.

The Swedish data is broadly consistent with aggregate NSW annual inspection data. It is not however necessarily directly applicable to Australia due to differences in the composition of the vehicle fleet, operating conditions, vehicle utilisation and possibly other factors identified earlier.

The VACC 1994 Roadworthiness of Vehicles Survey provides a perspective on the condition of vehicles at the time of potential change of ownership. The data was drawn from a randomly selected sample from some 5000 Roadworthiness Certificates (RWC) obtained from VicRoads archival records. The survey revealed an extra-ordinary average failure rate of around 79 percent (Table 8).

This data is of particular interest as it is so markedly different from the ACT, NSW and Swedish data reported above. The survey revealed an increase in the percentage of vehicles recording a defect with age - 60 percent at four years of age increasing to around 85 percent for vehicles over 10 years of age. It also revealed an increased number of average faults with age - 2.5 per vehicle for those four years old increasing to 5.7 per vehicle for those over 10 years old.

The most common reported defect in the VACC Survey was brakes (40 percent of vehicles), followed by turn signals (39.1 percent of vehicles) and tyres/wheels (30.1 percent of vehicles). The incidence of defect type is reported in Table 9.

TABLE 8 - Vehicle Defect Data - VACC Roadworthiness Survey June 1994

	Defective vehicles by vehicle age											
	Pre 1984	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**Total**
Vehicles tested	2,868 (57%)	338 (6.7%)	411 (8.2%)	324 (6.5%)	284 (5.7%)	299 (5.0%)	280 (5.6%)	143 (2.9%)	56 (1.1%)	17 (0.3%)	6 (0.1%)	5,026 (100%)
Vehicles with *no* faults	16.8%	19.5%	20.2%	21.6%	23.6%	21.1%	32.1%	40.6%	57.2%	53.0%	16.7%	20.3%
Average faults per vehicle	5.7	4.2	4.0	3.5	3.5	3.2	3.0	2.5	2.6	2.8	4.0	4.8

TABLE 9 - Incidence of vehicle faults - VACC Roadworthiness Survey June 1994

Defect	Percentage of vehicles exhibiting the faults
Brakes	40.0
Turn signals	39.1
Wheels and tyres	30.1
Windscreen wipers	28.9
Windscreen	24.4
Fuel/oil leaks (est.)	25.0
Suspension	22.7
Exhaust	20.4
Headlamps	19.3
Steering	12.8

Brief comment on the incidence and nature of identified defects is presented in Table 10.

TABLE 10 - Incidence and nature of vehicle defects. VACC Roadworthiness Survey June 1994

Description of defect	Number of observations	Comments on the primary causes of failure at inspection
Brakes	3,207	Inadequate linings/pads on drums/discs accounted for 1,030 observations
Turn Signals	2,676	Defective operation accounted for 1,577 observations
Windscreen Wipers	1,893	Defective operation accounted for 989 observations, condition accounted for 904 observations
Wheels/tyres	1,726	Defective tyres accounted for 1,354 observations
Suspension	1,519	
Windscreen	1,505	Material/defective condition accounted for 1,175 observations
Headlamps	1,204	Defective operation accounted for 464 observations, incorrect aiming for 426 observations
Fuel and oil leaks	1,204	
Exhaust	1,027	
Steering	772	

The question raised is why was the defect rate so much higher in Victoria than reported in ACT or NSW? Answers are to be found from an analysis of the survey population, the purpose of the inspection and inspection standards.

While the sample was drawn at random the vehicle population was heavily biased being derived only from second hand vehicles intended *for sale*. Being derived from inspections undertaken at the time of potential change of ownership, the VACC sample contains a smaller proportion of younger vehicles than the Australian passenger vehicle fleet. Comparison of data in Table 8, with that in Table 11 illustrates the point. Vehicles under five years of age constitute some 4.4 percent of the VACC sample compared with 20 percent of the national fleet.

When questioned VicRoads staff stated that they believed that the data from the 1994 VACC Roadworthiness of Vehicle Survey was not representative of the condition of the passenger vehicle fleet in Victoria. They suggest that some motorists may defer routine maintenance prior to the sale of a vehicle and may use the Roadworthiness system as an assessment of the minimum repair work necessary to sell the vehicle. In these circumstances the data would overstate the extent of defects.

VicRoads also advised that Roadworthiness Certificates were required to meet consumer protection objectives. Reflecting these objectives, VicRoads inspection guidelines incorporate a preventative maintenance perspective rather than requiring a strictly limited "pass or fail" on the time of inspection. Victorian Roadworthiness Certificates have a currency of 30 days.

VicRoads indicated that it regarded the Roadworthiness inspection arrangements as both comprehensive and rigorous. They acknowledge that defects identified at the time of inspection may include items which were "adequate" at that time but which may be considered by a licensed mechanic as likely to deteriorate and develop into defects with safety implications within the 30 days currency of the Certificate. They advised that in the event a vehicle defect were to emerge (after the purchase of a vehicle) which could reasonably have been expected to have been recorded in a Roadworthiness Certificate, there was potential for litigation. This, together with the prospect of generating repair work, provides strong incentives for the exercise of "conservative" judgments by licensed mechanics.

Differences of approach to inspection are also apparent between some PMVI programs and Roadworthiness Certificate inspections. Roadworthiness testing in Victoria and Queensland is undertaken in authorised private garages and provides for the disassembly of componentry (eg., brakes). While on-road testing may be undertaken, the assessments differ from those previously conducted in ACT testing stations where dynamic testing of brakes was undertaken. Thus inspection inevitably involves extensive exercise of judgment. Further discussion of the issue of inspection standards is presented later in this Chapter.

The question is what may be usefully drawn from these data sets.

Firstly, with the exception of the ACT random inspection data and NRMA Tyre Survey, none of the data sets can reasonably be claimed to be representative of the in-service condition of the vehicle fleet.

Secondly, both the ACT random inspection data and NRMA survey are limited in the scope of the vehicle defects examined.

If nationally representative the ACT random inspection data suggests that a minimum of perhaps 1.3 percent of the vehicle fleet contains serious mechanical defects. (These vehicles when inspected were not permitted to be driven.)

While the failure rates at annual inspection in NSW and the ACT are broadly consistent, and consistent with Swedish data they cannot be taken as representative of the overall in-service condition of the vehicle fleet. Neither can the extensive failure rates evidenced in the VACC study.

In relation to particular defects, the ACT random inspection data and the NRMA survey provide a reasonable basis for concluding that a minimum of 10 percent of the vehicle fleet has tyre defects. The NRMA survey also indicates serious under inflation of tyres may be evident in around 9 percent of the fleet. These statistics are not necessarily cumulative, simply because they may represent similar groups of drivers ie., persons who do not maintain their tyres.

Without knowledge of the response of vehicle owners to annual PMVI programs it is not possible to accurately assess the proportion of the fleet with other particular defects eg., brakes, steering and suspension, lights.

4.3 The age of the Australian motor vehicle fleet

Ageing of the Australian motor vehicle fleet is of concern to some observers. The Bulletin (1996 Grennan) reported, “Australia’s car fleet is dangerously old ... the oldest in the developed world, and the problem is getting worse”.

Australia’s car fleet is ageing. The median age of the Australian passenger vehicle fleet in 1994 was around 10 years, and the light commercial fleet was around 11 years. Twenty years earlier only around 25 percent of vehicles were over 10 years of age.

This phenomenon is not unique to Australia. A. B. Svensk Bilprovning (1992) reported that around 33 percent of the Swedish passenger fleet was over 10 years of age compared with only 24 percent in 1981.

The size of the aged component of the Australian motor vehicle fleet has also grown considerably over the past 20 years. As indicated in Table 11 around 4.5 million passenger vehicles and 830,000 light commercial vehicles were over 10 years of age. Twenty years earlier there were only around 1.4 million passenger vehicles over 10 years of age.

Vaughan (1992) indicated ageing of the motor vehicle fleet has a twofold effect; “physical deterioration” and the absence of safety features of more modern vehicles which would have otherwise displaced aged vehicles (ie., loss in potential safety benefits).

However older vehicles need not necessarily be unsafe if properly maintained. Aged “collectors” cars which are to be seen in some car club competitions provide ample evidence of old vehicles in excellent mechanical condition.

Vaughan in an analysis of fatalities in NSW between 1977 and 1991 also observed that the number of fatalities in vehicles up to 12 years of age had decreased over the period while fatalities in vehicles 13 years and older had increased. At first glance the observation appears to support the contention that old vehicles are less safe.

Statistical association between older vehicles and high fatality rates has been used by the VACC and the FCAI to support the proposition that older vehicles should be scrapped by government fiat. *However, a statistical association between older cars, and fatal and serious crashes does not necessarily imply a cause and effect - ie, older vehicles lead directly to fatalities. It may well be that older cars are more likely to be driven by younger drivers who may take greater risks*. MUARC (1993) research lends support to this contention.

TABLE 11 - Registered Motor Vehicles by Year of Manufacture

Year of Manufacture	Passenger Vehicles			Light Commercial Vehicles		
	No.	Percentage	Average for the period	No.	Percentage	Average for the period
to 1930	3,305	0.0	0.0	441	0.0	0.0
1931-58	21,620	0.4	0.0	6,795	0.4	0.0
1959-70	317,642	3.5	0.3	62,123	3.9	0.3
1971-74	516,964	5.7	1.4	112,061	7.1	1.8
1975-78	1,049,064	11.6	2.9	213,069	13.5	3.4
1979-82	1,627,391	18.0	4.5	289,564	18.3	4.6
1983-86	1,873,062	20.7	5.2	319,728	20.1	5.0
1987-88	792,865	8.8	4.4	110,784	7.0	3.5
1989	500,036	5.5	5.5	83,882	5.3	5.3
1990	498,336	5.5	5.5	78,817	5.0	5.0
1991	415,557	4.6	4.6	63,301	4.0	4.0
1992	433,607	4.8	4.8	72,512	4.6	4.6
1993	455,911	5.0	5.0	75,037	4.7	4.7
1994	502,011	5.6	5.6	86,538	5.5	5.5
Not stated	31,126	0.3	0.3	9,466	0.6	0.6
Total	9,038,491	100		1,584,118	100	

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4.4 Vehicle inspection standards and identification of vehicle defects

Vehicle inspection standards have been a focus of controversy. The issues are basic; what constitutes a "safety related defect" that should be included for inspection, and what testing procedures and standards should be adopted.

McMinn (1974) observed "the inspection process paid insufficient attention to the critical safety items and included too many other items". (Anecdotal information suggests this observation may continue to be pertinent.) Fifteen years later NHTSA (1989) observed considerable variation in inspection standards between US States. Ease of inspection appeared to be a primary criterion, with all PMVI States inspecting tread wear, headlamps, horn and wipers. Significant variation was evident in the approach to inspection of items such as steering and brakes. The NHTSA summary of vehicle inspection standards is reproduced at Table 12.

TABLE 12 - Summary of items included in US State Motor Vehicle Inspection Programs (NHTSA 1989)

Vehicle Systems and Equipment Items Inspected	Number of States Inspecting Equipment Items	Percentage of States Inspecting Equipment Items
Brakes		
Brake Failure Indicator	6	27
Pedal Pressure	13	59
Pedal Reserve	18	82
Linings	9	41
Fluid	18	82
Road or Platform Test	17	77
Parking Brake	19	86
Tyres		
Tread wear and Damage	22	100
Mix of size and type on same axle	9	41
Wheels (Rims, Nuts, Discs, Hub Caps)	15	68
Steering Suspension		
Ball Joint	12	54
Springs	14	64
Shock Absorbers	14	64
Free-play	21	95
Linkage	14	64
Alignment	5	23
Fuel (Lines, Tank Cap)	11	50
Exhaust (Muffler, Exhaust and Tail Pipe)	21	95
Lighting and Signals		
Headlamps	22	100
Beam Aim	17	77
Beam Indicator	15	68
Stop Lamps	22	100
Tail Lamps	22	100
Turn Signals	22	100
License Plate Lamps	14	64
Reflectors	14	64
Horn	22	100
Visibility		
Windshields	20	91
Side and Rear Windows	20	91
Mirrors	16	73
Defroster/Defogger	4	18
Wipers	22	100
Washer	4	18
Body Components		

Doors	13	59
Floor Pan	12	54
Seats	10	45
Hood Latch	13	59
Seat Belts	13	59
Head Restraints	0	0
Bumpers	12	54
Fenders	12	54

In contrast to the variation in US inspection standards, the ECE have sought to harmonise testing standards among member States.

Differences in inspection standards and approach are evident in Australian jurisdictions and make inter-jurisdictional comparisons difficult. The differing inspection standards are in part a reflection of testing facilities eg., dynamic brake testing available in government testing stations compared with "wheel pull" procedures in private garages. Brakes may meet performance requirements of dynamic testing but wheel pull inspection if undertaken may show some minor weeping of brake fluid. This raises the question - if the brake performance meets the dynamic testing requirements on the day should the vehicle be failed for defective brakes. The decision will depend on the purpose of the test, inspection guidelines and their interpretation.

Similarly does minor seepage of fluid from the power steering fluid reservoir constitute a defect? The answer is "may be" - it depends on the rate of fluid loss and whether the driver monitors levels in the fluid reservoir. Without this information an inspector is unable to make a sound judgement. In these circumstances recourse is made to administrative guidelines and personal judgement.

Differences in standards are also illustrated by the approaches adopted by jurisdictions in relation to "oil leaks" and lights. While most jurisdictions include oil leaks as an inspection item differing standards have been adopted regarding what constitutes an oil leak.[2] In one Australian jurisdiction it is not an offence to drive a vehicle with defective headlights during day light hours.

The difference in expert opinion on what constitutes an appropriate inspection standard is also illustrated in relation to tyre wear. As reported previously NRMA (1993) adopted a minimum 3mm tread depth standard while the legal standard in Australian jurisdictions allows for lower tread levels. The NRMA position serves to illustrate the point that whatever standards for component deterioration are set, they involve a judgement as to what is desirable in terms of minimum "safety margins" in a range of driving, weather and road conditions.

The standards adopted in jurisdictions also reflect the purpose of the test - either to warrant that the mechanical condition of the vehicle inspected was acceptable at the time of

[2] NRTC (1995) has proposed a uniform standard.

inspection (annual inspection) or that the vehicle was "roadworthy" for the duration of the roadworthy certificate (eg., 30 days in Victoria).

The application of vehicle inspection standards also frequently requires interpretation by a vehicle inspector. While some vehicle componentry may have failure characteristics of a "go or no go" nature (eg., lights) other componentry with significant safety implications inevitably involves a period of deterioration or may involve intermittent failure. While "go/no go" componentry is readily amenable to decision-making, other componentry undergoing deterioration (eg., tyres, brakes, suspension) require judgements to be made. The results from dynamic testing may also differ from judgements made from static testing.

It is also often difficult to identify some defects where vehicles have been "prepared" for inspection and evidence removed - eg., it is not uncommon for an engine bay to be cleaned prior to inspection to remove excess oil. Anecdotal information of tyres and rims which have been borrowed to pass inspection abound in folklore.

Based on overseas research, and assessment of Australian vehicle inspection programs there appears to be considerable variation in the standards adopted and in the interpretation of those standards.

