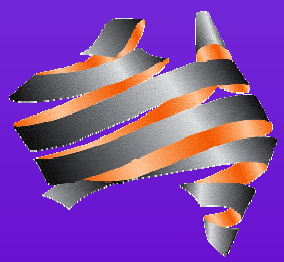
AP-R213

INVESTIGATION OF INTERNAL BUS SAFETY MEASURES



AUSTROADS

Investigation of Internal Bus Safety Measures
First Published 2002

National Library of Australia
Cataloguing-in-Publication data:

Investigation of Internal Bus Safety Measures
ISBN 0 85588 636 6

Austroads Project No. RS SS.C.060

Austroads Publication No. AP–R213 /02

Prepared by

Shannon Newman, ARRB Transport Research
Melissa Coutts, ARRB Transport Research

Published by Austroads Incorporated
Level 9, Robell House
287 Elizabeth Street
Sydney NSW 2000 Australia
Phone: +61 2 9264 7088
Fax: +61 2 9264 1657
Email: austroads@austroads.com.au
www.austroads.com.au

INVESTIGATION OF INTERNAL BUS SAFETY MEASURES

AUSTROADS
Sydney 2002

AUSTROADS PROFILE

Austroads is the association of Australian and New Zealand road transport and traffic authorities whose purpose is to contribute to the achievement of improved Australian and New Zealand transport related outcomes by:

- developing and promoting best practice for the safe and effective management and use of the road system
- providing professional support and advice to member organisations and national and international bodies
- acting as a common vehicle for national and international action
- fulfilling the role of the Australian Transport Council's Road Modal Group
- undertaking performance assessment and development of Australian and New Zealand standards
- developing and managing the National Strategic Research Program for roads and their use.

Within this ambit, Austroads aims to provide strategic direction for the integrated development, management and operation of the Australian and New Zealand road system — through the promotion of national uniformity and harmony, elimination of unnecessary duplication, and the identification and application of world best practice.

AUSTROADS MEMBERSHIP

Austroads membership comprises the six State and two Territory road transport and traffic authorities and the Commonwealth Department of Transport and Regional Services in Australia, the Australian Local Government Association and Transit New Zealand. It is governed by a council consisting of the chief executive officer (or an alternative senior executive officer) of each of its eleven member organisations:

- Roads and Traffic Authority New South Wales
- Roads Corporation Victoria
- Department of Main Roads Queensland
- Main Roads Western Australia
- Transport South Australia
- Department of Infrastructure, Energy and Resources Tasmania
- Department of Infrastructure, Planning and Environment Northern Territory
- Department of Urban Services Australian Capital Territory
- Commonwealth Department of Transport and Regional Services
- Australian Local Government Association
- Transit New Zealand

The success of Austroads is derived from the synergies of interest and participation of member organisations and others in the road industry.

EXECUTIVE SUMMARY

Introduction

The recent report *Review of the School Bus Safety Action Plan* (Austroads AP-R207, 2002) detailed the implementation of a range of school bus safety measures by jurisdictions and also provided a methodology for refining and prioritising measures contained in the National School Bus Safety Action Plan. The report also confirmed earlier findings that the large majority of school child "bus" fatalities occurred after the child had alighted from a bus and had attempted to cross the road. The report recommended that jurisdictions give priority to those measures which address the primary cause of school bus related fatalities.

The report also noted a number of measures that were considered to be complex and potentially costly to implement and which, while not addressing the primary cause of school bus related fatalities, were of particular concern within the community. These measures included:

1. Installing of 3 point (lap-sash) seat belts in school buses in Australia.
2. Fitting school buses with higher seatbacks (improving compartmentalisation).
3. Requiring school buses to be limited to carry one child to each single seat, compared to current three-for-two seating policy.
4. Prohibiting standing passengers, thus ensuring that all children are seated while the bus is moving.
5. Improving the rollover strength of buses.

Austroads, through its School Bus Safety Advisory Group, commissioned ARRB Transport Research (TR) to examine the implications of implementing each of these five vehicle-based countermeasures. It is intended that this report will be provided to the Australian Transport Council (ATC) to assist them in their deliberations of school bus safety measures.

This project sought to:

- Investigate the costs and associated implications of implementing each of the five vehicle-based countermeasures or actions listed above.
- Determine the economic value of each countermeasure or action.
- Identify the tasks involved and the timing options for implementation.

The project was conducted in two stages. During the first stage key stakeholders and bus manufacturers were contacted in an effort to collect information relating to the operation of school bus fleets across Australia. During the second stage the collected information was reviewed. The financial costs and implications associated with the potential implementation of the vehicle-based countermeasures under investigation were also examined as part of this review.

This examination provides an analysis of the potential costs that could be expected if additional internal bus safety measures were implemented. This information is expected to assist jurisdictions in their consideration of school bus safety issues.

Research evidence

Based on research evidence and crash data, this investigation has found that:

- The risk of being struck by passing traffic, as a pedestrian, when crossing the road after alighting from the bus presents a considerably greater risk to children than travelling as a bus passenger during school commuting hours.

- There is varying evidence about the safety implications of fitting seat belts to school buses, allowing standees to travel in a moving vehicle, allowing three children to occupy the seating capacity intended for two adults, and the need for higher seat backs offering improved compartmentalisation.
- There is conflicting evidence regarding the effectiveness, safety implications and cost of fitting seat belts on school buses. Evidence from studies conducted in the United States, where dedicated school bus fleets operate, suggest that compartmentalisation offers the most effective protection for occupants in the event of a frontal collision, but offers less adequate protection for side-impact collisions and rollover crashes where occupants are ejected from the seating compartment. It is anticipated that lap-sash seat belts may improve occupant protection in these situations.
- There are conflicting views associated with permitting the carriage of standees and implications relating to a decision to end this policy. There is a lack of evidence to indicate that seated travel is significantly safer than travelling as a standing passenger in a moving bus. Similarly, there is a lack of evidence that permitting three children to occupy the seating capacity of two adults compromises passenger safety.
- The debate over the safety of school buses, the benefits of compartmentalisation, the cost of installing seat belts and other countermeasures relative to the safety gains that are likely to result is well-documented. However, the research is mixed and the evidence is largely inconclusive due to the low number of crashes associated with school bus travel.

The Australian Situation

Current application of countermeasures under investigation

At present, in Australia:

- Three-point (lap-sash) seat belts are not widely available on school buses, with the exception of coach style vehicles which, depending on the year of manufacture, are required under the Australian Design Rules (ADRs) to be fitted with lap-sash seat belts.
- Consistent with the application of seat belts, high-backed seats are not generally provided in school buses, except when coach-style vehicles are used to transport children for school services.
- All jurisdictions in Australia currently permit carriage of passengers who have to stand on route service buses, provided buses are designed with allocated standing areas and handholds. However, the number and conditions permitting standees vary between jurisdictions.
- With the exception of the Australian Capital Territory, all Australian jurisdictions permit the three-for-two seating policy for scheduled runs (and some special runs in dedicated school bus services). This policy generally applies only to children aged 12 years or younger.
- The extent of rollover protection offered by buses varies between jurisdictions and where provided, is done so in accordance with ADRs depending on the size of the bus and when the bus was constructed.

Composition of the School Bus Fleet

Based on the information provided relating to the composition of the bus fleet involved in the transportation of children in each jurisdiction this study has found that:

- The nature of school bus fleets differs considerably between jurisdictions. Some jurisdictions operate dedicated school buses while others do not. Further, the number of buses, the average age and the average seating capacity of these buses vary across jurisdictions. For example, the average age of fleets varied from 9 years to in excess of 20, years and the average seating capacity ranged from 32 to 57.

- Some jurisdictions noted that if one or more of the countermeasures under investigation were to be introduced, they may need to be introduced beyond just dedicated school bus fleets. Therefore, these jurisdictions noted that consideration is required of the result on other buses if one or more of the countermeasure were introduced.
- The amount of information that jurisdictions were able to provide varied, as did the level of detailed information.
- Some jurisdictions provided information relating to buses designed and operated primarily for the transport of disabled passengers. However, because of the difference in design and construction of these buses (i.e. they are constructed or fitted with hoists and standards to transport passengers in wheelchairs) and subsequent carrying capacities, these buses have not been included in the costing procedures applied in this investigation.
- Based on the information that was available, and the need to provide an overview of school buses operating at a national level, this investigation does not differentiate between the types of buses operating within the school bus fleet and those operating within the general service route fleet. While it is acknowledged that some buses are designed differently, and thus provide different types of safety features depending on the primary purpose of the vehicle, such differentiation would require access to very detailed information on the bus fleets operating in each jurisdiction. The availability of such information would provide for a more rigorous costing and capacity regime to be applied to determine the financial implications associated with implementing one or more of the countermeasures examined in this investigation.

As a result of investigating the legislative and/or regulatory changes that may be required, if one or more of the countermeasures under investigation were introduced, a number of changes were identified. The key amendments to vehicle design and construction standards and to relevant road rules and traffic acts are summarised as follows.

Australian Design Rules (ADRs) and Australian Standards (AS)

Installing three-point lap-sash seat belts and fitting higher backed seats:

- A number of the ADR's detailed in this report set limitations on the installation and use of seat belts (see ADR68/00, ADR 4/03, ADR 66/00), and some standards may require review or amendment if one or more of the five countermeasures or actions is introduced. For example, under current regulations route buses are exempt from requiring seat belts (see ADR68/00). Further, ADR 4/03 requires all omnibuses manufactured on or after 1 January 2000 to have seat belts fitted to all seating positions where seat belt anchorages are fitted. Despite this, the ADR does not appear to provide other requirements relating to the fitment of seat belts in buses. References to seating height or other occupant protection requirements (such as seat padding, etc) are not provided in this ADR, nor has an amended version of ADR 68/… been drafted to accommodate these changes. This amendment means that there may be omnibuses in Australia manufactured after 1 January 2000 that have seatbacks less than 1.0 metre in height yet are fitted with seat belts. Therefore, there appears to be a deficiency in the requirements provided for installation of seat belts to these types of omnibuses. If seat belts were to be considered for installation in school buses amendments to one or more ADRs would be required.

Limiting school buses to carrying one child to each single seat

- The ADRs provide design and construction standards for seats, with the intent that one seat is provided per person. Therefore limiting school buses to carry one child to each single seat should not effect the ADRs nor require any amendments. Further to this, representatives from Queensland Transport have indicated that there has been recent approval of the use of McConnell Educator 2/3 seats with seat belts under ADR 68/00. These seats offer three-for-two seating capacity on seat-belted seats.