4.5 Reliability of PMVI

A further issue is how realistic is it to expect that vehicle defects will be identified at inspection?

Although now dated, the US McDonald and Romberg Study (1977) provides some insights. From an in-depth examination of 671 vehicles involved in 420 crashes they judged that around *one-quarter* of 1600 observed defects *were defective at the time of PMVI. In relation to the 131 defects identified as definitely, probably or possibly causing the crash or increasing its severity, only 16 were judged to have been present at the time of inspection*. ie., 115 developed after inspection.

This study suggests it is unrealistic to expect a major proportion of crash related defects to be apparent at the time of inspection. Furthermore it suggests that PMVI is not necessarily reliable in identifying defects which were apparent at the time of inspection and had caused or contributed to crashes.

Information is not publicly available on the reliability of Australian motor vehicle inspection systems. None of the motor vehicle inspection schemes operated in Australian jurisdictions have adopted Quality Assurance Systems. Furthermore systems auditing is limited. The NRMA (1991) expressed concerns over the low level of audits undertaken of AIS in NSW. Discussion with RTA staff suggest that the level of auditing remains comparatively low. VicRoads staff have indicated that it relies on "system abuse" being identified through the investigation of consumer complaints.

Inspection systems which utilise centralised testing stations such as in the Northern Territory and previously in the ACT offer the prospect of greater levels of consistency and reliability than decentralised systems using private garages (eg., NSW, Vic, Qld.). However, even in centralised government owned and operated inspection systems inconsistencies occur due to the human element and also to the inconsistent application of standards, eg., despite advice from FORS in 1984 that cracking of the floor pan of VB-VH Commodores at front seal mounts was not a safety defect, the ACT Motor Vehicle Registry intermittently required owners to undertake costly and unnecessary repairs. Similarly, arbitrary standards have been applied in relation to the vexed issue of "oil leaks".

Concerns have been expressed over the use of authorised private garages for vehicle inspection. NRMA (1991) concluded "The NSW AIS Scheme is poor value for money and is much less effective than other systems in detecting defects in vehicles". They concluded the problems with the NSW AIS Scheme included "conflict of interest by participants", a low level of inspection expertise, "lack of specialised equipment necessary for high quality inspections", a low level of audits of AIS Scheme, a low level of penalties for poor inspection, and that it "inherently lacks quality control". The NRMA recognised that for the AIS Scheme to be improved, fees would need to rise, and that it "would almost certainly result in the costs exceeding benefits".

Choice (1994) quoted the General Manager of Vehicle Registration for the NSW RTA as indicating that the new Safety Check system "was based more on performance testing than examining components", had sought to remove "nit-picking rules" and "redefined" rules to make them less open to "interpretation from garage to garage". RTA has confirmed that a re-accreditation of inspectors has been undertaken and auditing tightened up. While some initiatives have been undertaken to improve AIS systems (eg., NSW Safety Check), anecdotal information suggests the system remains fundamentally flawed.

Some further insights are provided by Choice from limited case studies of vehicles submitted for inspection in the ACT, NSW and Victoria. It reported anecdotal information which demonstrated differences in testing outcomes between Australian jurisdictions. An ACT registered Commodore had been presented for a Victorian Roadworthiness Certificate to enable registration. It was failed at test with extensive faults identified and an estimated repair cost of $1,500. The vehicle was examined by ACT testers, finding the only defect being an "oil leak".

Choice (1984, 1989) tested the performance of selected NSW motor dealers in relation to car servicing. In the tests vehicles with introduced safety defects were provided to a range of service centres including franchise dealers for the make of vehicle, franchise dealers for another make of vehicle, representatives of a chain of car servicing specialists, a department store servicing vehicles, and a service station. A third of service providers in the 1984 study were NRMA accredited, and all but one were members of the Motor Trades Association (MTA). Both trials included service providers who were AIS. In 1989 Choice reported that the average proportion of service items completed by a service centre was only 56 percent. "Poor results were recorded for three of what we regard as safety related matters; inspection and adjustment of the rear brakes (42%), the parking brake (50%), and replacement of a burnt out stop light (50%)". "This confirms the results of our 1984 trial".

The problem of lack of reliability of inspection systems is not unique to Australia. A wide range of overseas studies has confirmed problems with reliability of inspection systems.

Wolfe and O'Day (1985) concluded from a review of 41 States that "PMVI programs are not as reliable in detecting degraded safety components and forcing their repair as was envisioned by PMVI proponents".

WHICH? the UK Independent Consumer Guide (1993) revealed major discrepancies in testing outcomes for a vehicle submitted for testing to 36 garages approved for annual MOT inspection. Of the 36 garages 15 reportedly failed items which were acceptable and other garages overlooked critical safety items.

The New Zealand Consumer (1990) concluded that the roadworthiness scheme was "nothing short of a national scandal". A national survey conducted by the Association revealed "an entirely hit and miss (testing) service" provided by authorised New Zealand garages.

Based on overseas research and Australian experience, the reliability of motor vehicle inspection programs must be seriously questioned.

4.6 PMVI and the incidence of vehicle defects

The majority of the research into the relationship between PMVI and vehicle defects comprises *comparative* studies across jurisdictions and is methodologically flawed. The research relies frequently on self-selecting samples, or sampling of vehicles presented for mandatory inspection, and frequently does not recognise differing inspection arrangements, technical standards and interpretation, administrative effort nor the extent of random inspection.

The conclusions drawn from these studies are mixed, although the majority support the contention that PMVI is associated with improved mechanical condition of vehicles.

Other conclusions drawn from these studies include that the establishment of suitable technical standards, appropriate staff training and consistency of administration are likely to be central to outcomes, and furthermore that the frequency of inspection also has a potential significant bearing on outcomes.

Despite shortcomings in the majority of research there is a general recognition that PMVI results in an improvement in the average mechanical condition of the motor vehicle fleet.

- NHTSA (1989) *"PMVI was effective in limiting the number of poorly maintained vehicles on highways."*
- GAO (1990) *"Accepts NHTSA conclusion that PMVI reduces the number of poorly maintained vehicles on the highways."*
- Fosser (1992) *"The technical condition of inspected vehicles improved compared with those not inspected."*

An overview of selected studies and conclusions is presented in Table 13.

TABLE 13 - Overseas research into PMVI and reduction in the level of vehicle defects

Source	Comment
McCutcheon & Sherman, US 1968	This research compared defect rates in vehicles presented for inspection in selected US PMVI States with results of Police inspection in non-PMVI States. It concluded PMVI led to better maintained vehicles. A relationship between frequency of inspection and defects is apparent. However sampling based on vehicles presenting for inspection is fundamentally flawed and hence conclusions cannot be regarded as definitive.
Ultra System, US 1971 US 1973	This research involved some 2,500 vehicles and efforts were made to obtain representative samples. It concluded PMVI reduced the rate of vehicle defects. The research was based on comparison of a random selection of vehicles inspected at diagnostic centres in selected non-PMVI States, with those at inspection stations in Washington DC. Some problems with consistency of inspection data were reported. This research compared vehicle condition in PMVI and non-PMVI States and involved some 3,500 vehicles. Greater emphasis was placed on objective criteria to improve consistency across diagnostic centres. It generally supported the conclusion of 1971 study, but there were some "anomalies" demonstrating substantial differences in effectiveness in PMVI States. Both studies were NHTSA sponsored. They involved "self-selecting" samples and vehicles presented for registration inspections. Hence the sampling methodology was flawed and the conclusions must be regarded as dubious.
McMinn, US 1974	This research was based on a random inspection of 20,000 vehicles. It observed increases in vehicle defect rate from 23 percent one month after inspection to 35 percent four months after mandatory inspection.

TABLE 13 (continued)

Source	Comment
Innes & Eder, US 1977	This research involved a large sample - some 66,000 vehicles. Failure rates in PMVI States were generally lower than in non-PMVI States, although there were exceptions. The conclusions cannot be regarded as definitive as the population included a self-selecting sample and vehicles presented for registration related inspections.
Bentley & Heydt, US 1977	This NHTSA sponsored research confirmed McMilan US (1974) observations. The vehicle defect rate rose from 23 percent one month after inspection to 39 percent at 12 months. The methodology involved in part a self-selecting sample and hence the conclusions could not be regarded as definitive.
McDonald & Romberg, US 1977	This research was based on an in-depth analysis of 671 vehicles involved in 420 crashes. A quarter of 1600 observed defects were assessed as existing at the time of PMVI. Only 16 of 131 defects judged as definitely, probably or possibly causing or increasing the severity of crashes were present at the time of PMVI.
Milne, US 1978	This NHTSA sponsored research involved some 900 vehicles. No significant differences in defect rates were apparent between States with PMVI in the form of semi-annual, annual, or on change of ownership. The survey was potentially flawed as it involved a self-selecting sample. The report also revealed the consistency of inspection was a major issue.
Eder et al, US 1978	This study relied on vehicles presented for inspection at authorised stations (it did not comment on the issue of “prepared” vehicles). Defect rates in PMVI States were consistently lower than in States relying on random inspections.
Eder, US 1980	This research involved a before and after study in a US State which discontinued PMVI. It concluded discontinuance of PMVI contributed to poorer vehicle condition (brakes (+4.3%), steering (+7.1%), suspension (+6.1%)). The research was potentially flawed as it involved a self-selecting sample.

TABLE 13 (continued)

Source	Comment
Flora, Copp & Tholen, US 1980	This research involved a statistical least square regression analysis based on a random field survey in Michigan. It concluded failure rates for particular components, eg., brakes, tyres, exhaust were a function of age, and also the rate of vehicles failing inspection increased with age.
White, NZ 1988	This research involved analysis of over 20,000 inspection records for vehicles presenting for six monthly PMVI in New Zealand. It observed that failure rate peaked for vehicles 15 years of age and predicted that the recheck rate for five year old vehicles would increase from 33.4% to 41.2% in the event the inspection interval was increased from six months to one year. However sampling based on vehicles presenting for inspection is fundamentally flawed and hence conclusions cannot be regarded as definitive.
Fosser, Norway 1992	This research was based on a controlled experiment over four years on 224,000 vehicles aged six to 12 years in Norway. For vehicles subjected to annual inspection the rate of defects per vehicle was lowered, but no difference in defect rate was observed for vehicles inspected every three years compared with the control group of vehicles which were not inspected.

4.7 Motor vehicle inspection - an ephemeral effect?

By its very nature motor vehicle inspection can only offer the prospect that a vehicle is in adequate mechanical condition at the time of inspection. Similarly roadworthiness certificates issued at *change of ownership* are only intended to warrant mechanical condition for the period of the certificate (eg. 30 days in Victoria).

Tyres for example which met minimum standards of tread depth on the day of inspection may wear below minimum standards shortly afterwards but may continue to be used until the time of the next inspection. Similarly brakes which met testing requirements on the day may have limited thickness of brake lining and may become faulty shortly after inspection. Against this background it is not surprising that research suggests annual PMVI does not have an enduring effect.

This position is supported by a range of now dated US studies. The largest and perhaps most methodologically sound early US study was undertaken by McMinn (1974) who observed from a randomly selected sample of 20,000 vehicles in New Jersey a failure rate of 23 percent in the first month after inspection, rising to 35 percent at four months and 39 percent one year after inspection.

Based on an analysis of New Zealand crash involvement data and vehicle age and time since inspection, White (1986) concluded that PMVI had an immediate impact on the mechanical condition of vehicles which faded over ensuing months. It should be noted that the inspection interval was six months for vehicles over six years of age.

White (1988) concluded from a census of New Zealand inspection records that vehicle age and distance driven between inspections was associated with failure rates at inspection. This conclusion could not be regarded as definitive as the study methodology was based on the results of an inspection process which did not recognise whether repairs were undertaken during the interval between inspections.

Fosser (1992) concluded that improvement in vehicle condition arising from PMVI was not enduring. He observed that after *a year* there was "only a small difference between a car which has been inspected and one which has not been inspected".

It is difficult to form a judgement on whether the more rigorous and exacting standards applied in relation to some change of ownership inspections compared with annual inspections are of greater significance and of greater enduring consequence. What can be said however is that on average the term between inspection is longer than for PMVI programs. RTA (1994) data on length of ownership by vehicle age suggests that for vehicles aged between three and ten years the *average* period of ownership is around three years, reducing to around two and a half years for vehicles between eleven and twenty years of age.

Based on international research, it is unrealistic to expect motor vehicle inspection programs to have an enduring effect. Benefits have been demonstrated to diminish significantly within six months, and are unlikely to be apparent after one year.

From an effectiveness viewpoint the question which is often overlooked but must be addressed is, if PMVI reduces vehicle defects, how effective is it in reducing the number and types of defects which contribute to crashes. This question is addressed in Chapter 6.

5.

THE ROLE OF VEHICLE DEFECTS IN CRASHES

5.1 Introduction

Causes of crashes can be related to the interaction of a range of factors including the driver, the road/traffic environment and the vehicle (including vehicle defects).

The greatest contributors to crashes have been demonstrated to be related to the driver and road/traffic environment, with the contribution of vehicle defects being of lower order of magnitude. Nevertheless the contribution of vehicle defects to crashes continues to be a controversial issue.

Asander (1992) expressed the widely held view that "there is no simple method to clarify the exact mechanism of accidents and establish their real cause ... there is nearly always a multitude of interacting factors, of which no single factor can be given more importance than others ..." The interaction of causal factors is illustrated in the analysis of FORS Fatal File data for 1992 presented later in this report (Table 27).

Many studies have relied upon police data and concern has been expressed both overseas and locally over the accuracy of police reporting. Further discussion of these issues is presented below.

5.2 Overseas research

Factors affecting the driver, the road/traffic environment and the crashworthiness including mechanical condition of vehicle fleets are known to vary, sometimes markedly between countries and hence it is not surprising that overseas research has produced differing estimates of the association between vehicle defects and fatal crashes.

A wide range of research into crashes associated with vehicle defects was reported by Rompe and Seul (1985) and an overview is reproduced for the period 1960 to 1982 in Table 14. In summary they concluded

> *"probably between 3 percent and 5 percent of all accidents are caused primarily by vehicle defects, which are also one of the contributing factors to or aggravate, a further 7 percent to 18 percent of all accidents."*

Estimates of the contribution of vehicle defects to crashes based on police crash reporting have generally been lower than estimates prepared from in-depth investigations.
These estimates are not automatically transferable to Australia in the 1990s because of differences in the factors affecting driver behaviour, the road/traffic environment and the crashworthiness of the Australian motor vehicle fleet.