Prohibiting bus passengers from standing on a moving bus

- While ADR 58 /00 allows buses to be designed and constructed for standing passengers, the practice of permitting passengers to travel as standees on moving buses is based on jurisdictions' individual traffic regulations and passenger transport legislation. Therefore, should a decision be made to restrict standees from travelling on moving buses, then relevant traffic regulations would need to be amended to prohibit children travelling as standing passengers on moving school buses.

Review of bus design standards such as rollover strength

- ADR 59/00 provides the design and construction standards for the rollover strength of buses. However, while one jurisdiction representative suggested that this ADR may need to be amended since it only applies to buses with more than 16 passengers, another suggested that there is no need to review this ADR at this time. All ADRs are currently being reviewed with a view to harmonisation with European regulations. However, ADRs that are applicable to buses are unlikely to change. Another jurisdiction suggested that while the current ADRs are sufficient to carry across to school buses, it may be preferable to draft a new ADR covering the design and construction of these vehicles if the standards are different to other buses.

Relevance of Australian Standards

Most jurisdictions indicated that the only Australian Standards applicable to the five countermeasures under investigation involved were those called upon by the ADRs. For example, should retrofitting of seat belts be required for a bus that is presently in service, compliance with Australian Standards for seat belt manufacture would be required.

Australian Road Rules (ARRs), Traffic Acts and Codes

Part 16 of the ARRs, titled **Rules for persons travelling in or on vehicles** regulates the wearing of seat belts by drivers and passengers, the responsibility of bus drivers for minors travelling on school buses and those individuals that are exempt for wearing a belt. In addition, there are a number of traffic Codes or Acts that regulate the operation of bus services at a jurisdictional level that may be relevant in the consideration of implementing one or more of the countermeasures under investigation. These acts and codes generally contain policies relating to three-for-two seating arrangements and permitting standees to travel on moving buses, and may or may not supersede the regulations outlined in the ARRs.

This examination found that the potential introduction of one or more countermeasures under investigation may result in the need for amendments to the ARRs and relevant traffic regulations and codes as follows:

- If seat belts were installed in school buses, legislative or regulatory changes would be required to clarify the responsibilities of both the drivers and the passengers for correctly wearing seat belts where fitted. This would include determining the age of passengers for whom bus drivers are expected to be responsible for ensuring seat belts are worn.

- If the policy allowing three-for-two seating was abolished, various state and territory passenger transport regulations that currently permit three children to occupy two adult seats would need to be amended accordingly.
- Similarly, if the policy allowing students to travel as standees on school buses was abolished, various state and territory passenger transport regulations and acts would also need to be amended accordingly.
- In comparison, it appears that any decision to mandate the installation of high-backed seats and/or improve rollover protection regimes in buses would not result in any changes or amendments to road law or passenger transport regulations. Nor would the introduction of these initiatives result in any changes to current three-for-two seating practices or passenger standee policies.

Capacity and cost implications

One of the objectives of this investigation was to determine the capacity and cost implications that may be expected if one or more of the five countermeasures under investigation were introduced. The following three cost options were explored:

Option 1: The cost to retrofit the existing fleet of buses used to transport children to and from school with high-backed seats and seat belts (and to replace those vehicles that cannot be retrofitted with new ADR compliant vehicles).

Option 2: The cost to replace vehicles in the existing fleet that do not meet current rollover protection standards, and to retrofit seat belts to buses that do meet these standards. This ensures that buses offer both rollover protection and seat belts.

Option 3: The cost to replace the entire fleet of buses used to transport children to and from school with ADR compliant vehicles offering rollover protection, high-backed seats and seat belts.

In addition, the complexities involved in calculating the financial and capacity implications associated with a decision to end policies providing for three-for-two seating and standees in jurisdictions, where this is taken up, were examined.

It should be noted that a number of assumptions have been made in order to determine preliminary cost implications associated with the countermeasures under investigation. These include assumptions about fleets operating in individual jurisdictions, costs provided by bus manufacturers and outfitting agencies, and assumptions about buses meeting (or failing to meet) relevant ADRs. These assumptions need to be taken into account when considering the potential financial implications associated with introducing one or more of the countermeasures under investigation.

Background to costing procedure

Costs for installing seats with seat belts

For the purposes of this investigation, the cost to supply and install a suitable seat with a lap-sash seat belt and provide suitable anchorage is **$502 per passenger (including GST)**. Based on this estimate, the cost to supply and fit seats with seat belts and anchorage to a 48-seater bus would be approximately $24,090. This cost is based on the assumption that the bus frame and under-bearings are suitable for retrofitting seat belts.

#Note: The additional costs associated with modifying the walls and strengthening the floor of existing buses which may be required before fitting seats have not been estimated. This would require further information about the age and make of individual buses in the relevant fleets. However, as a rough guide, consultation with bus manufacturer indicated that required wall and floor modifications could cost approximately $4,000 per bus.

Costs for purchasing new buses

While the cost of purchasing a new bus which offers both rollover protection and set belts will vary according to the particular make and model of the bus, the seating capacity and the safety features offered, for the purposes of this report, the following estimates have been applied:

- Small bus with seating capacity of less than 25 seats–**$100,000** (incl. GST).
- Large bus with seating capacity of 25 to 70 seats–**$260,000** (incl. GST).

Number of buses used in cost calculations

The variations in fleet composition and operating practices across jurisdictions result in considerable difficulties in comparing costs and capacity implications.

Some jurisdictions could only provide detailed information for a proportion of the total number of buses that may be involved in the transport of children to and from school. However, some jurisdictions are aware that additional buses may be affected by the introduction of one or more of the countermeasures and, where provided, these additional buses have been included in the total number of buses for the purposes of cost calculations presented the in following sections.

To assist the reader's understanding of the financial implications presented later in this report, Table A presents the estimated number of buses that have been included in the cost implication calculations.

Table A: Estimated number of buses for application in cost calculations

State	Estimated number of buses affected
QLD	2,964
VIC	3,604
NSW	9,646
SA	798
WA	787
TAS	850
ACT	462
NT	138
Total	**19,249**

Option 1: Fitting the existing fleet with seats with seat belts

For the purpose of this report, the costs for fitting the existing fleet with seats with seat belts are based on all seats in buses that can be retrofitted and include the installation of anchorage. If the availability of suitable anchorage could be determined, it is anticipated that the cost of retrofitting seats with seat belts would reduce by up to $100 per seat. It should be noted that costs were calculated from information supplied by representatives from each jurisdiction.

The *Voluntary Modifications of Existing Buses and Coaches: Guidelines to Improve Occupant Protection* recommend that Toyota model buses do not have the required body strength or floor strength to successfully install anchorage points, high backed seats, and seat-belts. Therefore, where bus make information was provided and Toyota buses identified, this make of bus has been removed from the retrofitting calculation, and costs associated with replacing all Toyota buses with new vehicles have been provided.

Table B presents the capital cost associated to retrofit seats with seat belts to the existing bus fleet, where retrofitting is suitable, and the additional cost of replacing buses where retrofitting is not appropriate to ensure all buses offer appropriate seats with seat belts. By default, the proportion of buses that would need to be replaced, based on this cost option, would also provide occupants with improved rollover protection. This option would result in retrofitting costs totaling more than $440 million with a further $250 million to replace those buses that are not suitable for retrofitting.

Table B: Estimated cost of retrofitting seat belts into the existing bus fleet

State	Number of buses	% of fleet that can be retrofitted	Estimated cost to retrofit ($ M)	% that cannot be retrofitted	Estimated cost to replace ($ M)	Total ($ M)
QLD	2,964	84.6%	$51.5	15.4%	$59.6	$111.1
VIC	3,604	90.8%	$77.7	9.2%	$33.0	$110.7
NSW	9,646	100.0%	$275.5	0.0%	$0.00	$275.5
SA	798	73.2%	$10.6	26.8%	$21.3	$31.9
WA	787	57.2%	$10.1	42.8%	$34.6	$44.7
TAS	850	40.0%	$5.6	60.0%	$91.8	$97.7
ACT	462	90.0%	$9.5	10.0 %	$12.1	$21.6
NT	138	86.8 %	$2.8	13.2 %	$1.7	$4.5
Total	**19,249**		**$444.3**		**$254.1**	**$697.4**

DISCLAIMER: The above estimates relate to the costs associated with retro-fitting seats and seat belts only, and do not include wall and floor modification costs.

Option 2: Replacing for rollover protection and retrofitting seats with seat belts

An alternative approach to retrofitting seat belts to existing buses and replacing those that are not suitable for retrofitting, is to consider replacing vehicles that do not meet current rollover protection standards, and retrofit seat belts to those that do meet current standards (and that are suitable for retrofitting).

Based on investigations into the rollover strength of buses and discussions with a reputable bus manufacturing company, it has been suggested that buses built prior to the implementation of the relevant ADR on rollover strength (ADR59/00), would not be suitable for upgrading to meet a desired rollover standard. This is due to changes in both the construction and the material strength in the manufacturing of buses since 1992. As a result of these changes, it is considered that modifications to buses built pre-1992 would not offer structural integrity comparable to that provided by current rollover design standards. Therefore, without detailed information pertaining to the specific design, structure and engineering criteria of buses operating in Australian fleets, a very rough estimate of the cost implications to meet both rollover protection standards and fit seat belts was calculated.

A cost estimate for each jurisdiction to meet both rollover standards and seatbelt fitment follows. For all states the cost to replace the buses that do not meet rollover protection is based on the proportion of buses operating with:

- less than 25 seating capacity in each jurisdiction was multiplied by $100,000;
- 25 or more seating capacity in each jurisdiction was multiplied by $260,000.

Table C presents the capital costs required to replace existing pre-1992 vehicles to meet rollover standards and to retrofit seatbelts to those that already meet current rollover standards (where appropriate). This option would result in bus replacement costs totaling more than $2,160 million with a further $250 million to retrofit seats with belts to those buses that already meet current rollover standards.

Table C: Estimated costs associated with replacing buses that do not meet rollover standards and retrofitting seat belts to remaining buses

State	Number of buses	% of fleet that do not meet rollover standards	Estimated cost to replace ($ M)	% that could be retrofitted	Estimated cost to retrofit ($ M)	Total ($ M)
QLD	2,964	66%	$432.8	34%	$20.8	$453.6
VIC	3,604	57%	$221.8	43%	$36.8	$258.6
NSW	9,646	50%	$1,253.9	50%	$137.7	$1,391.6
SA	797	67%	$40.6	33%	$4.8	$45.4
WA	787	60%	$52.3	40%	$34.9	$87.2
TAS	850	60%	$91.8	40%	$5.6	$97.4
ACT	462	50%	$56.5	50%	$5.3	$61.8
NT	138	38%	$13.4	62%	$1.7	$15.1
Total	**19,249**		**$2,163.1**		**$247.6**	**$2,410.7**

DISCLAIMER: The cost to retrofit buses with seat belts, this calculation has not taken into consideration the inability to retrofit Toyota buses. Further information relating to the year of manufacture would be required. These additional costs would need to be factored in separately.

Option 3: Replacing the existing bus fleet with new buses (rollover and seat belts)

Table D provides an indication of the capital costs associated with replacing all the existing buses with new buses that offer higher backed seats, greater occupant protection via compartmentalisation, improved rollover protection and seat belts. These estimates establish that the capital costs, if the entire fleet were replaced tomorrow, could total more than $4,635 million.

Table D: Estimated costs for purchasing new buses

State	Number of buses	Estimated cost ($ M)
QLD	2,964	$654.5
VIC	3,604	$876.5
NSW	9,646	$2,507.9
SA	797	$162.9
WA	787	$137.1
TAS	850	$153.0
ACT	462	$112.7
NT	138	$30.6
Total	**19,249**	**$4,635.2**

While these costs provide the worst case scenario, in terms of replacing the fleet with new vehicles, they do not account for changes in carrying capacity that would occur as a by-product of introducing seat belts. These additional costs have been considered in the following sections.

Cost implications associated with reduced carrying capacity

If legislation decreed that all school buses required the installation of seat-belts, there would be the further implication of reduced carrying capacity due to the loss of standing passengers and the loss of seating three children to two seats, depending on particular legislation in each state.

Estimates of the potential costs associated with reduced carrying capacity are included in Table E. These are based on varying criteria, dependant upon the relevant information supplied by each jurisdiction. In the main these relate to the additional number of buses required to carry the same passenger load. Based on the jurisdictions for which information is provided, costs associated with reduced carrying capacity are estimated to total around $1,785 million.

Table E: Estimated costs associated with reduced carrying capacity

State	Estimated cost ($ M)
QLD	$177.8
VIC	$244.9
NSW	$915.0
SA	$3.5
WA	$116.5
TAS	-
ACT	$21.2
NT	-
Total	**$1,785.9**

DISCLAIMER: The costs associated with student displacement and route issues have not been taken into account.

Current subsidy arrangements

States and Territories provide substantial subsidies for various school bus services. These subsidy schemes vary across jurisdictions in terms of the amount of subsidy provided the number of students eligible for subsidy or concessional travel and the conditions. Overall, if there was an increase in the number of buses required to carry the same passenger load, as would be the case if seat belts were introduced, and/or if three-for-two seating and standee policies were abolished, then the scale of subsidy and school transport funding arrangements would need to increase in order to offset additional fleet costs required to carry the same passenger load.

Implementation issues

To examine phasing in options and issues associated with the implementation of each of the five countermeasures, information relating to the current implementation of these initiatives and barriers or issues for future implementation was requested from jurisdictions.

Once again, as the nature of school bus travel and bus operating practices differ across jurisdictions, views relating to implementation also vary. However, based on the advice regarding potential implications associated with introducing one or more of the countermeasures examined in the investigation, the following common points can be made:

- The length of time to replace the entire fleet with new ADR compliant buses offering rollover protection, seat belts and improved compartmentalisation through higher backed seats, would vary dependent on the number of buses currently replaced on an annual basis, the level of funding that could be provided and the capabilities of the bus building industry to manufacture the required number of buses.
- Manufacturing and outfitting agencies would be required to develop implementation plans to outline the rate at which the bus building industry could manufacture new buses and/or retrofit seat belts. This information would assist jurisdictions to develop more accurate implementation plans.
- Based on the advice provided, if it was decided to implement one or more of the countermeasures under investigation, it is probable that safety features would be implemented or phased in as vehicles in the fleet required replacement. Decisions to implement these features would also impact on general route bus services operating in both rural and metropolitan environments.
- The implementation of seat belts would require not only the development of implementation plans, but would also require strategies outlining the ongoing maintenance procedures to ensure seat belts are maintained in sound condition and good working order. Additionally, a schedule of vehicle inspections and maintenance standards would need to be developed and implemented. The costs associated with such maintenance programs would be additional to those costs depicted in this investigation.
- It was also suggested that the implementation of seat belts would require further investigation into the liability issues associated with wearing, or not wearing seat belts at all times. The responsibilities of drivers, parents and passengers, and the implications of breaching these responsibilities, would need to be clearly identified in legislation. Consideration also needs to be given to the issue of whether a child is safer left standing on the side of the road, waiting for another bus because no belted positions remain, in comparison to a driver allowing a child to board the vehicle and travel unbelted or standing.
- Many jurisdictions noted that the potential to abolish three-for-two seating practices and standees policies are by-products of the fitment of seat belts. The expected cost implications of these by-products are considerable. The repercussions associated with the removal of these practices could include increases in traffic congestion and vehicle emissions due to greater fleet sizes and additional administrative costs associated with changes to bus timetables, route adjustments and passenger transfers. It is also conceivable that increased number of buses on the road could negatively impact on the involvement of children involved in pedestrian crashes in the vicinity of a school bus during school commuting hours.

Conclusions

This investigation has examined the costs and implications associated with the potential implementation of three-point lap sash seatbelts, the fitment of seats with higher backs, abolishment of three-for-two seating practices and standee policies and improvement of the rollover strength of the current school bus fleet.

The known risks and benefits associated with the countermeasures under investigation have been documented in this report. The debate is well-documented over the safety of school buses, the benefits of compartmentalisation, the cost of installing seat belts and other countermeasures relative to the safety gains that are expected to result. However, the research is mixed and the evidence is largely inconclusive due to the low number of crashes associated with school bus travel.

The report provides a detailed picture of the composition of the bus fleet involved in the transportation of children in each jurisdiction and outlines the current adoption of these countermeasures. This highlights that the nature of school bus operations, and the level of detail available about these operations, differs considerably between jurisdictions. Any move to progress with the implementation of one of the countermeasures investigated would benefit from greater knowledge of fleet operations and further efforts to develop inventories of bus fleets operating both dedicated and non-dedicated services.

The Australian Design Rules (ADRs), Australian Standards, Australian Road Rules (ARRs) and Traffic Acts and Codes relevant to operation of school buses and the transportation of children on buses when travelling to and from school and the implications associated with introducing each countermeasure have been discussed. This discussion highlights that a decision to implement seat belts and/or higher seat backs would result in amendments to one or more ADRs. A decision to abolish three-for-two seating policies or standee practices would result in necessary changes to the Traffic Acts and Codes that regulate bus operations in individual jurisdictions.

Based on information supplied by jurisdictions, a preliminary analysis of the potential costs that could be expected if additional internal bus safety measures were implemented is presented. Three alternative cost options for upgrading buses are detailed for consideration. However, it should be noted that this analysis has applied a number of assumptions regarding the number and type of buses operating in bus fleets and the number which meet, or fail to meet, relevant ADRs. These assumptions need to be taken into account when considering the financial implications associated with introducing one or more of the countermeasures investigated. The provision of more detailed information regarding bus types and operating practices may see these assumptions modified.

Finally, the potential barriers or difficulties likely to be confronted by jurisdictions if one or more of the countermeasures was to be introduced have been detailed. The issues raised highlight that any decision to install seat belts, increase seat back height, improve rollover protection and prohibit three-for-two seating policies and/or abolish standee practices can not be entered lightly. The impacts are widespread. They include issues relating not only to changes in carrying capacity and funding arrangements, but also to the ability of the bus building industry to construct and upgrade buses as required, the need for implementation and vehicle maintenance plans to be developed and for issues regarding liability and responsibility to be clearly defined. Further consultation with road authorities, industry representatives and other key stakeholders would be required to determine suitable options to address the issues raised.

In conclusion, this investigation has provided a preliminary analysis of the potential implications that could be expected if additional internal bus safety measures were implemented. This report is expected to assist jurisdictions in their consideration of school bus safety issues.

CONTENTS

EXECUTIVE SUMMARY i

1. INTRODUCTION 1
- **1.1 Project objectives** 1
- **1.2 Project structure** 1
  - 1.2.1 Data collection 2
  - 1.2.2 Data review and estimation 2

2. RESEARCH FINDINGS 3
- **2.1 Background to safety of school bus travel** 3
- **2.2 Risks and benefits associated with vehicle based countermeasures** 3
  - 2.2.1 Overseas experience 3
  - 2.2.2 Do seat belts improve protection for school bus occupants? 4
  - 2.2.3 What protection does compartmentalisation offer in frontal collisions? 4
  - 2.2.4 Do seat belts offer greater protection than compartmentalisation in rollover crashes? 5
  - 2.2.5 Are seat belts viable for school buses operating in Australia? 6
  - 2.2.6 Are standees at greater risk of injury than seated occupants? 7
  - 2.2.7 Does seating three children in two adult seats compromise occupant safety? 7
  - 2.2.8 Summary of research evidence 7

3. THE AUSTRALIAN SITUATION 9
- **3.1 The application of countermeasures across jurisdictions** 9
  - 3.1.1 Three-point (lap-sash) seat belts 9
  - 3.1.2 Provision of high-backed seats to improve compartmentalisation 9
  - 3.1.3 Allowing standees to travel in moving buses 9
  - 3.1.4 Allowing three children to occupy the two adult seats 9
  - 3.1.5 Rollover protection 9
- **3.2 Composition of the School Bus Fleet** 9
  - 3.2.1 Fleet composition by jurisdiction 9

4. LEGISLATIVE AND REGULATORY ISSUES 15
- **4.1 Australian Design Rules** 15
  - 4.1.1 Applicable ADRs 15
  - 4.1.2 Would any ADRs require amendment? 18
- **4.2 Australian Standards** 20
  - 4.2.1 Relevant Australian Standards 20
  - 4.2.2 Would any AS required amendment? 20
  - 4.2.3 Current procedures for the retrofitment of seat belts in Australia 20
- **4.3 Australian Road Rules, Traffic Acts and Codes** 21
  - 4.3.1 Relevant Australian Road Rules 21
  - 4.3.2 Other relevant Traffic Acts and Codes 22
  - 4.3.3 Would ARRs, Traffic Acts or Codes require amendment? 26