TABLE 14 - Accidents caused by vehicle defects, ECE commissioned Report 1985

Survey	Number of accidents investigated	Percentage of accidents caused by vehicle defects		
		Police or comparable reports	In-depth Investigations	
			Probable cause	Probable contributory factor
Rhineland TIA 1960	1,000		4.8	19.3
Rhineland TIA 1982	2,326		1.5 - 8.7 *	
Federal Statistical Office 1972-1982	331,000	2.0-1.2		
Motor Traffic Insurer's Ass. 1973-1977	63,084	2.4-1.8		
Central Statistics Office Ireland 1962-1967	36,013	4.0-5.8		
British Army Op. Research Unit 1946			7.8	
Road Research Laboratory Birmingham Urban Accident Study 1970	 250		15.0 4.8	 33.2
TRRL 1974	2,130		5.6	
Public Prosecutors Office, Belgium			24.4	
ONSER 1970	500		3.1	7.1
JRPS Indiana University	312		4.1	12.5
California Highway Patrol 1970 Pennsylvania Turnpike Study NHTSA 1968-1970 NHTSA	409 448	 6.0	6.4 13 13.0	18.1
Highway Safety Foundation 1973	390		9.5	
Calspan 1970 1970	434 704			4.6 4.0
Nebraska 1972		2.6-5.6		
Texas 1971		3.0-4.0		
Tasmania 1970	1425	2.4		
DEKRA 1980			11	
MH-Hannover 1982	1732		8.5	
Daimler-Benz 1982	9267	2.1		
Ministry of Transport, Japan 1983		1.3		
1982 French Police statistics: Fatal accidents (motorways) Accidents causing injuries		 6.1 11.4		

Rompe and Seul (1985)

* Increasing with the age of the vehicle.

5.3

Road Crashes in Australia

The BTCE (1992) provided a comprehensive perspective on road crashes in Australia. It estimated that 590,852 road crashes occurred in Australia in 1988 involving 1,068,166 vehicles. The estimate includes those crashes officially reported together with an estimate of *unreported* crashes. Fatal crashes constituted 0.43 percent, crashes involving hospitalisation 3.29 percent and crashes involving a medically treated injury 9.11 percent. Non injury crashes constituted the largest group (62.95 percent) with an estimated 72 percent of these being unreported.

Fatal and serious injury crashes which provide the vast majority of crash analysis data constituted less than 4 percent of all crashes. These two crash types were however estimated to account for 56 percent of the total cost of road crashes.

Crash statistics are also reported by State and Territory agencies. The data is generally drawn from police data and therefore only include *reported* crashes. For this reason the percentage of crashes according to category (fatal, serious injury, injury, non injury) reported by these jurisdictions varies markedly from the BTCE estimates.

Data reported by the RTA (1995a) provides a further perspective on passenger vehicles and light commercial vehicles. A comparison of the crash involvement rate indicates marked differences according to vehicle type. The crash involvement rate for passenger vehicles (crashes per 10,000 registered vehicles) differed from those of light commercial vehicles, with the rate for passenger vehicles being between 130 percent (for fatal crashes) and 210 percent (for non injury crashes) of the rate for light commercial vehicles.

The crash involvement rates for these two vehicle categories were nevertheless markedly lower than for articulated trucks (which are subject to inspection under a heavy vehicle inspection program) which is to be expected from the generally greater exposure (vehicle kilometres of travel) of heavy vehicles. Further information is reported in Table 15. The crash involvement rates for non injury crashes is likely to significantly understate the real position due to the large number of these crashes which go unreported.

TABLE 15 - Crash involvement rates* for selected categories of vehicles

	Crash Rate by Crash Type				
Vehicle Category	**Fatal**	**Serious Injury**	**Other Injury**	**Non Casualty**	**All Crashes**
Passenger vehicles	2.3	21.3	74.7	209.3	307.6
Light commercial vehicles	1.7	12.5	38.5	99.7	152.4
Articulated trucks	38.7	113.1	219.7	512.4	883.9
All registered vehicles	2.6	22.2	72.7	181.1	285.6

Source RTA (1995a)
* rate per 10,000 registered vehicles in NSW

5.4 Data from selected Australian government agencies

Queensland DOT (1995) analysis of police data for all vehicle types reveals some common factors associated with both *fatal* crashes and *all* crashes. The analysis also reveals some marked differences. "Disobeying traffic rules" was the highest ranking factor for both crash groupings and "driver inexperience" was second ranking in fatal and third ranking in all crashes.

However, "alcohol and drugs", "speed", "negligence" and "driver age" were ranked markedly higher as factors associated with fatal crashes than all crashes.

Significantly "vehicle defects" was ranked 12th of 14 factors associated with fatal crashes and 11th of 14 factors associated with all crashes.

Vehicle defects were assessed as being associated with only 4 percent of fatal crashes and 4 percent of all crashes in Queensland in 1995. This contrasts with 6 percent and 4 percent respectively in Queensland in 1993.

It is also noted that the number of vehicles in Queensland identified with defects contributing to fatal crashes has more than doubled over the last five years (1991-1995) compared with the previous five years. Whether this is due to greater attention by Police to the issue of defects or an underlying trend remains unclear.

RTA (1995b) analysis of NSW Police data for all vehicle types indicates that "equipment failure or fault" was associated with 0.5 percent of fatal crashes, 0.9 percent of crashes resulting in "serious injury", 1.2 percent of crashes involving "other injury" and 1.0 percent of "non casualty" crashes. In discussions RTA have expressed concern over police crash reporting and are of the view that the contribution of vehicle defects to crashes is significantly understated. They estimate that vehicle defects are a causal factor in 4 percent of crashes and a contributing factor in perhaps up to 9 percent of crashes involving light vehicles.

The South Australia Parliamentary Committee (1995) reported that the State Government Insurance Office estimated that less than 1.7 percent of crashes giving rise to third party claims were associated with vehicle defects.

The Industry Commission (1994) reported that vehicle defects were associated with around 5 percent of fatal crashes in Victoria.

In Australia, published government statistics indicate vehicle defects to be a cause or contributory factor in between 2 percent and 6 percent of reported crashes depending on jurisdiction.

5.5 In-depth Australian research

In-depth Australian research into the association between vehicle defects and crashes is both limited and dated.

The CCRAM (1978) in-depth study conducted in Melbourne involved examination of a random sample of fatal and serious injury crashes which occurred in 1975-76. Of 166 casualty crashes "defects in cars" were assessed as "highly probably causative" in 1.2 percent of crashes and "probably causative" in a further 5.4 percent of crashes. Heyworth and McLean (1986) reported that "the corresponding percentages in the Adelaide In-depth Study conducted in 1976 and 1977 were 1.0 percent and 5.3 percent". Neither study relied on police data and were undertaken by multi-disciplinary assessment teams.

It should be noted that both studies were conducted in metropolitan areas and accordingly would under report crashes in rural areas. Heyworth and McLean (1986) have acknowledged "A study based on higher-speed crashes in a rural area might reveal a greater contribution from defects in cars".

In view of changes in vehicle technology, vehicle manufacturing, the regulatory environment, the road/traffic environment and other factors in the 20 years since these studies, some doubt must now exist as to their specific detail, including the assessed percentage of crashes arising from vehicle defects.

The RTA (1995c) announced an 18 month investigation involving inspection of some 5,000 vehicles involved in fatal and serious injury crashes by over 200 specially trained inspectors. The scope of the study includes all vehicle categories including light vehicles (passenger and light commercial vehicles). This study will provide valuable additional information on NSW crashes. The applicability of conclusions for NSW to other jurisdictions will however require careful consideration having regard to the potential for differences between jurisdictions.

5.6 Victorian Police data

Victoria Police in the context of this study have supplied information on in-depth examinations conducted by the Mechanical Inspection Section of some 1,683 vehicles involved in fatal and serious injury crashes in 1994 and 1995. The inspections were undertaken by experienced qualified mechanics who attended the crash scene and frequently arranged for crashed vehicles to be removed to a central depot for further detailed examination. Inspectors reports were assessed in the context of detailed crash investigation, reconstruction and review processes and procedures undertaken by the Accident Investigation Section (AIS). Staff of this Section reportedly attended all fatal and more serious injury crashes within a 100 km radius of Melbourne and the more complex crashes which occurred in rural Victoria. (AIS estimated they attended at least 70 percent of all fatal and serious injury crashes in the State.) Brief examination of the processes adopted by the AIS revealed a rigorous and comprehensive approach to crash investigation.

The Victoria Police data revealed a high proportion of vehicles exhibiting defects (35.6 percent) many of which were of a minor nature. Significantly only 2.2 percent of vehicles were assessed as having defects which had caused or definitely contributed to the fatality or more serious injury crash.

The data indicates that between 1.1 percent and 2.1 percent of crashes (depending on year) were caused by vehicle defects and between 3.6 percent and 5.2 percent of crashes were definitely contributed to by vehicle defects. Allowing for the data sample this is consistent with the conclusions drawn in Section 5.4. Further information is provided in Table 16.

TABLE 16 - Fatal and serious injury crash data - Victoria 1994, 1995

Category	Year	
	1994	**1995**
No. of fatal crashes	382	474
No. of serious injury crashes	193	203
No. of vehicles inspected	832	851
No. of vehicles with defects	313	287
No. of crashes		
caused by vehicle defects	8	5
to which vehicle defects contributed	12	12

Victoria Police (1996)

5.7 Adequacy of Police data

Concern over the adequacy of police crash investigation and reporting has been expressed in US research and by some Australian commentators.

Consideration of US research led the GAO (1990) to observe "Police accident reports are the source of most data, but they tend to understate the number of accidents in which defective vehicle components contributed to the cause. If driver error or poor road conditions are involved, the investigating officer may not recognise that worn brakes or tyres helped cause or aggravate the accident."

Wolfe and O'Day (1985) commented that under reporting of vehicle defects by police could be expected as they "seldom have an opportunity to do more than a superficial inspection of the involved vehicles".

The RTA (1995d) and NRMA (1992) have echoed similar concerns in relation to the adequacy of information on the roadworthiness of vehicles involved in NSW crashes. NRMA have commented that police who "generally attend a crash scene are not technically qualified in vehicle inspection. They do not carry equipment which enables them to properly mechanically inspect a vehicle and they have many other duties at a crash scene, such as clearing the road and controlling traffic. They cannot be expected to properly inspect a vehicle for defects".

RACV (1989) makes the point that "a systematic investigation of road accidents by multi-disciplinary teams appears to be the most suitable approach to estimating the proportion of accident defects attributable to 'mechanical defects'".

Investigations have revealed significant differences between Australian jurisdictions in police organisational arrangements and standing orders for crash investigation. Some jurisdictions have highly centralised arrangements and mandatory requirements for fatal crashes and the more serious injury crashes to be investigated by specialist investigators and qualified mechanics (eg., Victoria), while others have decentralised arrangements and standing orders which do not mandatorily require attendance of specialist investigators or qualified mechanics at all fatal crashes (eg., NSW).

Variation in the quality of crash investigation and reporting by some police services was evidenced in the sample of FORS Fatal Files (1992) examined.

In these circumstances concern over the adequacy and comprehensiveness of data from *some* police services appears justified. It should be noted however that police investigation activity and evidence in relation to all fatals is subject to Coronial inquiry processes.

As mentioned previously Victorian Police data (1996) was drawn from comprehensive and rigorous investigation processes involving multi-disciplinary teams and is considered accurate. Furthermore the total defect rate identified for vehicles involved in fatal and serious crashes (35.6 percent) is broadly consistent with that identified by McLean, Aust, Brewer and Sandow (1979) (around 40 percent).

5.8 FORS Fatal Files (1988, 1990, 1992)

FORS Fatal Files (1988, 1990, 1992) are derived from State and Territory Coronial inquiries which incorporate independent consideration of police and other evidence associated with fatal road crashes.

FORS Fatal Files (1988, 1990, 1992) reveal that fatal crashes involving light vehicles are declining - the 1446 fatal crashes reported in 1992 constituted a decline of 31 percent below that reported for 1988. Despite this decline the total number of fatal crashes related to vehicle defects in light vehicles have remained about the same - an average of around 40 fatal crashes per year involving light vehicles with defects.

Vehicle defects were assessed as causing or contributing to an average of only 2.3 percent of fatal crashes involving light vehicles.

The contribution of vehicle defects to fatal crashes involving light vehicles varied markedly between jurisdictions. Over the three years for which data was collected Victoria, SA, ACT recorded an average of less than 1.8 percent of fatal crashes being related to vehicle defects (lowest group), NSW and Queensland were in the middle range 2.0 percent and 2.25 percent respectively, while the highest group included WA (4.1 percent), Tasmania (4.6 percent) with NT highest at 14.0 percent. Further information is reported in Table 17.

FORS Fatal Files may also potentially understate contributory factors as distinct from causal factors in fatal crashes. Reasons include the onus of proof applied by Coroners (compared with that applied by researchers), perceptions of those presenting evidence at Coronial hearings as to what may be acceptable, and reliance on police crash investigations.

TABLE 17 - Contribution of vehicle defects to fatal crashes FORS Fatal Files 1988, 1990, 1992

	NSW	Vic	Qld	SA	WA	Tas	NT	ACT	All
Crashes	1786	1261	966	438	461	153	121	58	5244
No. of light vehicles	2244	1619	1221	533	550	202	134	84	6587
Crashes related to defects	35	15	21	5	19	7	17	1	120
Vehicle defect-related crashes as % total crashes	2.0	1.2	2.2	1.1	4.1	4.6	14.0	1.7	2.3

The Fatal Files data for light vehicles indicated that single vehicle crashes accounted for 63 percent of all fatal crashes, multiple vehicle crashes accounted for 34 percent and crashes involving pedestrians some 3 percent.

While the involvement of vehicle defects with fatal crashes is small, vehicle defects were associated with almost twice the number of single vehicle crashes as multiple vehicle crashes (75 crashes compared with 41 crashes). Some commentators have said that the police are more inclined to arrange for a vehicle to be inspected from a single vehicle crash than a multiple vehicle crash and hence the conclusions drawn in relation to multiple vehicle crashes understate the real position. The evidence however does not necessarily support this contention. In some jurisdictions where inspection reports were available for over 80 percent of fatal crashes the percentage of vehicle defects which were assessed as causal or contributory to the crash was higher in multiple vehicle crashes than single vehicle crashes eg., SA, NT. Further information is presented in Table 18.

TABLE 18 - Fatal crashes - Light vehicles with a contributory defect(s) by crash type. FORS Fatal Files 1988, 1990, 1992

Crash type	Defect type						
	Normal tyre blowout	Tyre defect	Main brakes	Steering	Towing appara-tus	Other	Total vehicles
Single	27	26	9	6	0	7	75
Multiple	8	12	12	3	3	5	41
Pedestrian	0	1	1	0	0	2	4
Total	35	39	22	9	3	14	120

5.9 The nature of vehicle defects

FORS Fatal Files (1988, 1990, 1992) indicates for light vehicles that tyre problems constituted the greatest contributor to defect-related fatal crashes (61 percent) followed by brakes (18 percent) and steering (7 percent).

Tyre problems comprised "normal tyre blowouts" and "tyre defects", represented in approximately equal proportions (47 percent compared with 53 percent). They were the cause of a greater proportion of single vehicle crashes than multiple vehicle crashes (some 71 percent compared with 47 percent).

5.10 Some conclusions

The survey of literature and data sources indicates that only limited definitive Australian research is available on the contribution of vehicle defects to road crashes.

Data sets available are primarily related to fatal crashes and to a lesser extent serious injury crashes both of which constitute less than 4 percent of all crashes (but 56 percent of the estimated cost of road crashes).

Despite the substantial resources devoted to Coronial inquiries, lingering concerns remain regarding the consistency, assessment processes and criteria adopted in forming judgements as to whether vehicle defects were causal or contributory. These concerns centre on the levels of proof required by legal processes compared with the likelihood or probability which may be comprehended in scientific research (implying a potentially lower level of proof).