5. CAPACITY AND COST IMPLICATIONS 27
- **5.1 Background to cost procedure** 27
  - 5.1.1 Assumptions and cautionary words 27
  - 5.1.2 Costs for installing seats with seat belts 27
  - 5.1.3 Costs for purchasing new buses 28
  - 5.1.4 Number of buses used in cost calculations 28
- **5.2 Option 1: Fitting the existing fleet with seats with seat belts** 29
  - 5.2.1 Queensland 30
  - 5.2.2 Victoria 30
  - 5.2.3 New South Wales 31
  - 5.2.4 South Australia 31

5.2.5 Western Australia....31
5.2.6 Tasmania....31
5.2.7 Australian Capital Territory....32
5.2.8 Northern Territory....32
5.3 Option 2: Replacing for rollover protection and retrofitting seats with seat belts....32
5.3.1 Queensland....34
5.3.2 Victoria....34
5.3.3 New South Wales....34
5.3.4 South Australia....34
5.3.5 Western Australia....34
5.3.6 Tasmania....35
5.3.7 Australian Capital Territory....35
5.3.8 Northern Territory....35
5.4 Option 3: Replacing the existing bus fleet with new buses (rollover and seat belts)....35
5.5 Cost implications associated with reduced carrying capacity....36
5.6 Current subsidy arrangements....38

6. IMPLEMENTATION ISSUES 42
6.1 Queensland....42
6.2 Victoria....43
6.3 New South Wales....43
6.4 South Australia....44
6.5 Tasmania....45
6.6 Northern Territory....45
6.7 Remaining jurisdictions....45
6.8 Summary of implementation issues....45

7. SUMMARY OF RESEARCH FINDINGS 47
7.1 Research evidence and crash data....47
7.2 Australian situation....47
7.3 Legislative and regulatory issues....48
7.3.1 Australian Design Rules (ADRs) and Australian Standards (AS)....48
7.3.2 Australian Road Rules (ARRs), Traffic Acts and Codes....49
7.4 Capacity and cost implications....50
7.4.1 Option 1: Fitting the existing fleet with seats with seat belts....50
7.4.2 Option 2: Replacing for rollover protection and retrofitting seats with seat belts....51
7.4.3 Option 3: Replacing the existing bus fleet with new buses (rollover and seat belts)....51
7.4.4 Cost implications associated with reduced carrying capacity....51
7.4.5 Current subsidy arrangements....51
7.5 Implementation issues....52

8. CONCLUSION 53

9. REFERENCES 54

APPENDIX A REQUEST FOR DATA/INFORMATION RELATING TO SCHOOL BUSES 55

APPENDIX B RELEVANT SECTIONS FROM THE AUSTRALIAN DESIGN RULES (ADRS) 61
ADR 68/00 Occupant Protection in Buses....61
ADR 66/00 Seat strength, seat anchorage strength and padding in omnibuses....61
ADR 4/03 Seat belts....63

1. INTRODUCTION

The recent report, *Review of the School Bus Safety Action Plan* (Austroads AP-R207, 2002), detailed the implementation of a range of school bus safety measures by jurisdictions and the methodology for refining and prioritising measures contained in the National School Bus Safety Action Plan.

The report also confirmed earlier findings that the large majority of school child "bus" fatalities occurred after the child alighted from a bus and recommended that jurisdictions give priority to those measures which address this primary cause of school bus related fatalities.

The report also noted a number of measures that were considered to be complex and potentially costly to implement and which, while not addressing the primary cause of school bus related fatalities, were of particular concern within the community. These measures included:

1. The installation of 3 point (lap-sash) seat belts in school buses in Australia.
2. Fitting school buses with higher seatbacks (improving compartmentalisation).
3. Requirement for school buses to be limited to carry one child to each single seat compared to current three-for-two policy.
4. Prohibiting standing passengers, thus ensuring that all children are seated while the bus is moving.
5. Improving the rollover strength of buses.

Austroads, through its School Bus Safety Advisory Group, commissioned ARRB Transport Research to examine the implications of implementing each of these five vehicle-based countermeasures. It is intended that this report will be provided to the Australian Transport Council (ATC) to assist them in their deliberations of school bus safety measures.

1.1 Project objectives

The objectives of this project were to:

- Investigate the costs and associated implications of implementing each of the five vehicle-based countermeasures or actions listed above.
- Determine the economic value of each countermeasure or action.
- Identify the tasks involved and the timing options for implementation.

1.2 Project structure

To determine the feasibility of implementing the five vehicle-based countermeasures listed above, two clear stages were defined. During the first stage key stakeholders and bus manufacturers were contacted in an effort to collect required information. During the second stage the collected information was reviewed. The financial costs and implications associated with the potential implementation of the vehicle-based countermeasures under investigation were also examined as part of this review.

This examination provides a preliminary analysis of the potential costs that could be expected if additional internal bus safety measures were implemented. It is anticipated that this report will assist in the next round of decision making at a national level.

1.2.1 Data collection

To obtain the required information a detailed data request was drafted. A copy of this request is included in Appendix A. This request posed a series of questions in order to obtain information relating to each countermeasure or action under the following core areas:

- Legislative and/or regulatory issues;
- Capacity and cost implications;
- Associated risks and benefits; and
- Implementation issues.

State Road Authority representatives

With the Working Party's support, representatives from each state and territory road authority were contacted. A list of the initial representatives contacted is presented in Appendix B. Other representatives contacted subsequent to the initial contact are also listed in Appendix B.

Representatives from each State Road Authority (SRA) were asked to read the details of the request and consider what information they were able to access, collect and provide. Further, they were asked to advise if information should be sought from other key stakeholders such as the Department of Transport, Department of Education or other relevant bodies. If additional contacts were recommended, they were asked to supply contact details for appropriate representatives.

Bus manufacturers and outfitting agencies

Representatives from a sample of bus manufacturers and outfitting agencies were contacted and invited to provided information pertaining to:

- the installation of 3 point (lap-sash) seat belts in buses;
- the suitability of particular seat types;
- the requirement of reinforcement in the bus walls and floor to accommodate the seat belts;
- seat anchorage suitability;
- rollover protection; and
- the associated cost for each of the above.

1.2.2 Data review and estimation

Following collection of requested data the information was reviewed. Complexities involved in calculating the financial and capacity implications based on the information provided by jurisdictions were identified. A method of determining the capacity and cost implications associated with the countermeasures under investigation was developed and subsequently applied.

The results of this data review and estimation process form the basis of this report. The report provides a inventory of the nature of bus fleets, particularly school bus fleets, operating across Australia and it quantifies, in a preliminary way, the potential costs that could be expected if additional internal bus countermeasures were to be implemented.

2. RESEARCH FINDINGS

2.1 Background to safety of school bus travel

It is well documented that travelling by school bus represents one of the safest modes of transport offered to children. Based on crash data and research evidence, the risk of injury to occupants while travelling as a passenger is low. The greatest risk to children travelling to or from school is as pedestrians moving around a school bus.

A recently published report, titled the *Review of the School Bus Safety Action Plan* (Austroads AP-R207, 2002), indicated that in Australia a total of 28 children were killed during travel to and from school in association with a school bus across the five-year period investigated[1]. The report further indicated that of these 28 fatalities, the majority (n=22) were as a result of children being struck by passing traffic when crossing the road after alighting from the bus, and one killed while trying to cross the road to board the bus. Five of the 28 children were killed while travelling as bus passengers: two while attempting to alight from the bus; two as a result of a collision with another vehicle; and one as a result of a child learning out of the window of the bus. These figures illustrate that the risk of being struck by passing traffic, as a pedestrian, when crossing the road before or after alighting from the bus presents a considerably greater risk to children than travelling as a bus passenger during school commuting hours.

Despite statistical evidence, there remains a strong perception in the community that travel on board a bus is less safe than in a passenger vehicle. There is a perception that children are not adequately protected in school buses because they do not have seat belts. There is documented evidence to support the use of restraints in passenger vehicles and evidence of their value in saving lives. Many parents report a desire to continue this safety regime from the family car to travelling in a bus, so that each child occupies a belted position and wears the fitted restraint correctly.

2.2 Risks and benefits associated with vehicle based countermeasures

2.2.1 Overseas experience

In the United States, where dedicated school bus fleets operate, new school buses are required to meet safety standards as outlined in the Federal Motor Vehicle Safety Standards (FMVSS). Standards 208 to 210 detail requirements for occupant crash protection, seat belts assemblies and seat belt anchorage, while standards 220 to 222 contain specific requirements relating to improved rollover protection, roof structure, seating and seat belt use, fuel systems and bus body joint integrity.

FMVSS 222: School Bus Passenger Seating and Crash Protection contains specific requirements relating to occupant protection requirements for school bus passenger seating and restraining barriers. The purpose of this standard is to reduce the number of deaths and the severity of injuries that result from the impact of school bus occupants against structures within the vehicle during crashes and sudden driving manoeuvres. It applies to all seating positions in a school bus, though not to the driver's seat. While Standard 222 does not require the fitment of seat belts to school buses, this standard improves occupant protection by offering passive design safety features (including energy absorbing, well spaced seats) to improve occupant protection.

[1] This crash data was sourced from the *ATSB Fatality Crash Database* for the following five years of available data: 1992, 1994 1996, 1997 and 1998.

2.2.2 Do seat belts improve protection for school bus occupants?

Considerable research has been carried out in the United States and Canada examining the effectiveness of seat belts as a means of protecting children from injury or death. However, despite considerable testing and research into the use and fitment of seat belts, the debate as to whether they offer improved occupant protection has continued. As reported in Austroads (AP-207, 2002):

> *' … a wide range of studies examine the safety of compartmentatlistion compared with the level of occupant protection offered by seat belts. Compartmentalisation appears to offer adequate protection for occupants in frontal impact collisions, with some concerns as to its effectiveness in collision involving high lateral forces and cases of bus rollover. Further, there is difficulty in determining whether the addition of appropriate occupant restraint systems such as seat belts will achieve the same level of occupant protection as that which could be achieved through number of other cost effective and practical measures.' (Austroads, AP-R207, 2002, p26)*

Crash testing

Results of full scale crash testing conducted by Transport Canada in 1984 indicated that Hybrid III dummies restrained by lap-belts experienced far greater head acceleration than unbelted dummies (see Farr, 1984). Based on the test results, Farr (1984) concluded that the installation of seat belts in school buses may result in an increase in the risk of head injures to belted occupants in a severe frontal collisions, as occupants "heads may strike seatbacks in front such that energy absorption was not possible" (NTSB, 1999, p2). As a follow up, in 1986 Transport Canada tested five different types of seats fitted with seat belts for increased occupant protection. The results indicated that rear-ward facing seats provided the greatest potential occupant protection during frontal collisions and near-frontal collisions, as these seats allow the crash forces to "be spread over the back of the rearward-facing occupant instead of being concentrated on the head"(Canada Safety Council, 2000, p1).