In relation to fatal crashes FORS Fatal File data (1988, 1990, 1992) confirms that major differences are apparent between jurisdictions in the contribution of vehicle defects to crashes with the contribution within NT (which has a PMVI program) being the highest and 12 times that in Victoria (without PMVI) and the lowest. FORS Fatal File indicated that vehicle defects on a national average contributed to 2.3 percent of fatal crashes involving light vehicles.

An overview of the assessed contribution of vehicle defects to crashes by jurisdiction is reported in Table 19.

TABLE 19 - Overview of assessments of the contribution of vehicle defects to crashes by jurisdiction

Jurisdiction	Comment		
NSW	Fatals	2.0%	av. FORS Fatal File for 1988, 1990, 1992
	Fatals	0.50%	RTA (1995b) report of police data
	Fatals & serious injury	4.0% causal	RTA (1995d) estimated
Victoria	Fatals	1.2%	av. FORS Fatal File for 1988, 1990, 1992
	Fatals & serious injury	2.2%	av. Victoria Police for 1994, 1995
Queensland	Fatals	2.2%	av. FORS Fatal File for 1988, 1990, 1992
	Fatals	4.0%	Qld. DOT (1995)
	All crashes	4.0%	Qld. DOT (1995)
SA	Fatals	1.1%	av. FORS Fatal File for 1988, 1990, 1992
	Crashes involving third party claims	1.7%	State Government Insurance Office (SGIO) (1994)*
WA	Fatals	4.1%	av. FORS Fatal File for 1988, 1990, 1992
Tas	Fatals	4.6%	av. FORS Fatal File for 1988, 1990, 1992
NT	Fatals	14.0%	av. FORS Fatal File for 1988, 1990, 1992
ACT	Fatals	1.7%	av. FORS Fatal File for 1988, 1990, 1992

* Data reported by the South Australia Parliamentary Committee (1995)

The question arises as to what national average vehicle defect-related crash involvement rate may be used for the purposes of conducting an economic evaluation.

FORS Fatal File (1988, 1990, 1992) data for Victoria and South Australia is consistent with that observed in the only two in-depth crash studies conducted in Australia. It is also noted that the rate for NSW of 2.0 is four times the level reported by the RTA (based on police data). In these circumstances the FORS Fatal File (1988, 1990, 1992) average national rate of 2.3 percent may perhaps be appropriate in relation to fatal crashes *caused* by vehicle defects in light vehicles.

In the event the FORS Fatal data were to understate the position for fatals and serious injury then a "composite" national estimate could be generated. Adoption of the RTA rate of 4.0 percent for fatal and serious injury crashes combined with 4.0 percent in Queensland (DOT estimate) for all crashes, 2.2 percent fatal and serious injury in Victoria (police estimates), 1.7 percent in South Australia (SGIO estimate), and average FORS Fatal Files rates (1988, 1990, 1992) in other jurisdictions results in a national average composite rate of 3.7 percent.

Both the Victorian and South Australian studies also reported that 5.3 percent and 5.4 percent of fatal crashes respectively were "*probably causative*". While these studies have limitations, they constitute the only available Australian research.

If these observations are accepted as appropriate in other jurisdictions and for all crash types then this data suggests that scenarios for light vehicle related crash involvement rates may be lower bounded at 2.3 percent and upper bounded at 7.7 percent.

RTA have also speculated on a "probably causative" rate of up to 9 percent but Keatsdale is unaware of the basis of the estimate.

In these circumstances Keatsdale has undertaken economic evaluation on the basis of four scenarios, with the rate of all crashes involving defects in light vehicles set at 2.3 percent, 3.7 percent, 7.7 percent and a highly speculative 9.0 percent.

6. PMVI AND REDUCTION IN CRASHES

6.1 Introduction

As discussed in Chapter 4, serious concerns have been expressed as to the reliability and effectiveness of PMVI programs. Furthermore, research suggests that the effect of PMVI is time limited. Despite these limitations, most authorities believe that PMVI programs generally lead to improvements in mechanical condition.

The question arises: *how realistic is it to expect that vehicle defects (designated as causal or contributing to fatal and serious crashes) would be cost effectively reduced through PMVI?*

To answer this question, an examination of available research has been undertaken. McLean et al (1979) and FORS Fatal File (1992) also provide case studies for examination.

6.2 International research

US research conducted over the past 25 years has provided a primary source of information on the question of whether PMVI leads to reduced fatalities or crash rates.

Rompe and Seul (1985) observed "The most accurate and cautious US surveys suggest that periodic roadworthiness tests could reduce the number of accidents caused by vehicle defects by about 50%". Based on the figures reproduced in Table 14 (above, p.40) they concluded: "This implies a reduction of between 2% and 3% in the total number of accidents caused by vehicle defects, and a further 4% to 9% partially caused or aggravated by defects". They also reported that US surveys had produced evidence that periodic roadworthiness tests could "reduce the number of road fatalities by between 5% and 10%". They concluded - "it is fair to assume these two findings are more or less compatible".

The majority of US studies have comprised time-series analyses in particular jurisdictions and comparative studies across jurisdictions. Greater statistical sophistication has been reflected in more recent "econometric" studies.

As previously observed the initial US time-series research must be regarded as relatively simplistic as it failed to recognise developments in motor vehicle technology, improvements in the road environment and economic and other factors. More recent time-series analyses have sought to address these problems. While the earlier studies produced a range of conflicting conclusions the more recent studies suggest, on a statistical basis, an association between PMVI and fatalities or crash rates.

Even the more recent and sophisticated US time-series studies appear to be limited due to difficulty with quantification of various factors and failure to comprehend others eg. the effects of the various levels of random vehicle inspections and the varying levels of public sector initiatives designed to increase awareness of road safety over time. To attribute reductions in fatalities over time to PMVI without reference to these factors must undermine the validity of conclusions drawn from this research. As NHTSA (1989) has observed in relation to the more prominent time-series analyses by Jackson et al (1982) and Loeb and Gilad (1984) “there must be some other important factors which co-vary with inspection”.

Fundamental methodological issues also diminish the validity of other studies eg., White (1986) (NZ) and Berg et al (1984) (Sweden).

A range of cross-sectional statistical studies have also found an association between PMVI and fatalities and/or crash rates. Some more recent and sophisticated studies have also included “deterrents” in the form of insurance premiums. These studies also appear limited due to failure to comprehend the effects of a range of factors including the varying levels of random vehicle inspection, the nature and intensity of public education effort, public traffic enforcement activity and levels of road safety consciousness across jurisdictions.

NHTSA (1989) in their review of US studies reported there was *“no conclusive evidence in the literature that periodic motor vehicle inspection programs are or are not effective in reducing crashes”*.

NHTSA went further: *“analyses of Fatal Accident Record System (FARS) and State crash data files failed to show any evidence .... which would suggest that PMVI programs affect crash involvement rates of older vehicles compared with newer ones”. “Our attempts to correlate (the number of poorly maintained vehicles) with a reduction in crashes on highways failed to show any significant effect of PMVI”*.

GAO (1990) criticised NHTSA conclusions. GAO concluded from their review of the NHTSA Report and some minor statistical analysis that “even taking into account methodological limitations of individual studies, their relative consistency in pointing to a safety benefit from periodic inspection justifies the conclusion that these programs reduce crash rates. The magnitude of the crash reduction could not be determined because of the data limitations and the methodological problems encountered by those who have studied it.” It would be interesting to know how the GAO managed to “take into account the methodological limitations of individual studies” eg., biased (self-selecting) samples , the potential for co-variance etc.

NRMA (1996) reported that the German TUV (testing company) had concluded from “a wide range of studies on inspection systems and defects, mainly from the European Union but including some from the US” ... that a well run inspection system would lead to a 2.3% overall reduction in crashes due to defects. TUV were also reported as concluding such an inspection system would be **27.4** percent effective in contrast to Rompe and Seul's conclusion of 50 percent.

These conclusions are curious given the findings of Fosser (1992). As discussed previously the study was conducted in Norway over four years with 46,000 vehicles inspected annually; 46,000 vehicles inspected in the first year, but not subsequently; and a control group of 112,000 vehicles (not inspected). Vehicles were aged six years to 12 years. It constitutes the most comprehensive and methodologically sound purpose designed large scale experiment undertaken.

Fosser concluded that neither the crash rate nor crash severity differed significantly (statistically) between the 3 groups, ie., crash rate was not related to vehicle inspection.

An overview of selected studies is presented in Table 24.

TABLE 24 - Overview of selected studies concerning PMVI and Crash Rates.

Source	Comment
Little, US 1968,1971	Introduction of PMVI was apparently associated with an increase in fatality rates per 100,000 inhabitants based on six US States including control groups.
Schroer & Peyton, US 1979	For the first year after inspection reported a 9% reduction in average crash involvement of cars inspected.
Crain, US 1980	Compared fatality rates in selected States with PMVI and without and concluded no statistical difference in fatality rates.
Van Matre & Overstreet, US 1982	Concluded a 10% lower fatality rate per 100,000 inhabitants in States with PMVI compared with other States.
Loeb & Gilad, US 1984	PMVI reduced the number of fatalities and crashes, based on a time-series analysis of New Jersey data 1929-1979.
Berg, Danielsson & Junghard, Sweden 1984	Concluded PMVI was associated with a 14% decline in police reported crashes, based on time-series analysis Sweden 1955-1991 (PMVI introduced in 1966).
White, NZ 1986	Concluded PMVI was associated with lower crash rates; crash rates were lowest immediately after inspection.
Robinson, US 1989	Concluded no effect of PMVI on fatality rates could be detected from all US States (50).
Loeb, US 1990	Statistical association between PMVI and fatalities established from regression analysis including a wide range of factors; time-series data 1952-1982.
Zlatoper, US 1991	Statistical association between PMVI and fatality rates established from regression analyses

	including a wide range of factors - cross section analyses based on 1987 fatal data for US States.

6.3 Crash rates and PMVI

Reliable data for all crashes is not available to enable examination of the association between PMVI and overall crash rates. However FORS (1994) provided national fatality data for all Australian jurisdictions.

An analysis was undertaken to examine the association between fatality statistics and the various forms of PMVI. Fatality rates for 1994 per 10,000 registered vehicles, per 100 million vehicle kilometres travelled and per 100,000 population were tested for association with jurisdictions with annual PMVI (NSW, NT, ACT), those with change of ownership PMVI (Vic, Qld), and those jurisdictions without PMVI (SA, WA, Tas). Data is reported in Table 25.

TABLE 25 - Fatality Rates by Australian Jurisdiction and the Type of Inspection Program

The nature of inspection by jurisdiction	**Fatality rates (1994)**		
	per 10,000 registered vehicles	**per 100 million vehicle kilometres travelled**	**per 100,000 population**
PMVI (annual)			
NSW	2.04	1.44	10.76
NT	4.69	4.60	23.96
ACT	0.96	0.61	5.65
Inspection at change of ownership			
Vic	1.38	1.23	8.44
Qld	2.21	1.49	13.17
No inspections			
SA	1.82	1.43	11.09
WA	1.91	1.29	12.40
Tas	1.81	2.00	12.28

FORS (1994) Road Fatalities Statistical Survey

Statistical analysis does not support an hypothesis of an association between PMVI and reduction in fatality rates. *This cross jurisdiction analysis for 1994 can be justifiably criticised for not including and hence isolating differing factors related to the road environment, the driver, public education and public enforcement effort across jurisdictions. The unknown differences in these factors may well obscure a small but nevertheless plausible association between PMVI and reductions in fatal and serious injury crashes.*

Analysis of the FORS Fatal File (1988,1990, 1992) indicates the percentage of fatal crashes involving causal vehicle defects in light vehicles was lowest in jurisdictions with PMVI at change of ownership, while jurisdictions with annual PMVI and without PMVI were statistically indistinguishable. Data is reported in Table 26.

TABLE 26 - PMVI and fatal crashes involving light vehicles

The nature of inspection	Number of fatal crashes	Number of fatal crashes involving defects	Percentage fatal crashes involving defects	Percentage fatal crashes involving tyre problems *
PMVI (annual)	1965	55	2.80	1.93
Inspection at change of ownership	2227	36	1.61	1.07
No inspection	1052	31	2.94	1.23
Total	5244	122	2.3	1.4

FORS Fatal Files (1988, 1990, 1992)
* tyre problems include tyre blowouts and other tyre defects including under inflation

Similarly, for the largest vehicle defect category, tyres, annual PMVI does not appear effective, with the rate of tyre problems in annual PMVI jurisdictions exceeding those in other jurisdictions. Differences between jurisdictions with inspection at change of ownership or no inspections are not statistically significant.

Observations from this statistical analysis must however be treated warily. This analysis suffers from the methodological flaws of the previous analysis, ie., it fails to account for a range of factors unique to each jurisdiction. In these circumstances any conclusions drawn from the analysis may be questioned.

6.4 Examination of the likely effectiveness of PMVI with regard to Adelaide In-depth Accident Study data

The McLean et al (1979) Adelaide In-depth Accident Study, although dated, is probably the most pertinent Australian research. It constituted a randomly drawn sizeable sample, was not limited to fatal crashes (it comprised crashes to which an ambulance was called) and was not reliant on police investigation. Investigations were undertaken by a multi-disciplinary professional team including an engineer, psychologist and medical officer.

Overall 183 crashes were investigated which involved collisions with other vehicles, and 46 which involved a single vehicle (colliding with a stationary object, roll over/running off the road).

The majority of the crashes where vehicle defects were identified as contributing, also involved a range of other factors. Almost two-thirds of drivers were under 26 years of age, around half the vehicles were at least 10 years old, and around a quarter of drivers had a blood alcohol count (BAC) above the legal limit. A brief cameo of each of the crashes is reported in Appendix 1.

The study identified three crashes in which vehicle defect(s) were a major causal factor; 11 crashes in which vehicle defect(s) were a significant cause; and five crashes where defects were a possible cause (vehicles which almost certainly would have been in the crash had the defect not been present).

Worn tyres and/or mix of tyre types and/or rims accounted for around two-thirds of crashes (nine of the 14) where defects were considered a major cause or significant contributory factor. In comparison defective brakes accounted for only around one-third (five out of 14). In two cases a combination of worn tyres and poorly performing brakes were jointly considered as the cause or significant contributory factor.

For the five crashes considered as possibly being caused by defects, poorly functioning brakes accounted for four and worn tyres were associated with two.

Under-inflated tyres or significant differences in pressure between tyres was evident in only two of the crashes. In contrast to FORS Fatal File (1988, 1990, 1992) neither tyre blowouts or tread separation were reported as a cause of a single crash. However, the crashes investigated were in the Adelaide metropolitan area where travel speeds could be expected to be lower than in rural areas, and hence relatively less "stress" applied to tyres.

Analysis of the data leads to the conclusion that none of the defects identified as a major significant or possible contributory cause of any of the nineteen reported crashes associated with vehicle defects would ***definitely*** *have been identified prior to the crash.*

What can be said is that many of the defects associated with mismatching tyres/rims, fitting of non-standard equipment or removal of safety equipment would have been expected to have been identified within a maximum of 12 months of their introduction or occurrence had an annual PMVI program been in operation. PMVI at change of ownership would have further reduced the likelihood that the defects would have been identified prior to a crash. This assumes that owners with defective vehicles would not drive their vehicles in an unregistered condition (and hence avoid the necessity to present for PMVI). It also assumes that non-standard items (eg., rims, tyres) were not temporarily removed to ensure a "pass" at inspection only to be refitted subsequently. Both these behaviours were identified by the author in a small number of cases in the context of ACT annual PMVI.

6.5 Examination of the likely effectiveness of PMVI with regard to a Selected FORS Fatal File

The FORS Fatal Files provide case study material against which the effectiveness of PMVI can be examined.

For a selected year detailed examinations were made from Coroner's reports and associated police reports for 28 crashes where vehicle defects were considered to have caused or contributed to the crash. *The analysis indicated that a wide range of defects were either not identified at PMVI, or were not amenable to identification at PMVI, or probably developed subsequent to PMVI.* Further case study details are reported in Table 27.

Details provided in Table 27 have been limited at the request of FORS to avoid the potential for identification of individuals or particular crashes. Information was not available in relation to nine fatal crashes in the selected year where vehicle defects were identified as a causal or contributory factor.

TABLE 27 - Qualitative assessments drawn from an annual FORS Fatal File: 28 fatal crashes involving passenger vehicles with contributory vehicle defects

Description of circumstances	Description of vehicle/ driver	Comment
Single vehicle crash. Rural. Tyre blew out, vehicle collided with a tree on the opposite side of the road.	20 year old vehicle, driver had less than three years driving experience.	Vehicle was subject to annual PMVI.
Single vehicle crash. Rural. Tyre blew out, vehicle rolled and collided with a tree on the opposite side of the road.	15 year old vehicle, driver had at least 15 years driving experience.	Vehicle was subject to annual PMVI.
Single vehicle crash. Urban. Late evening, tyre blew out, vehicle overturned.	12 year old vehicle.	Vehicle was subject to annual PMVI.
Single vehicle crash. Urban. Late evening, tyre blew out, vehicle overturned.	Two year old vehicle.	Vehicle was under warranty and was not at the time subject to annual PMVI.
Single vehicle crash. Midday. Low tyre tread, driver lost control of vehicle and collided with road furniture.	43 year old vehicle, driver with four years driving experience.	Vehicle was subject to annual PMVI.
Single vehicle crash attributed to tyre defect.	16 year old vehicle.	Vehicle was subject to annual PMVI.
Single vehicle crash due to unspecified vehicle defect(s).	Nine year old vehicle.	Vehicle was subject to annual PMVI.
Single vehicle crash. Rural. Vehicle was considered unroadworthy due to missing suspension components, an empty brake fluid reservoir, bald tyres and other items. The fatality was attributed in part to a tyre blowout.	Vehicle was over 10 years old. Driver was unlicensed and recorded a high BAL.	Vehicle was subject to annual PMVI.
Single vehicle crash. Rural. The vehicle was travelling at over 100 kph when a tyre blew out. The driver lost control of the vehicle which overturned. The driver was not wearing a seat belt and thrown from the vehicle.	Vehicle was around four years old.	Vehicle was subject to annual PMVI.
Single vehicle crash. The vehicle was considered unroadworthy due to a lack of serviceable tread depth. On entering a bend, the vehicle started to slide, the driver lost control of the vehicle which overturned and hit an obstacle.	N/A	Vehicle was subject to inspection at change of ownership.

Table 27 (continued)

Description* of circumstances	Description* of vehicle/ driver	Comment
Single vehicle crash. Rural. The driver lost control of the vehicle which was considered to be driving too fast for conditions (gravel road). The vehicle was considered unroadworthy due to defects in lights, indicators and steering. These steering defects may have contributed to the fatality (although this was considered unlikely). The passenger was not wearing a seat belt and was thrown from the vehicle.	N/A	Vehicle was subject to inspection at change of ownership.
Single vehicle crash. Urban. Both rear tyres were "devoid of tread". At a speed estimated at around 150 kph the driver lost control of the vehicle which overturned.	Vehicle was around five years old. Driver had more than five years driving experience.	Vehicle was subject to inspection at change of ownership.
Single vehicle crash. Rural. 4WD vehicle rolled after a tyre blew out. Passenger who was not wearing a seat belt was thrown from the vehicle and killed.	Vehicle was around 10 years old. The driver was mature aged.	Vehicle was subject to inspection at change of ownership.
Single vehicle crash. Rural. The vehicle lost traction on a "greasy" road. "Unserviceable" rear tyres and "excessive speed" in the conditions were considered to have contributed to the fatality.	N/A	Vehicle was subject to inspection at change of ownership.
Single vehicle crash. Urban. The driver lost control of the vehicle which slewed across the road and rolled. The fatality was attributed to a combination of excessive wear in the steering and irregularities in the road surface.	Vehicle was over 15 years old. Driver recorded a high BAL.	Vehicle was not subject to PMVI or inspection at change of ownership.
Single vehicle crash. The vehicle had defective steering and brakes. The vehicle collided with road furniture.	Vehicle was over 10 years old. Unlicensed (disqualified) driver who recorded a BAL above the limit.	Vehicle was not subject to PMVI or inspection at change of ownership.
Single vehicle crash. At extreme speed the tyre blew out. The deceased was not wearing a seat belt and was thrown from the vehicle. The vehicle had been fitted with a tyre of incorrect speed rating.	Vehicle was around five years old. The new tyre had been fitted following an inspection at time of recent purchase.	Vehicle was not subject to PMVI or inspection at change of ownership. The vehicle had been "serviced" by a garage shortly before the crash.

Table 27 (continued)

Description* of circumstances	Description* of vehicle/ driver	Comment
Single vehicle crash. Rural. A range of vehicle defects were identified. The fatality was attributed to tread separating from a tyre. The deceased was seated on the tray of the vehicle and was thrown out when the driver lost control of the vehicle.	Vehicle was eight years old. Driver recorded a high BAL.	Vehicle was not subject to PMVI or inspection at change of ownership.
Single vehicle crash. The vehicle was considered unroadworthy due to very low tread depth on the tyres. At a speed in excess of 100 kph, the driver lost control of the vehicle, crossed to the opposite side of the road and hit a tree.	Driver recorded a very high.	Vehicle was not subject to PMVI or inspection at change of ownership.
Two vehicle crash. The vehicle was unroadworthy as it had "low tread" on tyres. The driver lost control of the vehicle in a bend, and crossed into the path of oncoming traffic. The driver was killed in the ensuing collision.	10 year old vehicle. Driver had around two years driving experience.	Vehicle was subject to annual PMVI.
Multiple vehicle crash. A vehicle with a tyre defect crossed into the path of an oncoming vehicle. A collision occurred.	12 year old vehicle.	Vehicle was subject to annual PMVI.
Two vehicle crash. Urban. An "inappropriate" combination of tyres on the vehicle and excessive speed in wet and slippery conditions resulted in the driver losing control. The vehicle veered into oncoming traffic, colliding with another vehicle.	Vehicle less than 10 years old. Mature aged experienced driver.	Vehicle subject to inspection at change of ownership.
Two vehicle crash. The vehicle towing a trailer collided with an oncoming vehicle. The trailer was unroadworthy due to "insufficient tread on tyres" and "excessive bush travel on the draw bar". "Reduced braking efficiency" and possible "overloading of trailer" were considered to have contributed to the accident.	N/A	Vehicle trailer subject to inspection at change of ownership.

Table 27 (continued)

Description* of circumstances	Description* of vehicle/ driver	Comment
Two vehicle crash. The driver sought to avoid an oncoming and out of control vehicle. Due to bad wheel alignment sustained in a recent accident, the driver was unable to steer the vehicle. The vehicle overturned killing the driver.	Vehicle around 10 years old. Young driver.	Vehicle subject to inspection at change of ownership. Driver reportedly knew of pre-existing defect.
Two vehicle crash. An unroadworthy vehicle (with defective brakes, steering, seat etc.) may have failed to observe a traffic sign at an intersection and collided with another vehicle. A passenger in the latter vehicle who was not wearing a seat belt was thrown from the vehicle and died. Poor road design was also considered a contributing factor in the fatality.	The unroadworthy motor vehicle was at least 15 years old. The driver of this vehicle was elderly and may have suffered eyesight and alertness deficiencies.	Vehicle was not subject to PMVI or inspection at change of ownership.
Two vehicle crash. Vehicle defects included brakes, tyres, lights, suspension, windscreen. “Excessive speed” and “poor mechanical condition” contributed to the fatality.	Vehicle over 20 years old. New owner of around one month.	Vehicle was not subject to PMVI or inspection at change of ownership but garage advised the vehicle owner of defective brakes.
Two vehicle crash. Both front tyres were low in tread depth. The driver lost control of vehicle and crossed into the path of an oncoming vehicle.	N/A	Vehicle was not subject to PMVI or inspection at change of ownership
Two vehicle crash. The vehicle towing a caravan crossed into the path of an oncoming vehicle. The crash was attributed to a tyre blowout on the caravan.	N/A	Vehicle/caravan subject to inspection at change of ownership.

*Descriptions were prepared from inspection of Coroners’ files, including vehicle inspection reports and other material included in the FORS Fatal File for a particular year. At the request of FORS details have been limited to avoid identification of individuals or particular crashes. Coroners’ reports and/or information were not available for nine fatal crashes where vehicle defects were identified as a contributory factor.

6.6 Some Conclusions

While it has been established that certain percentages of crashes are caused or contributed to by vehicle defects, the question arises as to how effective PMVI may be in reducing these defects.

Statistical analyses reported in overseas research have resulted in conflicting observations, some reporting an association between PMVI and reduced fatality rates, others the contrary. With the exception of Fosser (1992), a purpose designed experiment with a control group, the majority of research is methodologically flawed.

Analysis of FORS (1994) crash rate data across jurisdictions suggests no association between PMVI and a reduction in fatality rates. A similar observation can be made from the FORS Fatal File (1998, 1990, 1992) in relation to annual PMVI. As with similar overseas statistical analysis, the methodology fails to account for a range of other factors unique to each jurisdiction which may well obscure a small but nevertheless plausible association between PMVI and reduced crashes ie., the analysis must also be regarded as inconclusive.

Rompe and Seul (1985) have suggested PMVI in a European context may be 50 percent effective in reducing crashes caused by vehicle defects. In an Australian context this assessment is considered to be high having regard to an assessment of the information provided in Table 27.

Analysis of case studies from FORS Fatal File (1992) indicates that vehicle defect-related fatal crashes continue to occur in PMVI jurisdictions. These case studies also indicate a wide range of defects - not just tyre problems - appear not to have been reduced or appear unlikely to be reduced by PMVI.

Against this background three levels of effectiveness of PMVI in reducing defect related crashes has been assumed for the purposes of BCR calculations, 33 percent (lower bound), 50 percent (possible), 66 percent (upper bound).

7. BENEFITS OF PMVI

7.1 Introduction

A range of road safety and other benefits have been attributed to mandatory motor vehicle inspection programs. These include reduction in crashes (fatal, serious injury, injury, property); reduction in environmental costs (arising from lower fuel consumption and reduced emissions); greater availability of the vehicle fleet (productivity type benefits); industry related assistance benefits arising from increased business turnover and higher employment levels; reductions in vehicle theft (attributed to the direct benefit of identification of stolen vehicles and the deterrent value) and consumer protection benefits (adequate description and representation of the vehicle).

It may also provide "non tangible" benefits to vehicle owners, such as those "feel good" perceptions including from having an "independent" assessment of the mechanical condition of the vehicle, and the satisfaction of having an apparently roadworthy vehicle (ie, meeting legal requirements).

7.2 Accident costs

As required by the terms of reference this report focuses particularly on the road safety benefits of PMVI.

BTCE (1994) estimated that in 1993 over half a million road crashes occurred in Australia including some 1,732 fatal crashes, 17,000 crashes involving hospitalisation of victims, and 47,000 crashes involving medical treatment of victims.

BTCE estimated that road crashes in 1993 cost Australia some $6.1 billion; with the average cost by category as follows: fatality $752,400; hospital injury $113,100; medical injury $11,900 and property damage $5,000. These estimates were developed from the comprehensive methodology described in BTCE (1992). The social costs included lost earnings, foregone family and community contributions, pain and suffering, property damage, insurance administration, losses to non victims, travel delay, hospitalisation and rehabilitation, medical, accident investigation, legal and court, ambulance and search and rescue.

The BTCE have applied an ex-ante human capital asset valuation model to estimate the value of a life foregone. This approach applies a net present value to the estimated future income stream of the deceased and other social costs categorised above. This methodology places a significantly lower value on the life of the very young (who incur costs met privately but also by the public sector, and whose income generation stream is significantly time lagged [and hence relatively heavily discounted]) and the elderly (whose income stream is limited in time and who may draw heavily on public expenditure). Consequently this methodology gives greater economic worth to 18 to 25 year olds who are coincidentally over-represented in motor cycle and passenger vehicle crashes, and lower economic worth to the elderly who are over-represented in pedestrian accidents. An alternative less "mechanical" but somewhat more conjectural welfare economic approach based on willingness to pay is discussed at Appendix 1 of the BTCE Report.

Notwithstanding the difficulties of the ex-ante human capital asset valuation model, it has been accepted as providing a basis for public investment decision making over the last 20 years (eg., Bureau of Roads (1973), Black Spot Program Report BTCE (1995)). Accordingly the BTCE (1994) estimation of the average cost of road crashes (fatality, hospitalisation, medical injury, property only) has been adopted as the basis for the estimation of benefits (costs avoided) and productivity and time costs used in this report.

7.3 Crash costs attributable to passenger vehicles and light commercials

The BTCE (1994) estimate of $6.1 billion for road crashes in Australia is for all categories of vehicles (heavy vehicles, buses, trucks, motor cycles and light vehicles). The question arises as to what percentage of the total cost is attributable to light vehicles? An answer may be found by estimating and then removing from the $6.1 billion the cost of single vehicle and multiple vehicle crashes not involving passenger vehicles and light commercial vehicles. FORS Fatal and serious injury data for 1993 indicates that at least 305 fatalities and 2457 serious injury accidents should be excluded. Based on BTCE average costs for these categories of accidents, the cost of road crashes associated with passenger vehicles and light commercial vehicles is estimated to be around $ 5.6 billion. This estimate must be regarded as an upper bound estimate as it does not exclude the cost of non serious injury and property damage crashes involving articulated trucks, trucks, buses, motor cycles etc.

An alternative estimate may be provided by scaling the estimated cost of road crashes attributable to light vehicles in proportion to their representation in fatal crashes (1735 for 1993) ie, by 0.806. On this basis the cost of road crashes involving light vehicles is estimated as $4.91 billion. This must be regarded as a lower bound estimate as RTA (1996) data indicates a comparative over-representation of light vehicles in property only crashes.

It should be noted however that to the extent that annual or change of ownership PMVI programs have reduced crashes, then the BTCE estimate of the cost of road crashes would understate the position were these PMVI programs not in place. This issue is discussed further in Chapter 9.