However, it is important to note that there has been some debate regarding the validity of the testing and conclusions drawn as a result of the Canadian school bus crash tests. Canada's National Coalition for School Bus Safety (NCSBS) has criticised the earlier Canadian tests, suggesting that they were "set up to prove the unworthiness of seat belts"(Yeager, 1985). The NCSBS argued that the use of these Hybrid III dummies in crash testing has been criticised elsewhere for resulting in excessive head injury criteria readings and that the tests did not provide information on neck and throat injuries as the necks of dummies were not instrumented. Overall the NCSBS concluded that the Canadian tests were designed to present the chosen seat "in the best possible way, and, because of the high crash forces, the dummy height and stiffness, the Thomas seat, to show the use of seat belts on school buses in the worst way" (Yeager, 1985, p2).

2.2.3 What protection does compartmentalisation offer in frontal collisions?

As an alternative to seat belt use, another approach to maximise safety of school bus occupants is termed 'compartmentalisation'. This approach offers passive design protection to occupants and is defined as "a protective envelope consisting of strong, well-padded, well anchored closely spaced seats that have energy absorbing seat backs" (McCray and Barsan-Aneli, 2001, p1). This approach to occupant protection was investigated in a study undertaken by the Centre of Transportation Studies and Research (CTSR, 1989) where it was concluded that compartmentalisation, together with enhanced safety standards (i.e. joint integrity), offers adequate safety in frontal impact collisions.

During 1987, the National Transportation Safety Board (NTSB) commissioned a study to evaluate how well compartmentalisation (as specified in the USA Federal Motor Vehicle Standards) protected unrestrained occupants and to determine whether lap-belt use may have altered the severity of occupant injuries. This study found that of a total of thirteen school bus passenger fatalities investigated, lap-belt use would have probably prevented two deaths, made no difference in ten deaths, and could not be determined for one death. The study also found that 90% of unrestrained passengers in the crashes examined received minor injuries. Based on the crashes examined, the NTSB (1987) reported that death and serious injuries sustained by occupants were more likely to be attributable to occupant seating position being directly in line with the crash forces, rather than a result of being unrestrained at the time of impact.

Overall, the NTSB concluded that the compartmentalisation standards offered in large post-standard school buses perform well in protecting passengers from injuries in a range of crashes, particularly frontal collisions, and reflect an exceptionally safe form of transportation (NTSB, 1987).

As a follow up, in 1989 the NTSB undertook a similar investigation into the crashworthiness of small post-standard school buses and vans used to transport children to and from school. The NTSB reported that small post-standard school buses also provided good protection for school aged occupants. The study found that restrained and unrestrained occupants experienced similar patterns of injuries and concluded that seating position was a more significant factor in determining level of injury sustained than belt status. The NTSB further concluded that passengers seated in the front rows of small buses were at greater risk of head or facial injuries than other occupants, attributing the finding to the absence of restraining barriers.

2.2.4 Do seat belts offer greater protection than compartmentalisation in rollover crashes?

Overseas research findings

A special investigation conducted by the NTSB (1999) sought to determine whether currently available occupant protection systems may have mitigated injuries in cases of vehicle rollover and high lateral force. This investigation involved the examination of four crashes involving side-impact with another vehicle of similar or greater mass and two involving rollover incidents. Three of the six crashes were simulated to identify the dynamics of the vehicle and to determinate impact on occupants during the collision sequence. The results indicated that occupants that were not located in the area of intrusion but were retained in their seating compartment benefited from compartmentalisation. In comparison, those who were not retained in their seating compartment impacted on surfaces not designed to absorb energy. This finding raised concern that current compartmentalisation does not protect all passengers during lateral impacts with vehicles (i.e. in crashes where the bus impacts with heavy vehicles and in side-impact and rollover collisions). In these collisions many passengers do not remain within the designated seating compartment and often impact with objects other than seatbacks including other passengers, bus walls, windows and other seats.

The NTSB concluded that while compartmentalisation is highly effective for frontal impact collisions, the most common form of bus related crashes, this approach offers less adequate protection for side-impact collisions and rollover crashes.

The National Highway Traffic Safety Administration (NHTSA) are currently evaluating available and prototype safety restraint systems in large school buses as part of an extensive research program to develop the ‘next generation occupant restraint system’ (McCray and Barsan-Aneli, 2001). NHTSA is using computer simulations to determine and compare the effect of compartmentalisation, lap-belt restraints and lap-sash restraints on occupant safety. The study has simulated these systems for frontal impact collisions using three different Hybrid III dummies to represent an average sized six year old child, a 12 year old adolescent and a large high school male, under three loading conditions:

(i) belted without any occupants seated behind;

(ii) belted with loading from unbelted occupants behind; and

(iii) unbelted occupants into seat in front of them.

The simulation study found that, firstly, compartmentalisation was most effective for smaller occupants while larger occupants, located at the rear of the bus, tended to override standard height seatbacks. Secondly, lap-belt systems resulted in only slightly greater neck injuries than compartmentalisation and in addition, lap-belts prevented larger rear occupants from overriding the seatback. Thirdly, lap-sash belt systems yielded greater safety performance than either compartmentalisation or lap-belt systems.

Based on the above findings, NHTSA concluded that adjustable lap-sash belts may offer improved safety performance for smaller children. At the present time, NHTSA is evaluating the effect of seatbacks, seat height and seat spacing on the performance of these occupant protection systems.

2.2.5 Are seat belts viable for school buses operating in Australia?

Many investigations into the safety of children travelling in and around buses in Australia have referred to the studies undertaken by Henderson and Paine (1994), which reported mixed opinions regarding the effectiveness of seat belts reducing death or injury to school children.

Henderson and Paine (1994) highlighted that in Australia, unlike America, very few buses are used exclusively as a school bus. Many buses are used to transport passengers for a variety of purposes. As a result, many of the constructional and safety features that are offered by the dedicated school bus fleet in America, including seat belts, cannot be simply applied to the Australian situation. Therefore, they reported that the effectiveness of seat belts depends largely on a number of other vehicle design features. Such design features include the type of seat fitted, other vehicle designs employed to minimise risk (i.e. seat height, seat padding), the type of belt used (lap-sash or lap-belt) and the extent to which all passengers use belts and adhere to vehicle policies. Henderson and Paine (1994) concluded that 3-point lap-sash seat belts are the only effective seat belt for student transport. They further highlighted the vehicle construction difficulties associated with retrofitting seat belts to buses to the current bus fleet and referred to the need for seat belts to be fitted in conjunction with other measures including floor strengthening and anchorage points.

Furthermore, Henderson and Paine (1994) estimated that the cost of installing effective seat belts would be very large. They highlighted that the cost would further increase as policies permitting three-for-two seating and the travel of standing passengers would need to be revised if seat belts were fitted. As a consequence, Henderson and Paine (1994) concluded that modification of seat design in buses in Australia may be a more effective method of preventing injury compared to the fitment of seat belts.

In Australia, like overseas, many seat belt advocates still maintain that seat belts have the potential to increase occupant protection, to improve passenger behaviour and to reduce driver distractions (Irwin & Faulks, 2000).

Irwin and Faulks (2000) further suggested that appropriate restraint systems and seating for all children may reduce the severity of injuries that might otherwise be sustained. Therefore, as a minimum, they suggested that bus seats and associated vehicle design standards should be redesigned to ensure they are compatible for the fitment of seat belts in the longer term.

2.2.6 Are standees at greater risk of injury than seated occupants?

There is some debate that standees are not afforded the same protection in crashes as seated occupants, as they are more vulnerable to serious injuries from even minor incidents and represent a potential threat to other passengers in the event of a crash. However, very few evaluations have been carried out comparing the relative safety of seated versus standing bus passengers.

Given the low risk of injury to a child as a bus passenger, Australian researchers have suggested that any additional risk posed by a child standing during the bus journey is very small (Henderson, 1996). It has been suggested that vehicle countermeasures could be adopted at minimal cost, such as passenger handholds and additional 'in vehicle' safety barriers, together with stricter application of load restrictions to increase occupant safety. In his review of the risks facing students who are require to stand during a bus journey, Henderson noted that the cost of achieving a "zero standing risk" would be far in excess of the "value of the injuries that would be saved" (1996, p1). Therefore, Henderson concluded that such expenditure would perhaps be of greater value if directed towards addressing pedestrian and bus crashes.

Some types of buses used in Australia are specifically configured to allow the safe travel of standing passengers. For example, low floor buses have hand rails and grab rails to provide greater protection to standing passengers. However, these type of buses are more often found operating in as general route service buses than as school buses. Further to this, it has been suggested that as a route service vehicle these buses may be more likely to be involved in high density and high movement situations, operating at low speeds and frequently stopping and starting, than buses dedicated to transporting children to and from school.

2.2.7 Does seating three children in two adult seats compromise occupant safety?

Consistent with concerns about standees, the practice of seating three children in two adult seats is often raised by members of the community as compromising occupant protection and an issue in need of resolution. However, once again there is little evidence to indicate that this seating practice results in injuries to school children.

2.2.8 Summary of research evidence

Based on research evidence and crash data, this investigation has found that:

- The risk of being struck by passing traffic, as a pedestrian, when crossing the road before or after alighting from the bus presents a considerably greater risk to children than travelling as a bus passenger during school commuting hours.
- There is varying evidence about the safety implications of fitting seat belts to school buses, allowing standees to travel in a moving vehicle, allowing three children to occupy the seating capacity intended for two adults, and the need for higher seat backs offering improved compartmentalisation.
- There is conflicting evidence regarding the effectiveness, safety implications and cost of fitting seat belts on school buses. Evidence from studies conducted in the United States, where dedicated school bus fleets operate, suggest that compartmentalisation offers the most effective protection for occupants in the event of a frontal collision, but offers less adequate protection for side-impact collisions and rollover crashes where occupants are ejected from the seating compartment. It is anticipated that lap-sash seat belts may improve occupant protection in these situations.