7.4 Reduced environmental costs

Reductions in fuel consumption and emissions have been claimed as a benefit of PMVI in some overseas studies.

For the ECE, Rompe and Seul (1985) claimed a 3 percent fuel saving for a test interval of 3-1-1-1- (commencing at three years and at an interval of one year thereafter) and a 5 percent fuel saving for a test interval of 7-1-1-1-. Fuel savings constituted a substantial component of total estimated benefits eg., for the Federal Republic of Germany between 40.2 percent and 51.8 percent of the total benefit (corresponding respectively to the 3 percent and 5 percent fuel saving) ie., *the economic benefits attributed to fuel savings were almost equally as important as road safety benefits.*

The savings in fuel claimed by Rompe and Seul were related to better tuning of engines following PMVI. Since 1985 motor manufacturers have introduced computerised engine management systems (EMS) which continually monitor and adjust engine operation. With EMS incorporated in the majority of the Australian vehicle fleet, fuel savings would only arise from the diminishing fleet of older vehicles.

In Australia FORS (1996b) concluded that benefits could be achieved from a better maintained fleet; pollution could be reduced from between 9 percent and 25 percent below existing levels, with greenhouse gas and fuel savings estimated at some $200m annually. Other benefits such as those related to health, property were not quantified.

FORS has however noted that around 80 percent of the benefits were delivered by 20 percent of the fleet (primarily older vehicles) and has questioned whether subjecting all vehicles to an inspection and maintenance regime is likely to be the most cost effective means of achieving environmental objectives.

Emissions testing is not currently undertaken as part of PMVI in Australia. The additional *costs* to achieve the estimated annual benefits of $200m are unknown. The direct costs will depend on the testing regime and testing standards adopted. Additional social costs (eg. time related) will also be incurred. Keatsdale believes that unless the testing is highly targeted there is potential for costs to exceed the estimated benefits.

In these circumstances the benefits and costs of emission testing have been excluded from benefit cost calculations below.

Neither fuel savings nor reduction in emissions arising from PMVI were included in the benefit streams estimated by the RACV (1994) and NRMA (1991), nor were they included in the NHTSA (1989) estimates.

7.5 Increased fleet productivity; longer road life

Rompe and Seul (1985) suggest that the better mechanical condition of vehicles arising from PMVI will lead to their "longer availability time" although they suggest the benefits are almost "impossible" to estimate. Fosser (1992) reported that the improved condition of motor vehicles arising from PMVI has the potential to extend their working life, perhaps theoretically by up to 2 years.

On the other hand increasing the life of the older section of the fleet also defers the entry into the fleet of more modern vehicles incorporating improved features. Not only both primary crash avoidance eg. ABS but and secondary (injury limitation ie airbags).

Against this background, no allowance has been made in this Report for potential increases in fleet productivity arising from PMVI.

7.6 Improved awareness of the need for regular maintenance

Rompe and Seul (1985) suggest that PMVI may lead to a greater awareness of the need for regular maintenance. However the behavioural response of motorists to PMVI remains unclear as reported in Chapter 2.6. In these circumstances it is impossible to determine the nature and extent of benefits, if any.

7.7 Benefits to industry

A national PMVI program has the potential to provide a boost in business turnover for sections of the motor trades industry. To illustrate the point; if all passenger vehicles over 4 years of age were tested annually, this would result in annual checks of 7.2 million vehicles, some 5 million vehicles more than at present. Furthermore if the failure rate at inspection was 20 percent, repair of defects would be undertaken on an additional 1 million vehicles. Based on an inspection fee of $25 and an average repair cost of $100, an increase in annual turnover of up to around $225m may be expected.

Keatsdale estimates the potential direct employment effect of this form of inspection to be up to around 3000 additional inspectors (approved licensed mechanics). Further employment generation would arise from repair work, although it is likely to be substantially less than that arising from the inspection effort.

A national PMVI program based on use of private garages would require investment in specialised testing equipment and staff training. In the event the ECE model or the preferred NRMA model (centralised testing facilities) was adopted, an even greater investment program would be required as new facilities would need to be constructed.

Assessment of industry assistance is outside the terms of reference and accordingly has been excluded from benefit cost calculations.

7.8 PMVI and motor vehicle theft

Motor vehicle inspection, whether periodic or at change of ownership, is commonly believed to be an effective countermeasure to professional motor vehicle theft.

Motor vehicle theft in Australia is a major problem. The National Motor Vehicle Theft Task Force (1997) reported that the Australian rate of motor vehicle theft was second only to that in the UK, and far in excess of that in the USA. Over 122,000 vehicles were reported stolen in 1996, with around 26,000 unrecovered. NRMA (1995) estimated the cost of motor vehicle theft to insurers at $650m annually. Substantial additional community resources are also consumed in law enforcement, legal processes and gaols.

The potential "theft reduction" benefits of PMVI were examined by the South Australian Parliamentary Environment, Resources and Development Committee (1995). In evidence to the Committee, the SA Department of Transport is quoted as indicating; "There is insufficient evidence to suggest that substantial benefits would be derived from (PMVI) identity inspections". They reportedly observed that vehicle inspections undertaken in high risk categories detected "relatively few stolen vehicles". The Royal Automobile Association (RAA) of SA was also quoted as arguing that checks undertaken in the context of annual PMVI would "not improve the detection rate of vehicles with altered identification". The Committee concluded that there was "little evidence to suggest that substantial (theft reduction) benefits would be derived (from annual PMVI)".

In a commissioned report for the National Motor Vehicle Theft Task Force Keatsdale (1997) examined the feasibility of theft reduction strategies for vehicles stolen for profit. Keatsdale identified some 12 modus operandi used in professional theft and examined the effectiveness of a range of countermeasures including periodic motor vehicle inspection and motor vehicle inspection at change of ownership. Neither of these measures was found to be effective in countering the vast majority of commonly used modus operandi. Accordingly Keatsdale concluded there are no significant theft reduction benefits to be gained from PMVI.

7.9 PMVI and consumer benefit

The consumer benefits of annual PMVI were the subject of examination by the South Australian Parliamentary Environment, Resources and Development Committee (1995). The Committee reported evidence of the RAA which suggested that PMVI type inspections were of little value from a consumer protection viewpoint as they did not provide advice on the "mechanical soundness" of a vehicle.

The SA Consumer Affairs Commission was also reported as indicating that "Consumers may be induced to purchase vehicles believing that a certificate of roadworthiness is really a certificate that the car is completely free of defects and they do not need to have the vehicle further inspected. Value for money and road worthiness can be a long way apart in the purchase of a motor vehicle".

The ACIL (1996) NSW Motor Trade Review also questioned the consumer benefits of PMVI.

In these circumstances the consumer benefits of PMVI have been assumed as zero for the purposes of the BCR calculations.

7.10 A summary of the benefits attributable to PMVI

The aggregate benefits attributable to PMVI for inclusion in BCR calculations depend on the testing model to be adopted. The most critical aspects of the model include the vehicle age at time of commencement of testing and the inspection interval. Various models used for BCR calculations are discussed in Chapter 9.

Benefits which have been applied to BCR calculations are reported in Table 28.

TABLE 28 - Benefits attributable to PMVI

Benefit category	Range applied in BCR calculations
Accident costs attributable to light vehicles (1993)	Upper bound $5.6 b Lower bound $4/9 b (based on the following unit costs) fatal $752,400 hospital injury $113,100 medical injury $11,900 property damage only $5,000
Emissions Increased fleet productivity	neither benefits nor costs in cluded nil - not quantified
Industry assistance	nil - not quantified
Theft reduction	nil
Consumer benefit	nil

8. COSTS ATTRIBUTED TO PMVI

8.1 Introduction

The cost of vehicle inspection includes the inspection fees charged, the cost of repairs, the operating cost of delivery/collecting the vehicle from the inspection station, the loss of time associated with the above and costs associated with delivery/collection of those vehicles subsequently requiring repairs.

8.2 Inspection fees

The fees charged for vehicle inspections vary markedly. The time to undertake a vehicle test and hence the fee depends in large part on the purpose of the test, the vehicle elements/components to be inspected and the testing equipment and facilities available.

The cost of a comprehensive vehicle inspection is illustrated by the charges levied by motoring associations. Fees of $105 to $135 are typically charged for comprehensive pre-purchase vehicle inspections and these provide an assessment of the condition of all key elements of the vehicle including mechanical condition, paintwork, body work etc. They generally advise as to defects requiring immediate attention, deteriorating components which are likely to require attention in the foreseeable future, and other advice.

These comprehensive inspections do not just provide a “pass” or “fail” on the day of the test. The “added value” of this form of test is that it provides a warning to motorists of deteriorating components which in time may develop as a serious defect. These tests are generally recognised as providing an “independent” assessment of the vehicle, free of potential conflict of interest. They typically take 1 to 1.5 hours to complete in well equipped workshops.

In comparison, fees charged for Roadworthiness Certificates are substantially cheaper and such tests are generally focussed on mechanical condition of prescribed items. The fee for a Roadworthiness Certificate in Victoria is not regulated and “market rates apply”. VicRoads has reported that the average price for a motor vehicle inspection is between $40 and $45, but this can vary according to the complexity of the test. The fee for a Roadworthiness inspection in Queensland is set by government at $41.

Fees levied or proposed for annual motor vehicle inspection are substantially lower than for change of ownership inspection, being in the range $18.60 to $27.

Vehicle inspection/identification checks are also required in all jurisdictions at the time of registration of a vehicle transferred from interstate. The fees charged are also at the lower end of the scale (up to $35).

Further information on fees charged for motor vehicle inspections is provided in Table 29.

TABLE 29 - Fees charged for motor vehicle inspection

Source	Fee	Comment
NRMA	$105 - $125	Comprehensive report on all elements of vehicle condition including mechanical condition, paintwork, body work etc.
RACV	$115 on site $135 workshop	Workshop inspections include removal of wheels
RACQ	$85 - $130 mechanical $105 - $155 master	Master inspection includes mechanical components plus assessment of body and trim
Victorian Roadworthiness Certificate (RWC)	typically $45	Fees set by market. RWC valid for 30 days.
Queensland Roadworthiness Certificate (RWC)	set fee $41	Fee set by government RWC valid for 30 days.
NSW annual inspection fee NT annual inspection fee	$23 $18.60	System reportedly overhauled and simplified in 1992
ACT inspection fee for vehicle issued with "red defect" notice	$32	Red defect notice is issued at the time of random vehicle inspection
NSW interstate transfer inspection fee	$23 - $35	The higher fee is associated with "identification" checks for registration
ACT interstate transfer inspection fee	$31	Involves "identification" checks for registration
NRMA recommendations for an improved AIS system	$26 - $30 (1991)	
MTA South Australian annual inspection fee proposal	$27	Authorised garages

NRMA (1991) reported that it believed "well equipped and designed inspection centres" such as were reportedly offered by United Technologies to the NSW Government would charge a fee of around $18. This inspection fee provided the basis for costings by NRMA which lead to an overall benefit cost ratio for annual PMVI of between 1.2 and 1.9. By comparison in 1996 the ACT Government purpose built testing station which incorporated specialist dynamic testing equipment charged $32 per vehicle inspection. In these circumstances even allowing for inflation the NRMA cost estimate appears low.

In undertaking benefit cost calculations the RACV (1994) adopted two levels of fees, $25 and $50 for the cost of inspection.

Rompe and Seul (1985) adopted low inspection fees which contributed to the achievement of BCRs between 1.7 and 2.6. (Allowing for differences in exchange rates the actual fees charged for vehicle inspections by ECE Member States are frequently higher than assumed by Rompe and Seul).

In its analyses NHTSA (1989) recorded the comparatively low level of inspection fees charged by the US States (US$3 to US$15) in 1988. Even allowing for currency conversion and exchange rates these low fees appear unrealistic in the Australian motor trades environment.

Keatsdale has adopted a range of inspection fees of $25, $35, and $50 for a PMVI type inspection. These fees have been assumed to achieve full cost recovery (including return of capital investment) based on the application of commercial accounting standards.

No allowance has been made for the costs of supervision and auditing of the inspection system which would need to be undertaken by Government. These costs are considered to be relatively small compared with other costs.

8.3 Failure rates at inspection

The failure rate at inspection has direct consequences for elements of the total cost of PMVI, including repair costs and associated indirect costs.

The average failure rate in the NSW PMVI program as previously reported is around 20 percent. As discussed in Chapter 4 surveys and random inspections potentially representative of vehicle fleets in the ACT and NSW have revealed tyre defects in the range 10 percent to 12 percent. In these circumstances, having regard to the other defect types, it is not unrealistic to expect a 20 percent defect rate in the national vehicle fleet.

McLean et al (1979) and Victoria Police (1996) reveal a defect rate of between 36 percent and 40 percent. The defect rate at Roadworthiness inspection in Victoria (VACC 1989) was around 80 percent. These defect rates however cannot be considered as representative of the national vehicle fleet, as they involve over-representation of older vehicles.

For the purposes of sensitivity testing in the context of benefit cost calculations a range of defect rules have been adopted; 20 percent based on PMVI program; a speculative 30 percent and an unlikely upper bound limit of 40 percent.

8.4 Cost of repairs

Reliable information is not available on the cost of vehicle repairs from annual vehicle or roadworthiness inspections.

RACV (1994) in undertaking an economic assessment of annual inspections adopted a "conservative" estimate of an average of $100 per vehicle, but also included a higher figure of $200 per vehicle for "sensitivity" testing. The incidence and nature of defects identified by the Victoria Police (1996) provides a basis for estimating the likely cost of repairs. In the event these defects were identified at PMVI the average cost of repairs has been conservatively estimated by Keatsdale as around $200 per "failed" vehicle.

In the event the more stringent testing standards associated with Victorian Government roadworthiness tests were applied to an annual PMVI program, then the cost of repairs would be substantially higher, due to higher defect rates and the nature of repairs required to be undertaken.

Unlike the RACV, NRMA (1991) excluded vehicle repair costs in their benefit cost calculation.

Rompe and Seul (1985) acknowledged that indirect costs "must also include ... the cost of repairs which might not have had to be made without roadworthiness test". However they *excluded* the cost of repairs in calculating the benefit cost ratio on the basis that motorists were required to comply with safety legislation and that "any added costs for regular repair and maintenance must be weighed against the savings yielded by preventative repairs and the opportunity which they provide to avoid unnecessary repair work". (The only indirect costs included by Rompe and Seul were time costs associated with travel and driving the vehicle during testing.)

These studies illustrate the issue over what costs should be included in BCR calculation. FORS is of the view that BCR calculations should reflect a full cost rather than a partial cost perspective. (Private communication 1997).

Keatsdale has incorporated a range of average repair costs from zero (reflecting the partial cost perspective), and $50, $100, $200 to incorporate a full cost perspective.

8.5 Indirect costs associated with vehicle inspection

The indirect costs of vehicle inspection include the vehicle operating costs associated with the delivery and collection of the vehicle from the inspection centre and the associated "travel time" costs.

The actual indirect costs will depend on the nature of the vehicle inspection system (eg., centralised purpose built facilities or decentralised systems using authorised garages and inspectors).