- There are conflicting views associated with permitting standees to travel on vehicles and implications relating to a decision to end this policy. There is a lack of evidence to indicate that seated travel is significantly safer than travelling as a standing passenger in a moving bus. Similarly, there is a lack of evidence that permitting three children to occupy the seating capacity of two adults compromises passenger safety.

- The debate over the safety of school buses, the benefits of compartmentalisation, the cost of installing seat belts and other countermeasures relative to the safety gains that are likely to result are well-documented. However, the research is mixed and the evidence is largely inconclusive due to the low number of crashes associated with school buses.

3. THE AUSTRALIAN SITUATION

3.1 The application of countermeasures across jurisdictions

The previous section catalogued documented research that identified the risk facing children during the journey to and from school and outlined the risks and benefits associated with the five countermeasures under investigation. It also highlighted the lack of conclusive evidence about the relative safety gains of such measures. Before considering the potential implications associated with introducing one or more of these five countermeasures, it is useful to consider whether each countermeasure is currently applied across Australian jurisdictions and to consider the composition of the bus fleet used to transport children to and from school in this country.

3.1.1 Three-point (lap-sash) seat belts

Based on research documented by Austroads (2002), three-point lap-sash belts are not widely available on school buses in many jurisdictions. The exception is coach style vehicles which, depending on the year of manufacture, are required under the Australian Design Rules (ADRs) to be fitted with lap-sash belts (Specific ADR requirements are further detailed in Section 4).

3.1.2 Provision of high-backed seats to improve compartmentalisation

Consistent with the application of seat belts, high-backed seats are not generally provided in school buses, except when coach-style vehicles are used to transport children for school services.

3.1.3 Allowing standees to travel in moving buses

All states in Australia currently permit carriage of passengers who have to stand on route service buses, provided buses are designed with allocated standing areas. However, the number and conditions permitting standees vary between jurisdictions.

3.1.4 Allowing three children to occupy the two adult seats

With the exception of the Australian Capital Territory, all Australian jurisdictions permit the three-for-two seating policy for scheduled runs (and some special runs in dedicated school bus services). This policy generally applies only to children aged 12 years or younger.

3.1.5 Rollover protection

The extent of rollover protection offered by buses varies between jurisdictions and where provided, is done so in accordance with ADRs depending on the size of the bus and when the bus was constructed.

3.2 Composition of the School Bus Fleet

3.2.1 Fleet composition by jurisdiction

To assist with determining the implications associated with each of the five countermeasures, jurisdictions were invited to provide a summary of the composition of the bus fleet used in the transportation of children to and from school. Representatives were asked to provide an estimate of average vehicle age, the number of different types of vehicle makes and models and the design and safety standards offered by different types of buses.

The information provided has been reviewed and a summary of the operating practices for each jurisdiction has been prepared [2].

Queensland

Queensland Transport indicated that there are up to 3,000 buses involved in the transportation of children to and from school in the state. Around 1,600 are operated by contract service providers or schools themselves, with a further 850 buses operating as public passenger services service buses. Based on Transport Survey 2000, Queensland Transport has access to detailed data pertaining to age, make, model and seating capacity for around 2,500 buses.

The average seating capacity of the buses in the fleet is 41 and at present 120 buses are known to provide lap-sash seat belts.

The *Queensland School Transport Safety Task Force Report* (2001) indicated that more than half of the buses used to transport children to and from school are more than 15 years old, with 30% over 20 years old. Further, three quarters were built before 1992 and therefore do not necessarily comply with a number of current safety designs and ADR's.

The dedicated school bus fleet carries approximately 130,000 children and the non-dedicated school bus fleet carries an additional 20,000 children.

In Queensland current Passenger Transport Regulation (see latter sections for further details) allow three-for-two seating policy and permit the travel of standees on moving vehicles, subject to a number of conditions.

New South Wales

According to estimates supplied by the NSW Department of Transport (DoT) the NSW bus fleet consists of 12,156 registered vehicles of which 9,646 are estimated to be involved in the transportation of children to and from school. Of these, 1,931 are STA government operated buses, with a further 7,715 privately operated. NSW does not operate a dedicated bus fleet solely used for the transport of children.

New South Wales indicated that the age of the fleet is difficult to estimate given that information is not available for each individual bus. In NSW the average vehicle age is an accreditation requirement and is determined by a maximum fleet age which is 8 years for smaller buses and 12 years for larger buses.

Like Queensland, NSW estimated that the majority of buses used for the conveyance of school children are larger buses with a licensed adult seating capacity of 57 and a standing capacity of 27. The carrying capacity is further increased as NSW permits three children, if aged under 12 years, to occupy a seat designed for two adults, in addition to children standing.

Victoria

The Victorian Department of Infrastructure (DoI) indicated that there are around 1,600 buses contracted by the DoI to operate a free school bus system. However, it is estimated that there are a further 2,000 route service buses operating in the metropolitan and urban areas.

The average age of the buses in the fleet is 9 years, with the oldest bus in the fleet constructed in 1975. The average seating capacity is 47 seats per bus. The total capacity of the school bus fleet is 75,587 seats, with the take up of available seating at approximately 97 per cent.

[2] These summaries are based on ARRB TR's understanding from the information provided.

The carrying capacity is further increased as Victoria permits three children, if aged under 12 years, to occupy a seat designed for 2 adults, in addition to children standing. It is estimated that approximately 45 per cent of the fleet is operating at capacity.

South Australia

The South Australian Department of Education and Children's Services (DECS) indicated that there are 598 DECS owned and contract-operated to and from school buses in their system. In addition, there are believed to be approximately 58 DECS contracted buses that are modified for wheelchair accessibility, primarily to carry students with disabilities. DECS has also estimated that there are at least a further 200 buses operated by catholic schools, independent schools, local councils and private operators that provide dedicated school services. In addition, there are a number of fare paying passenger buses, which carry school children across metropolitan Adelaide.

The average age of the South Australian DECS owned school bus fleet is 12.6 years and the average age of the contract-operated buses is approximately 17 years. The average adult seating capacity of the combined DECS owned and contract-operated bus fleets is 48 seats per bus. Based on a spreadsheet presenting current DECS school bus usage in SA as of July 2002, the contract-operated bus fleet carries a total of 10,292 passengers, while the DECS owned bus fleet carries a further 7,759 passengers. In addition, 456 passengers are carried on DECS contracted accessible school buses. Therefore, more than 18,500 passengers are serviced by these fleets.

However, the actual adult/child carrying capacity of the DECS owned and contract-operated school bus fleets is greater that the "average seating capacity of 48 adults per bus" because of the following factors:

- In South Australia, the Road Traffic Act allows three children up to and including the age of 14 years, to occupy a double seat designed for two adult passengers and to certain specifications.
- In South Australia, the current DECS school transport policy allows students to travel as standing passengers on department provided school buses, subject to a number of conditions, which are designed to protect standing passengers.

Lap-belts are currently fitted on some DECS school buses (viz, driver and front passenger seat only) and other private buses (unaware of numbers and owners) outside the system. In view of reports that warn that the use of lap-belts could increase risk of injury in frontal impacts and threaten belt-induced internal injury to children, South Australian authorities stated their interest in being advised if lap-belts are likely to be prohibited as this will have additional implications for SA.

Western Australia

The Western Australia Department of Transport indicated that it operates 787 owned or contracted school buses. The average seating capacity of the fleet is 32 seats per bus. The remaining information for WA was based upon the feasibility report completed by ARRB (2001).

Tasmania

The Tasmanian Department of Infrastructure, Energy and Resources (DIER) operates 500 dedicated school buses that provide *free to user* services. An additional 150 route services may carry students and a further 200 Metro buses are also used in urban areas.

Tasmania stated that there is no regulation regarding the age of buses in service in Tasmania. As a consequence of this, the majority of school buses are quite old and many may not suitable for the fitment of seat-belts. Further, Tasmania indicated that the average age of buses in their fleet is around 20 to 22 years, with the large proportion of older dedicated school buses being balanced, in some degree, by the age of route service and Metro fleets.

Buses operating in the dedicated fleet are currently permitted to take up the three-for-two seating policy and are permitted to allow standees on moving vehicles. The seating capacity of the existing fleet is unknown.

Australian Capital Territory

Four bus operators provide school bus services via government contract in the ACT. Information about two bus companies operating in the ACT was sourced by the Department of Urban Services.

- *ACTION Buses* operate 363 buses, of which 347 are used for passenger services and 16 for disabled passenger services. The average age of the Action bus fleet is 12 years. This fleet has 15,970 seats available per day. It was stated that of the 322 school services operated by Action, 19 are operating at capacity.
- *Transborder Express* operate 12 buses. The average age is 10.8 years. The seating capacity of the buses in the fleet range from 48 to 65 seats per bus. The maximum number of seats offered by Transborder is 590. The total number of students registered for this service is 705. Of the 34 school service routes operating, 22 are operating at capacity.

Children make approximately 2,635,400 trips annually on these two bus companies.

A further two companies (Deane's Buslines and Keirs of Canberra) were contacted however information has not been supplied to date. It is known that Deane's Buslines operate 57 buses while Keirs of Canberra operate a further 46 buses. However further information regarding the use, age and make of these vehicles was not provided.

Northern Territory

The Public Transport Program of the Department of Infrastructure, Planning and Environment contracts various private bus companies and the Government Business Division operate approximately 138 dedicated and non-dedicated school buses in the Northern Territory.

There are approximately 72 school route services operating in the Northern Territory, with an estimated 65 per cent of buses carrying at their full capacity.

The average age of the fleet is 10 years old, with an average seating capacity of 40.

Representatives of the Northern Territory Government indicated that three-for-two seating and standees are practices which have been developed and agreed to by the contractors and the government department, and are not detailed in the NT legislation nor regulations.

Excluded information

It should be noted that some information was provided by jurisdictions in relation to buses designed and operated primarily for the transport of disabled passengers. However because of the difference in design and construction of these buses (i.e. they are constructed or fitted with hoists and standards to transport passengers in wheelchairs) and subsequent carrying capacities, these estimates have not been included in the number of buses depicted in Table 1. Furthermore, it is anticipated that the introduction of one or more countermeasures under investigation would yield different implications that are not directly comparable to those that may be incurred by the typical types of buses that transport for children to and from school. For these reasons, these additional buses have not been included in the cost calculations and capacity implications presented in later sections of this report.