Operation of the two ACT testing stations in the 1980s provides an insight into these costs. Inspection times for vehicle identification, communications equipment (indicators, horn etc.) and other equipment (windscreen wipers) were typically five minutes; while mechanical inspections "over the pits" and on dynamic brake testing machines were typically 10-15 minutes. Time in queues prior to tests was typically between 15 minutes and 40 minutes. Travel time to deliver the vehicle to the inspection station and return to work/home has been assumed on average to be 30 minutes. (Canberra has an excellent road network with limited road congestion compared with most other capital cities.) Persons living or working in outer suburban areas experienced major disruption to their working day in order to present their vehicle at the nearest inspection station.

Overall, the "one day of the year" trip to the Motor Vehicle Registry typically accounted for 1 to 1.25 hours of an ACT driver's time. To improve customer service a range of options were implemented including late openings and weekend operation of the testing stations. Appointment systems were examined but regarded as impractical. Information reported by a local radio station provided listeners with advice through the day on the waiting time at the Motor Vehicle Registries.

For the purposes of benefit cost calculation Keatsdale has adopted a range of assumptions based on purpose built testing stations. These include social time costs of 0.5 hours (inspection time only), 1.0 hour, and 1.5 hours and vehicle operating cost based on an estimated average 20 kms travel to present and collect the vehicle.

Rompe and Seul (1985) in their economic evaluation recognised travel time as a major cost component. (Indirect costs (including travel time) were slightly in excess of inspection costs (8-17 ECU compared with 7-15 ECU per test).)

An inspection system comprising decentralised authorised local garages offers potentially greater levels of customer convenience (refer Chapter 2.6). Drivers are not required to be "at the wheel" to take the vehicle "over the pits". "Travel time" costs may be limited to the time to deliver and collect the vehicle from the garage. For the purposes of the benefit cost calculation travel time of 30 minutes has been adopted.

For the purposes of benefit cost calculations a nominal range of indirect costs (social time costs and operating costs) have been included, namely zero, $20, $30, $40.

Social time costs were not included by either the RACV or NRMA in their calculations. Hence the resultant benefit cost ratio would tend to overstate the position.

Additional indirect costs may be incurred for vehicles where defects require rectification. For the purposes of benefit cost calculations a nominal range of indirect costs of repair have been included, namely from zero, $20, $30. These costs were not included by RACV (1994), NRMA (1991) or Rompe and Seul (1985) in their benefit cost calculations.

8.6 Cost of unwarranted repairs

Limited information is available on the contentious issue of unwarranted repairs.

Carnegie-Mellon (1975) reported on the testing outcomes of submitting a vehicle with introduced defects to 20 different testing stations in Pennsylvania. They concluded "the number of non-existent defects found ranged from none to 7 with an average of 1.75 and an average estimated repair cost of US$34.93" (around A$200 in 1993 dollars).

Schroer and Peters (1977) based on the examination of a sample of 15,000 vehicles, concluded 23 percent of repairs involving 32 percent of repair costs were unnecessary. In discussion of the research Wolfe and O'Day (1985) observed "females were somewhat more likely to be victims of unnecessary repairs than males". They also observed a significant decline in the rate of unnecessary repairs over the 16 month period of the project.

Choice (1994) quoted from the UK Consumers Association magazine "Which?", that "15 out of 36 garages (42 percent) failed its test car for items which were in fact acceptable under the current standards" and that "consumers would have ended up paying for unnecessary repairs". (The UK inspection system is based on use of approved private garages (as in NSW) for annual vehicle inspection.) Similar findings have been reported by the New Zealand Consumers Association (1994).

Problems with the NSW AIS have been reported by the NRMA (1991) including "conflict of interest by the participants" and a "low" level of audits both of which continue to exist in the "overhauled" system in operation in 1996. In these circumstances there is reason to believe that unwarranted repairs would result from inspections undertaken by some authorised garages.

Mechanical repair of motor vehicles also continues to be a major category of consumer complaints in most Australian jurisdictions.

For the purpose of calculations the cost of unwarranted repairs has been set at 32 percent of the total repair cost, for the range of repair costs identified in Chapter 8.4.

The costs of unwarranted repairs were not included by the RACV (1994), NRMA (1991) or Rompe and Seul (1985) in their calculations.

8.7 Value of travel time

For the purposes of economic analysis the value of travel time has been based on indexing of the BTCE (1992) estimate of $14 per hour indexed according to CPI to 30 June 1993.

8.8 A summary of the costs attributable to PMVI

For the purposes of benefit cost calculations Keatsdale has adopted a range of costs for inspection fees, the cost of repairs, indirect costs of inspection, indirect costs of repairs and unwarranted repairs. A range of failure rates at inspection have also been adopted. These are summarised in Table 30.

TABLE 30 - Costs attributable to PMVI

Cost categories	Range applied in BCR calculations
Inspection fees	$25, $35, $50
Cost of repairs	zero, $50, $100, $200
Indirect costs of inspection	zero, $20, $30, $40
Indirect cost associated with repair of defect	zero, $20, $30
Unwarranted repairs	zero, $30, $60
Failure rate at inspection	20%, 30% , 40%

9.

COST EFFECTIVENESS OF PMVI IN AN AUSTRALIAN CONTEXT

9.1 Introduction

To examine the cost effectiveness of PMVI in an Australian context it is necessary to compare associated social benefits and costs. The basis for estimating benefits and costs have been reported in Chapters 7 and 8 respectively.

9.2 Inspection models

A range of inspection models with differing times of commencement of inspection and inspection intervals have been examined to determine the cost effectiveness of PMVI. These include those currently in use in Australian jurisdictions, those examined by Rompe and Seul (1985), the minimum ECE requirement and a model focused on inspection of older vehicles (aged 10 years and over). The features of these models are described in Table 31.

TABLE 31 - Inspection models included in the examination of the cost effectiveness of PMVI

Model	Description (commencement age in years and interval between inspections in years)
NSW AIS system	4 - 1 - 1 - 1 - 1 - 1 - 1 - >
Vic, Qld. change of ownership	3 - 3 - 3 - 2 - 2 - 2 - > estimate
Rompe and Seul (1985)	
optimum	3 - 1 - 1 - 1 - 1 - 1 - 1 - >
minimum	7 - 1 - 1 - 1 - 1 - 1 - 1 - >
ECE minimum (Asander 1992)	4 - 2 - 2 - 2 - 2 - 2 - 2 - >
Old cars - hypothetical	10 - 1 - 1 - 1 - 1 - 1 - 1 - >

9.3 Vehicle population subject to PMVI

For the purposes of benefit cost calculations a light vehicle (passenger vehicles and light commercials) population of some 9.6 million vehicles at June 1993 has been adopted.

Annual PMVI programs were in operation in 1993 in NSW, ACT, NT and affected an estimated 2.6 million light vehicles annually. Change of ownership inspection programs were in operation in Victoria and Queensland and were estimated to include an estimated 1.4

million light vehicles in any one year. (This estimate is based on an average period of vehicle ownership of 2.7 years). Around 15 percent of the national light vehicle fleet was covered by new car warranties, and an estimated 8 percent of the light vehicle fleet was covered by a second-hand dealers warranty at some time during a typical year

9.4 Adjustment of benefit estimates to allow for States with PMVI

If PMVI programs lead to a reduction in road crashes, then the BTCE (1993) estimate of the cost of road crashes would understate the cost were these programs not in place.

Accordingly, to adequately estimate the potential benefits of PMVI applicable to passenger vehicles and light commercial vehicles it would be necessary to “adjust” the BTCE estimates. This is because the BTCE estimates would include the benefits of annual PMVI in NSW, ACT and NT and the benefits of change of ownership inspections in Victoria and Queensland.

The methodology to be used to recalculate the benefit estimates needs to be established. One possible basis is to make the adjustment in proportion to the vehicle population affected.

It is estimated that on average 4.0 million of the 9.6 million passenger vehicles and light commercial vehicles registered at 30 June 1993 would have been inspected under annual and change of ownership PMVI programs. On this basis for every 1 percent benefit attributed to inspection programs the BTCE estimated benefits arising from reduced road crashes would need to be factored upward by 1.7.

For the purposes of benefit cost calculations two levels of benefit estimates have been adopted - an unfactored benefit and a factored benefit of 1.7 times the unfactored benefit in recognition of the possible contribution of existing inspection programs to reduce road crashes.

9.5 Effectiveness of PMVI having regard to defect-related crash rates

As reported in Chapter 5 benefit cost calculations are to be undertaken on the basis of four scenarios, with the rate of crashes involving defects as a cause and/or contributing factor in light vehicles set at a national average of 2.3 percent, 3.7 percent, 7.7 percent and 9.0 percent.

It is crucial however that allowance is made for the likely effectiveness of PMVI in removing potentially fatal defects.

Having regard to the nature of tyre problems (the largest single causal or contributory factor) revealed from examination of the FORS Fatal File (1992) and the general difficulties in identifying these defects at annual PMVI, it is improbable that PMVI will be effective in causing these defects to be removed from the vehicle fleet. Similarly PMVI is unlikely to be effective in removing many other defects, simply because these *may* frequently occur during the interval between inspections.

For the purposes of undertaking the economic evaluation 3 hypothesised levels of efficiency of annual PMVI have been adopted, ranging from 33.3 percent, 50 percent and 66.7 percent, (the latter figure is perceived to be highly optimistic having regard to the analysis of the FORS Fatal File 1992 case studies).

The corresponding percentage of crashes which may be avoided by annual PMVI for specified levels of effectiveness of PMVI and the 4 scenarios of involvement of vehicle defects in fatal crashes is provided in Table 32.

TABLE 32 - Percentage of defect-related light vehicle fatal crashes which may be avoided through PMVI scenarios

Effectiveness of PMVI (%)	Lower bound 1 (L)	2 (M)	3 (M)	Upper bound 4 (H)
100	2.3%	3.7%	7.7%	9.0%
66.7 (H)	1.5%	2.4%	5.1%	6.0% *3
50 (M)	1.3%	1.9% *1	3.8% *1	4.6%
33.3 (L)	0.8% *2	1.2%	2.6%	3.0%

*1 most probable estimate range
*2 low probability lower bound estimate
*3 low probability upper bound estimate

The most likely reduction arising from PMVI in vehicle defect-related fatal crashes involving defects in light vehicles is estimated in the range 1.9 percent to 3.8 percent, with lower and upper bound estimates of 0.8 percent and 6.0 percent. The lower and upper bound limits are however improbable, but have been included for sensitivity testing purposes only.

9.6 Overview of benefits

For the purposes of the benefit cost calculation a range of benefits have been adopted involving estimates of the cost of road crashes attributable to light vehicles, factoring of these costs to incorporate assumptions regarding the effectiveness of existing PMVI programs, and a range of assumptions regarding the effectiveness of inspections in eliminating defects which cause or contribute to road crashes. Further details are provided in Table 33.

TABLE 33 - Factors affecting benefits - Upper and lower bound estimates

Factor	Lower bound	Upper bound
Estimated cost of road crashes attributable to light vehicles	$4.9b	$5.6b
Factoring of the cost of road crashes assuming PMVI . has not contributed to reduced road crashes . has contributed to reduced road crashes	Factor benefits by 1.0	Factor benefits by 1.7
Percentage reduction in road crashes having regard to various levels of effectiveness of PMVI and forecast levels of contribution of vehicle defects to road crashes	1.9 percent most probably 3.8 percent	6.9 percent

(1993 dollars)

A range of estimated benefits arising from the various combinations of these factors is reported in Table 34.

TABLE 34 - Estimated benefits of PMVI

	Percentage of road crashes reduced due to PMVI		
	Lower bound (1.9%)	**Most probably (3.8%)**	**Upper bound (6.0%)**
(A) For the cost of road crashes related to light vehicles estimated at $5.6b Existing PMVI programs assumed			
. not to have contributed to reduced road crashes (Factor 1.0)	$106m	$212m	$336m
. to have contributed to reduced road crashes (Factor 1.7)	$180m	$360m	$571m
(B) For the cost of road crashes related to light vehicles estimated at $4.9b Existing PMVI programs assumed			
. not to have contributed to reduced road crashes (Factor 1.0)	$93m	$186m	$294m
. to have contributed to reduced road crashes (Factor 1.7)	$158m	$316m	$500m

(1993 dollars)

9.7 Overview of cost calculations - inspection commencing at 4 years

The quantum of costs to be included in the benefit cost calculation depends on assumptions concerning the level of inspection fee, the level of indirect costs, whether a partial or full cost approach is adopted in relation to repair costs, the level of repair costs, the level of unwarranted repair costs and associated time costs. An overview of the various cost elements for a fleet of 7.7m light vehicles (vehicles 4 years and older) is reported in Tables 35, 36, 37 and 38.

TABLE 35 - Inspection related costs

Cost categories	Lower bound	Most probable	Upper bound
Inspection costs per vehicle	$25	$35	$50
Indirect costs of inspection per vehicle	$20	$30	$40
Total inspection cost for 7.7 million vehicles	$346m	$501m	$693m

(1993 dollars)

TABLE 36 - Repair related costs

Failure rate at inspection (assumed)	Estimated repair costs for the Australian fleet for various estimates of the average cost of repairs of defective vehicle		
	$50 per vehicle	$100 per vehicle	$200 per vehicle
20%	$77m	$154m	$308m
30%	$115m	$230m	$460m
40%	$154m	$308m	$616m

(1993 dollars)

TABLE 37 - Unwarranted repair costs

Failure rate at inspection (assumed)	Estimated costs of unwarranted repairs for the Australian fleet according to estimates of the average repair cost		
	$50 per vehicle	**$100 per vehicle**	**$200 per vehicle**
20%	$18m	$36m	$72m
30%	$27m	$54m	$108m
40%	$36m	$72m	$144m

(1993 dollars)

TABLE 38 - Indirect cost of repairs

Failure rate at inspection (assumed)	Estimated indirect costs associated with unwarranted repairs	
	Lower bound	**Upper bound**
20%	$31m	$46m
30%	$46m	$63m
40%	$62m	$91m

(1993 dollars)

9.8 Benefit Cost Ratios - inspection commencing at 4 years

For the purposes of calculation of benefit cost ratios upper bound benefit estimates were matched to upper bound estimates of cost, the most probable estimate of benefits and costs matched, and lower bound estimates of benefits and costs matched. An overview of the benefits, costs and resultant benefit cost ratios are reported in Table 39.

TABLE 39 - Benefit Cost Ratios for testing at 4 years

	Lower bound	Most probable	Upper bound
Benefits	$93m	$316m	$571m
Costs (Full cost approach)			
Inspection fees	$346m	$501m	$693m
Indirect costs			
repair costs	$77m	$230m	$660m
unwarranted repair costs	0	$36m	$108m
indirect repair costs	0	$31m	$46m
Total Cost	$423m	$898m	$1506m
BCR Full cost approach	0.22	0.35	0.38
Costs (partial cost approach)			
Inspection fees	$346m	$501m	$693m
Indirect costs			
unwarranted repair costs	0	$36m	$108m
Total Cost	$346m	$537m	$801m
BCR Marginal cost approach	0.27	0.59	0.71

In summary the benefit cost ratios based on full costs range from 0.22 to 0.38 and 0.27 to 0.71 based on a marginal cost approach, ie., annual PMVI for light vehicles commencing at 4 years is unlikely to prove cost effective. The use of a marginal cost approach is unacceptable to both BTCE and FORS as previously indicated.