Limitations of information provided

It should also be noted that based on the information that was available, and the need to provide an overview of school buses operating at a national level, this investigation does not differentiate between the types of buses operating within the school bus fleet and those operating within the general service route fleet. For example, this investigation does not differentiate between the design features associated with different makes and models of vehicles: for example, low floor buses (which offer hand grips and rails) as compared to say coaches (which are designed to increase compartmentalisation). While it is acknowledged that some buses are designed differently, and thus provide different types of safety features depending on the primary purpose of the vehicle, such differentiation would require access to very detailed information or inventories of the bus fleets operating in each jurisdiction.

Summary of available information

Table 1 presents the composition of school bus fleets used to transport children to and from school in Australia. This table highlights that some jurisdictions operate dedicated school buses and other do not. It further highlights that the number of buses, the average age and the average seating capacity of these buses varies across jurisdictions.

Further to this, some states indicated that if one or more of the countermeasures under investigation were to be introduced, they may need to be introduced beyond just dedicated school bus fleets, where these apply. It has been suggested that if additional safety countermeasure were introduced for buses primarily used for the transportation of school children, then children using non-dedicated, general route service vehicles would need to be provided with the same level of occupant protection. Therefore, Table 1 provides an indication of the additional number of buses that may be effected if one or more of the countermeasure were introduced.

Table 1: Summary of composition of school bus fleet across Australia

State/ Territory	No. of buses in fleet (for which detailed information was provided)	Type of fleet	Average age	Average seating capacity	Total seats available	Additional no. of buses (that may be affected)
QLD	2,964	Dedicated & Non-dedicated	More than 15 years	41	121,000	-
NSW	9,646	General Route Service	11.4 years	57	-	-
VIC	1,604	Private bus operators contracted by the government	9 years	47	75,587	Additional 2000+ route service buses providing school services
SA	311	DEC owned school buses	12.6 years	48	-	Additional 200+ buses providing school services
	287 [a]	Private bus operators contracted by DEC	17 years	48		
WA	787	Dedicated	-	32	-	-
TAS	500	Dedicated	In excess of 20 years	-	-	150 route service buses and 200 metro buses
ACT	359[b]	-	11	-	16,560	103 buses operated by two further companies in ACT
NT	138	Dedicated & route service	10 years	40	5,620	A proportion of data provided

[a] In addition to the 287 private bus operators contracted by DEC, there are around 58 buses offering disabled passenger service in DECS fleet. These have been removed from SA total as these are designed primarily to carry disabled passengers and would need to be accounted for separately. As a result, the total number of buses in SA (for which detailed information has been provided), when DEC owned school buses and private bus operators contracted by DEC are summed is depicted as 598.

[b] Sixteen buses offering disabled passenger service in the ACTION fleet have been removed from ACT total. These buses are of different structure and use to the general school bus service, and therefore, would need to be accounted for separately. As a result, the total number of buses in the ACT, for which detailed information has been supplied, is depicted as 359 in the above table.

4. LEGISLATIVE AND REGULATORY ISSUES

To determine the legislative and/or regulatory changes that may be required if one or more of the countermeasures identified were introduced, information about vehicle design and construction, and regulations and road laws relevant to the operation of buses for the transportation of children to and from school was required.

This section outlines relevant regulations and legislation, and provides some discussion of the implications associated with introducing one or more of the countermeasures under investigation.

4.1 Australian Design Rules

The Australian Design Rules (ADRs) are part of the Australian motor vehicles standards system and are determined by the Federal Minister for Transport under the Motor Vehicles Standards Act 1989. All new vehicles must be designed and constructed in accordance with relevant the ADRs.

4.1.1 Applicable ADRs

A recent investigation into the feasibility of fitting seat belts in school buses for a trial in Western Australia (ARRB, 2001) identified a number of ADRs as relevant to the provision of occupant protection and application of seat belts in buses. These ADRs related particularly to the appropriate design and construction of seats, seat strength, seat belts, seat anchorages, rollover strength and impact-absorbing padding and include:

- ADR 68/00 Occupant protection in buses.
- ADR 66/00 Seat strength, seat anchorage strength and padding in omnibuses.
- ADR 4/03 Seat belts.
- ADR 58/00 Requirements for omnibuses designed for hire and reward.
- ADR 59/00 Omnibus rollover strength.
- ADR 5/04 Anchorage for seat belts.
- ADR 3/02 Seats and seat anchorage.

The ADRs outline regulations and standards for five categories of omnibuses. Omnibuses are differentiated based on vehicle size and seating capacity, as follows:

- buses with a GVM up to 3.5 tonnes and up to 12 seats are defined as ‘MD1’.
- buses with a GVM up to 3.5 tonnes and over 12 seats are defined as ‘MD2’.
- buses with a GVM greater than 3.5 tonnes and up to 4.5 tonnes are defined as ‘MD3’.
- buses with a GVM greater than 4.5 tonnes and up to 5.0 tonnes are defined as ‘MD4’.
- buses with a GVM greater than 5.0 tonnes are defined as ‘ME’.

The summaries of each of these ADRs that follow have been extracted, with minor amendments, from the feasibility report completed for Western Australia (ARRB, 2001). Appropriate page references to the feasibility report have been provided.

ADR 68/00 Occupant protection in buses

The ADR specifies the requirements for seat belts in buses including the strength of seats, seat-anchorages, seat belt anchorages, child restraints anchorages, the provisions for protecting occupants from impact with seat backs and accessories on seats and arm rests.

This ADR applies to omnibuses over 3.5 tonnes (MD3 and MD4 class buses manufactured after 1 July 1995 and ME class buses manufactured after 1 July 1994) which seat more than 17 persons (including the driver and crew), and in which all seats have a reference height (seat back height) greater than 1.0 metre. ADR 68/00 specifies that in vehicles with seat backs greater than 1.0 metre in height, all front and rear seating positions must be equipped with seat belts. *Route Service Buses* and those with less than 17 seats are exempt from the requirements prescribed by this ADR.

ADR 68/00 specifies that seat belts can only be fitted to seats with a reference height of 1.0 metre that meet anchorage and strength requirements. This is interpreted to mean that buses with low-backed seat cannot be fitted with belts. Therefore, the first step in installing seat belts is to ensure that each bus is modified to incorporate high-backed seats and appropriate padding requirements.
(ARRB TR, 2001, p6)

ADR 66/00 Seat strength, seat anchorage strength and padding in omnibuses

This ADR also applies to omnibuses over 3.5 tonnes (MD3 and MD4 class buses manufactured after 1 Jan 1993 and ME class buses manufactured after 1 July 1992) which seat more than 17 persons (including the driver and crew), and in which all seats have a reference height (seat back height) greater than 1.0 metre. This specifies the requirements for the strength of seats, seat-anchorages and seat belt anchorages of certain omnibuses and for protecting occupants from accessories on the seats and arm rests. It further indicates that omnibuses complying with ADR 68/00 need not comply with this rule.

This ADR specifies that vehicles and seats must comply with the requirements of the ECE Regulation 80 which specifies the uniform provisions concerning the approval of seats of large passenger vehicles and of these vehicles with regard to the strength of seats and their anchorage. The scope of ECE Regulation 80 specifies that every passenger seat having a reference height of at least 1.0 metre should be installed facing forward and immediately in front of another forward-facing seat on a horizontal plane; not differing by more than 600 mm from the floor level of the other forward-facing seat.

Further, ADR 66/00 specifies that all fittings forming part of the back of the seat or accessories should be such as to be unlikely to cause any bodily injury to a passenger during impact. This requirement shall be considered satisfied if any part contactable by a sphere 165 mm in diameter presents a radius curvature of at least 5 mm.
(ARRB TR, 2001, p4)

ADR 4/03 Seat belts

This ADR specifies the requirements for seat belts to restrain vehicle occupants under impact conditions, to facilitate fastening and correct adjustment, to assist the driver to remain in his/her seat and thus maintain control of the vehicle in an emergency and to provide protection against ejection in an accident situation. This ADR was amended in 1998 and now applies to all omnibuses manufactured after the 1st January 2000 (MD1 to MD4 and ME). For omnibuses complying with ADR 68/00 only the driver's seat belt is required to comply with clause 17 to 19 of this ADR.

Essentially this ADR indicates that all omnibuses manufactured after January 1st 2000 must be fitted with seat belts, for all seating positions for which seat belt anchorages are required (in accordance with ADR 5/…).

> ADR 5/… indicates that seat belt anchorages are required for all positions in motor vehicles, including buses (light omnibuses that carry more than 12 people are the only exception to this requirements. These only require seat belt anchorages for front seat or unprotected passengers).
>
> Despite this recent amendment, this ADR does not appear to provide other requirements relating to the fitment of seat belts in buses. No reference to seating reference height or other occupant protection requirements (such as seat padding, etc) are provided in this ADR, nor has an amended version of ADR 68/.., been drafted to accommodate these changes. *(ARRB TR, 2001, p4)*

ADR 59/00 Omnibus rollover strength

This ADR applies to rollover strength of a single decked vehicle constructed for the carriage of more than 16 passengers, whether they are seated or standing. The rule specifies the strength of an omnibus superstructure to withstand forces encountered in a crash.

This ADR applies to MD2, MD3 and MD4 and ME vehicles, manufactured on or after 1 July 1993 and to ME buses manufactured on or after 1 July 1992. Omnibuses need not comply with this rule if the following proportion of the area of the upper surface of the floor between axles is not more than 550m above the ground. For a wheel base:

- Greater than 6.5m – 75%
- Less than 6.5m – 70%
- Less than 6.0m – 65%
- Less than 5.5m – 60%
- Less than 5.0m – 55%
- Less than 4.5m – 50%

Essentially ADR 59/00 stipulates that following appropriate rollover testing procedures (as outlined in the ADR), the superstructure is of sufficient strength so that no displaced part intrudes into residual space (that is, the space preserved in passengers compartment after testing) and no part of the residual space projects outside the deformed structure.

The ADR outlines test procedures to undertake rollover tests on (i) a complete vehicle, (ii) on a body section or (iii) on a section representative of a complete vehicle, and provides the calculations necessary to determine whether the superstructure meets prescribed requirements.

ADR 58/00 Requirements for Omnibuses Designed for Hire and Reward

This ADR specifies the requirements for the construction of omnibuses designed, and intended for licensing, hire and reward. These vehicles must also comply with all requirements for omnibuses set out in individual ADRs.