9.9 Other PMVI inspection models

Compared with the inspection model discussed above, the Rompe and Seul (1985) “optimum” inspection model provides for inspection commencing at 3 years and then at annual intervals. In an Australian context this could be expected to subject a further 480,000 vehicles to inspection (ie. the costs associated with PMVI would increase). The benefits of inspecting this group of vehicles is potentially lower than for older vehicles (occurrence of defects increases with age). At best the benefit cost ratios reported in Table 39 may apply, but they are likely to be lower for this inspection model.

The ECE (minimum) model provides for inspection commencing at 4 years and then at 2 yearly intervals. This would serve to halve the costs associated with PMVI identified in Table 39. As PMVI is recognised not to have an enduring effect (refer Chapter 4.7) it is reasonable to assume on average that the benefits of inspection may not be apparent after a year and or other unidentified defects will have occurred, hence the benefits could be expected to have halved. Consequently the benefit cost ratios discussed above are unlikely to change markedly.

Inspection at change of ownership commencing at three years is likely to be marginally less cost effective than annual inspection commencing at four years. This is because initial inspections on average will occur at three years (adding to costs but without proportional benefit), and on average at an interval of 2.75 years thereafter. While the total cost will be reduced, the benefits will also be proportionately reduced as PMVI is recognised as not having an enduring effect.

Focussing PMVI programs on older vehicles will substantially reduce the total costs.

Whether benefits for older vehicles can be realised from annual or bi-annual inspection is highly problematic. Vehicle defect data implies a substantially higher probability of defects occurring in older vehicles than for younger vehicles in the interval between inspections. Unless the timing of inspections is reduced to correspond with the probable emergence of defects, vehicle defects in older cars will emerge. Consequently annual PMVI is unlikely to prove cost effective for older vehicles. Whether bi annual PMVI would be cost effective is problematic.

9.10 Comparisons with other studies

The benefit cost ratios presented in this Table 39 differ from those reported by Rompe and Seul (1985), NRMA (1991) and RACV (1994) and others (refer Table 1). Factors which have lead to the differing outcomes in these assessments are discussed below.

Rompe and Seul reported benefit cost ratios in the range 1.7 to 2.6 for a PMVI model which included inspections commencing at four years and at yearly intervals thereafter. Between 40 percent and 60 percent of the benefit stream was associated with non road accident benefit (ie., fuel savings) which are inapplicable in the Australian context in the mid 1990's. Removal of these non accident related savings would result in a benefit cost ratio of between 0.99 and 1.30.

Furthermore their benefit calculations assumed reductions of between 5 percent and 10 percent in accident costs which appear unsustainably high in the Australian context in the mid 1990s. Their cost stream also appears unrealistically low in an Australian context, primarily due to their assumption of a comparatively low cost of inspections. Inspection costs were formulated on a theoretical basis, and assume very high levels of productivity with testing stations being open 250 days a year (includes public holidays). Experience of the ACT testing stations suggest these assumed productivity levels are not readily achievable in an Australian environment.

Because their assessment was formulated on the basis of centralised specialist testing facilities no recognition has been made of the cost of unwarranted repairs. As indicated in Chapter 4.5 if an inspection system is adopted which uses private garages the cost of unwarranted repairs is likely to be higher.

NRMA (1991) present differing perspectives regarding the use of private garages for conducting annual PMVI. They suggest "retaining the AIS scheme, while improving its costs ... is unlikely to have a benefit cost ratio of greater than one" (p.20), yet their conclusions (p.26) state that improving the standard of inspections in AIS "would almost certainly result in the costs exceeding the benefits".

Furthermore the NRMA assessment does not appear to include indirect costs or the cost of unwarranted repairs. As indicated earlier where an inspection system is based on private garages the cost of unwarranted repairs is likely to be understated. Inclusion of these costs would result in a halving of the NRMA estimate of a benefit cost ratio to around 0.5.

NRMA also concluded that "well equipped and designed inspection centres, supplemented by roadside inspections would have a potential benefit cost ratio in the range 1.2 to 1.9". Again the indirect costs of vehicle inspection do not appear to have been included in the cost stream, nor has the cost of roadside inspections. Recognition of these indirect costs in the benefit cost equation would at *best* lead to a benefit cost ratio in the range 0.6 to 0.95, excluding the cost of roadside inspections.

The RACV (1994) assessment of PMVI has included an apparently high cost structure with inspection costs of $50 and a repair cost of $100. The benefit cost ratio corresponding to a 1.8 percent inspection effectiveness (crashes prevented by PMVI) was estimated to be 0.12 and for an inspection effectiveness of 5 percent was estimated to be 0.34. Benefits were estimated using FORS data. The RACV did not include indirect costs nor the cost of unwarranted repairs which have been included in assessments presented in this report. Even allowing for these differences in cost categories the RACV estimates of total cost are relatively higher than those adopted in this report. Consequently RACV estimates of benefit cost ratio are lower.

It should also be noted that the RACV assessment was concerned with the cost effectiveness of changing from the current change of ownership program to annual PMVI.

9.11 Some Conclusions

A range of issues have served to drive the economics which in turn have demonstrated that PMVI is not cost effective. These include:

- PMVI is only one small factor in a range of factors affecting the roadworthiness of vehicles.

- PMVI has an intrinsic and fundamental weakness - it constitutes an inflexible periodic response to a problem which may occur at any time.

- The interval between PMVI inspections bears no relationship to the probability of a defect occurring - on the "one day of the year" a vehicle may be passed at inspection; during the other 364 days defects continue to occur, ie., PMVI does not have an enduring effect.

- Wide differences are apparent in items considered necessary for inspection from a road safety perspective - many items examined in the more "comprehensive inspection programs" are likely to be of only peripheral relevance, or none at all.

- Inspection standards vary and are open to wide interpretation where components deteriorate (as distinct from exhibiting a distinct failure mode). Reliability of inspection systems remains a major issue.

- The costs of PMVI are substantial compared with the benefits. While inspection costs may be reduced they constitute only one element of total cost.

- Indirect costs constitute a substantial proportion of total costs - roughly equal in magnitude or greater than the direct inspection costs.

- Indirect costs cannot readily be reduced and are unavoidable - efforts to achieve economies of scale in inspection generally increase indirect costs.

- Vehicle defects do not currently constitute a substantial contribution to fatal and serious injury accidents - the most costly categories of road accidents. Even if PMVI was intrinsically effective (and it isn't) the benefit stream would be limited.

This analysis does not in any way question the importance of maintaining vehicles in a good mechanical condition. However it emphasises that the concept of current PMVI programs are fundamentally flawed, and in the current environment is unlikely to be cost effective.

The question arises as to whether there are other instruments or means by which the regulatory authorities may intervene in a cost effective manner to reduce vehicle defect-related crashes involving light vehicles.

10. ALTERNATIVES TO CURRENT PMVI PROGRAMS

10.1 Introduction

As discussed in the previous Chapter, current PMVI programs are unlikely to prove cost effective because of their intrinsic and fundamental characteristics.

To develop a more cost effective inspection system it would be advantageous to match the timing of the intervention (inspection) to the emergence of likely defects and focus on those primary safety items demonstrated as major contributors to crashes. These measures would serve to reduce the costs.

10.2 Timing of public intervention

Risks to road users arise at any time of the day or night due to a combination of human factors, road environment factors and vehicle condition. While it is unacceptable and impractical for governments to continuously monitor their citizens, the community has accepted the concept of moderate intensity random traffic enforcement activity in relation to random breath testing (RBT) and speed.

Successful random programs have achieved behaviour modification by generating the perception of a real risk of detection of errant behaviour together with significant penalties/fines. In 1995 around five million random breath tests were conducted. In addition over one million speeding infringement notices (excluding speed camera related infringements) were issued nationally.

Random vehicle inspection activities are currently conducted by police in all jurisdictions but at low levels (on average around 1 percent of the national vehicle fleet annually). The effectiveness of this low intensity inspection is not known.

Vehicle condition may also be inspected on occasions in the context of other police traffic enforcement operations, primarily speed enforcement activities. Vehicles with obvious defects may also come to attention during RBT operations, although identification of vehicle defects is currently generally peripheral to RBT activity.

Extension of police RBT and speed infringement operations to include some form of vehicle inspection may offer an alternative to the formal PMVI program.

TABLE 40 – Police traffic enforcement activity, including vehicle inspection

	Examples of police traffic enforcement activity 1995			
Jurisdiction	**RBT intercepts**	**Rate per 100,000 vehicles**	**Speeding fines *[1]**	**Vehicle condition compliance offences/penalties/fines**
NSW	2.300,000	0.7	300,000	26,400
Vic	1.700,000	0.6	450,000	43,700 *[2] 3,600 *[3]
Qld.	*[7]		172,600	
SA	*[7]		41,000	10,000 *[4]
WA	*[7]		129,000	*[7]
Tas	*[7]		3,000 *[6]	*[7]
NT	*[7]		*[7]	*[7]
ACT	*[7]		13,000	up to 17,000 *[5]

Source – Police services
*[1] Excluding speed camera related fines.
*[2] Defect notices arising from inspection of some 50,700 vehicles.
*[3] Penalty notices (fines) for unroadworthy vehicles.
*[4] Estimate of vehicles inspected provided to SA Parliamentary Committee.
*[5] Target of 15,000 by vehicle inspectors and up to 2,000 by police as part of police operations.
*[6] Laser speed detection units only
*[7] Not available

10.3 Key safety items

Analysis of FORS Fatal Files (1988, 1990, 1992) indicates that two factors account for 79 percent of all defects in light vehicles causing fatalities. As mentioned earlier, tyres accounted for 61 percent and brakes accounted for 18 percent.

VACC Roadworthiness data (1994) recorded the top three defect categories as brakes, turn signal and wheel/tyre with defect rates of roughly equal magnitude. While reliable relevant in-service condition data is not readily available, ACT data and the NRMA investigations discussed previously have confirmed tyres as a major concern.

These data suggest that focussing inspection on key items such as tyres and brakes and to a lesser extent steering and turn signals is likely to provide the majority of benefits which may potentially be achieved through inspection activity.

Inspection of tyres and turn signals can be readily achieved through brief roadside inspection and the more advanced forms of deterioration in brakes and steering are also often amenable to simplified roadside inspection procedures.

10.4 Reducing costs of inspection

The use of brief screening procedures and the adoption of a focus on key safety items amenable to observation in field testing would serve to massively reduce the cost of vehicle inspections.

To further minimise cost it would be advantageous to incorporate the brief vehicle inspection within an existing traffic enforcement operation (or perhaps within the context of parking inspection operations). In this manner the additional activity constitutes only a *marginal* additional cost.

In view of the demonstrated success of RBT in changing community attitudes, and the reality that a cursory vehicle inspection of primary safety items could be undertaken when the vehicle is pulled over to enable the driver to be breath tested, inclusion of brief screening type vehicle inspections in RBT operations would appear to offer major advantages.

The outcome of roadside vehicle inspections incorporated as part of police traffic operations including RBT operations could include - a requirement to have an identified defect corrected, a fine/penalty, a direction to have the vehicle comprehensively inspected for roadworthiness and or defects corrected (say at an approved testing station/garage), a combination of all or any of the above, or where extremely serious defects are identified, the vehicle immediately removed from the road, with suspension of registration until the vehicle is presented for re-registration in a roadworthy condition.

It should be noted that introduction of random roadside inspection in the context of RBT operations may require amendments to State and Territory legislation, and further legislative changes may also be required to provide police with a full range of possible responses as described above.

Inspection of the majority of vehicles would be unlikely to take more than two minutes, and the inspections to be undertaken on the remaining vehicles (considered to have potential defects) would be unlikely to take more than three-four minutes at most. (A decision as to whether a full inspection was required would be unlikely to take any longer.) A full inspection would need to be conducted at approved testing stations. Based on NSW annual PMVI failure rates, around 20 percent of all vehicles subjected to a screening test could be expected to be required to have a comprehensive roadworthy inspection.

Adoption of this process provides a very low cost means of screening as it avoids the cost of comprehensive inspection of an estimated 80 percent of vehicles that would have passed at annual PMVI inspection.

The direct cost of police time involved in screening inspections is unlikely to exceed around $2 per vehicle. The cost of a full approved inspection remains unchanged (as reported in Chapter 8). Indirect costs of the screening inspections will also be extremely small, the marginal cost being less than $1 per vehicle. The indirect costs of a full approved inspection remains unchanged (as reported in Chapter 8). The cost to police services (and registration authorities) of administering such a system is unknown and would require investigation.

Random inspections may also be undertaken by dedicated enforcement teams (eg., police, transport inspectors, vehicle inspectors), but costs are likely to be significantly higher (perhaps as high as $20 per inspection) than including vehicle inspection as an adjunct to traffic operations including RBT.

Random inspections may also include field vehicle inspection units capable of virtually full roadworthiness inspections. However the full cost of inspection per vehicle is likely to be at least equal to that which would be charged by garages for annual PMVI inspections and probably considerably higher.

10.5 The cost effectiveness of integrating high intensity random vehicle inspection within existing police traffic operations

By incorporating vehicle inspections nationally into existing police traffic operations including RBT and speed enforcement operations, up to five million vehicles annually may be subject to a screening test and up to one million vehicles may be required to undertake a comprehensive vehicle inspection.

The cost (direct and indirect) of vehicle screening tests for the Australian light vehicle fleet is estimated at around $15m while the cost (direct and indirect) of consequential comprehensive vehicle inspections is estimated to be up to $45m. The consequent cost of repairs is estimated to be $77m (lower bound), $154m (most probable), and $308m (upper bound).

If a partial cost perspective is adopted in benefit cost calculations then at least $60m in annual benefits would need to be generated for this form of random inspection to be cost effective (benefit cost ratio of at least 1.0). In the event a full cost approach is adopted and repair costs included in the benefit cost ratio calculations then annual benefits of around $200m would be required to achieve a benefit cost ratio of at least 1.0.

The question is whether these levels of benefits are likely to be achievable from the system of random vehicle inspections described above. As reported in Chapter 9 estimates of the benefits of comprehensive annual PMVI are in the range $180m to $571m with the probable level around $360m. (Refer Table 39). With up to half the national vehicle fleet being subject to random vehicle screening type inspections and an expected 20 percent of these vehicles being required to undertake a comprehensive vehicle inspection (comparable to annual PMVI), this scheme may perhaps be expected to provide half the level of benefits of a national annual PMVI program. In these circumstances the benefits would be in the range $90m to $285m with the most probable level around $180m.

It could be argued that the effectiveness of such a scheme would be diminished due to the limited scope of the test conducted during screening. On the other hand the costs and inconvenience of being required to undertake a full roadworthiness inspection at any time also provide an incentive for motorists to monitor key items and maintain their vehicles in better condition.

A scheme of random vehicle inspections integrated in police traffic operations including RBT and speed enforcement operations may prove to be cost effective (ie., benefit cost ratio of at least 1.0 appears potentially achievable). Furthermore such a scheme could be trialed comparatively inexpensively in selected jurisdictions and its cost effectiveness evaluated.

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