This ADR applies to all omnibuses manufactured on or after 1 July 1998.

This ADR specifies the occupant capacity of a vehicle. This ADR specifies requirements for the loading and luggage conditions per passenger, aisle requirements, access to and from the vehicle, head room, access steps, guard rails, mirrors, hand rails, floors and emergency exists. It further specifies requirements for passenger ‘seats’, driver’s ‘seats’, interior doors and fittings, and lighting, fuel systems and fire extinguisher.

Essentially this ADRs specifies that a loading capacity of 65 kg per person is provided for each driver and passenger. The aisle width should not be less than 380mm in the case of large omnibuses (with carrying capacity greater than 25 persons) or 300 mm in the case of small omnibuses (with a carrying capacity of up to 25 persons). The ADR indicates that omnibuses should be provided with a suitable number of hand straps, hand rails or grips to ensure passenger safety, however the ADR does not specify what type of straps, rails or grips should be used, nor the number and location of these.

ADR 5/04 Anchorage for seat belts

This ADR specifies requirements for anchorages for seat belts assemblies to ensure that they are adequately secured to the vehicle structure and seat, and that they meet comfort requirements when in use.

ADR 5/04 specifies requirements for seatbelt anchorages, the design of these anchorages, lap belt and lap-sash belts, the location of anchorages and anchorages strength. It further provides requirements for adjustable anchorages, multiple anchorages and fitting anchorages to pillars. The ADR outlines sash guide requirements, the location of anchorage points and sash location points and techniques for testing anchorage points and seating positions.

Clause 5.1.2 specifies that seat belts anchorage's must be provided for all seating positions, except for light omnibuses (MD2) where anchorage's are only required for front seating and non-protected seats.

ADR 3/02 Seats and seat anchorage

This ADR specifies the requirements for seats, their attachment assemblies and installation to minimise the possibility of occupants being injured due to forces acting on the seat in the event of vehicle impact. This ADR applies to MD1 omnibuses manufactured on or after 1 July 1995 and to MD2 omnibuses manufactured on or after 1 January 2000, but not to MD3, MD4 or ME buses.

This ADR contains specifications regarding the appropriate loads which seats must be capable of carrying and accommodating in load testing situations. In relation to energy dissipation of seats, Clause 5.9 of this ADR specifies that the when tested, seats must not provide a "deceleration of the moving head greater than 80 times the acceleration due to gravity continuously for more than 3 ms". Furthermore, the ADR suggested that seat adjusters need not operate after the application of loads, but no release must occur during the application of loads.

4.1.2 Would any ADRs require amendment?

Installing three-point lap-sash seat belts and fitting higher backed seats

When considering the fitment of seat belts to school buses, the construction of the entire bus must be considered. Issues associated with fitting existing buses with seat belts need to be considered and compared to fitting seat belts in new buses. The type of seat belt to be installed, the design of the seat itself, other seating options, and the magnitude of the load for which the seat is designed must be considered. Additionally, the manner in which the seats are anchored, the bus floor structure, and the manner in which the bus body is connected to the chassis are also important.

A number of the ADR's detailed in this section pose limitations on the installation and use of seat belts (see ADR 68/00, ADR 4/03, ADR 66/00) and some standards may require review or amendment if one or more of the five countermeasures or actions is introduced. For example, under current regulations route buses are exempt from requiring seat belts (see ADR 68/00). Further, ADR 4/03 requires all omnibuses manufactured on or after 1 January 2000 to have seat belts fitted to all seating positions where seat belt anchorages are fitted. Despite this, the ADR does not appear to provide other requirements relating to the fitment of seat belts in buses. No reference to seating height or other occupant protection requirements (such as seat padding, etc) are provided in this ADR, nor has an amended version of ADR 68/… been drafted to accommodate these changes. This amendment means that there may be omnibuses in Australia manufactured after 1 January 2000 that have seatbacks less than 1.0 metre in height yet are fitted with seat belts. Therefore, there appears to be a deficiency in the requirements provided for installation of seat belts to these types of omnibuses. If seat belts were to be considered for installation in school buses amendments to one or more ADRs would be required.

Limiting school buses to carrying one child to each single seat

The ADRs provide design and construction standards for seats, with the intent that one seat is provided per person. Therefore limiting school buses to carry one child to each single seat should not effect the ADRs nor require any amendments. Further to this, representatives from Queensland Transport have indicated that there has been recent approval of the use of McConnell Educator 2/3 seats and seat belts under ADR 68/00. These seats offer three-for-two seating capacity with seat belts.

Prohibiting bus passengers from standing on a moving bus

While ADR 58 /00 allows buses to be designed and constructed for standing passengers, the practice of permitting passengers to travel as standees on moving buses is based on jurisdictions' individual traffic regulations and passenger transport acts.

Therefore, should a decision be made to restrict standees from travelling on moving buses, relevant traffic regulations would need to be amended to prohibit children travelling as standing passengers on moving school buses. This is discussed in further detail in Section 4.3.

Review of bus design standards such as rollover strength

ADR 59/00 provides the design and construction standards for the rollover strength of buses. However, while one jurisdiction representative suggested that this ADR may need to be amended since it only applies to buses with more than 16 passengers, another suggested that there is no need to review this ADR at this time.

Representatives from Queensland Transport indicated that all ADRs are currently being reviewed with a view to harmonisation with European regulations. However, ADRs that are applicable to buses are unlikely to change. Another jurisdiction suggested that while the current ADRs are sufficient to carry across to school buses, it may be preferable to draft a new ADR covering the design and construction of these vehicles if the standards are different to other buses.

4.2 Australian Standards

4.2.1 Relevant Australian Standards

The Australian Standards that may apply to the use and fitment of seat belts in school buses, and the move towards higher backed seats and improved rollover protection were investigated. Australian Standards AS 2596:1995 *Seat belt assemblies for motor vehicles* is the most relevant for the purposes of this investigation.

AS 2596:1995 Seat belt assemblies for motor vehicles

AS2596:1995 provides minimum performance requirements for seat belt assemblies in motor vehicles to ensure maximum level of occupant protection. The standard specifies the requirements for seat belt assemblies and part assemblies, intended for use with adults and larger children, or in conjunction with approved child restraints. Further to this, it specifies that the belt or restraint system applied must be designed so that, following correct installation and during appropriate use by a vehicle occupant, the risk of bodily injury in the event of a crash is minimal.

This Australian Standard contains specifications relating to:

- The seat belt buckle to ensure that it precludes incorrect use.
- The belt adjustment device so that it either adjusts automatically or so it has a readily accessible manual adjustable component that can be tightened with one hand to suit the occupants body position. The adjustment device needs to accommodate wearers in an appropriate position, so that in *(a) driver's position, the belt shall adjust from the 5th percentile female to the 95th percentile male, and (b) other seating positions from the 50th percentile six-year-old to the 95th percentile adult male* (6.2.3.1.100)
- Testing procedures for testing belt adjustment strength according to the standard and testing manually locking, automatically locking retractors and emergency locking retractors.
- Appropriate strap types and strength to ensure pressure is evenly distributed across wearer's body.

While the standard applies to seat belts in general, there is no specific mention regarding the application of this standard to seat belts on buses, or the application of seat belts in school buses.

4.2.2 Would any AS required amendment?

When questioned, most jurisdictions indicated that the only AS applicable to the five countermeasures or actions under investigation involved were those called upon by the ADRs. Therefore, should, for example, retrofitting of seat belts be required for a bus that is presently in service, compliance with Australian Standards for seat belt manufacture would be required.

For example, ADR 4/03 which, as previously mentioned, specifies that seat belts in motor vehicles and assemblies must be designed so that with adjustment, they are capable of being correctly fitted in accordance with AS2596:1995.

4.2.3 Current procedures for the retrofitment of seat belts in Australia

At present in Australia seat belts may be retrofitted to existing buses as per the *Guidelines for Voluntary Modifications* prepared for the former Federal Office of Road Safety (FORS, now the Australian Transport Safety Bureau). The *Guidelines* provide a good description of the implications of the installation of seat belts for other vehicle design features, and thus on the safety level provided by a bus (Bleakly, 1994).

The *Guidelines* highlight that seat design is a fundamental factor in determining if seat belts can be installed to improve occupant protection in buses. The use of lap-belts in buses with varying seat designs has been the subject of considerable debate for many years. Laps-belts used in conjunction with low back seats can increase the severity of injuries to the head and neck. Even in the event of minor frontal collisions, lap-belts used in conjunction with low back seats can cause an occupant to pivot at the waist, with their head striking down on the seat in front of them. In the event of a crash, the occupant would impact with the most rigid part of the seat, increasing the severity of injuries sustained to the head and neck. However, occupants travelling unrestrained in buses with low-back seats, will generally impact first with their knees, then their chest and head, reducing the severity of injuries sustained to the upper torso. In comparison, a frontal collision involving a buses with high-back seats will inevitably result in occupants impacting with the back of the seat–whether seat belts are fitted or not. In this case an appropriate seat belt can reduce an occupants impact with the seat in front (Bleakly, 1994).

Essentially, the *Guidelines for Voluntary Modification* **do not** suggest that lap-belts be installed in buses with high-back seats unless appropriate seats have been fitted (specifying a seat height of 1.0 metre) and seat belt anchorages and seat mounting have been strengthened. The *Guidelines* recommend that it is **not appropriate** to install lap-belts in buses with low-back seats. Rather, the *Guidelines* recommend that in buses with low seat backs, the seatbacks, handrails and partitions are fitted with high-density padding material, with a minimum thickness of 25 mm. In conclusion, the *Guidelines* advocate that seat dimensions, seat spacing, padding, anchorage, and even the direction the seat faces are criteria that **must** be considered if the installation of seat belts is to be deemed appropriate (Bleakly, 1994).

4.3 Australian Road Rules, Traffic Acts and Codes

4.3.1 Relevant Australian Road Rules

The Australian Road Rules (ARRs) introduced in December 1999 are part of a national scheme to provide uniform road laws throughout Australia. These ARRs define a *bus* as a motor vehicle built mainly to carry people, which seats over 12 adults (including the driver).

Rules referring to the wearing of seat belts by drivers and passengers, the responsibility of bus drivers for minors travelling on school buses and those individuals that are exempt for wearing belts are detailed in **Part 16** of the ARRs, titled **Rules for persons travelling in or on vehicles** and include the following rules:

264 Wearing of seat belts by drivers

This rule clearly specifies that the driver of a vehicle that is *moving, or is stationary but not parked*, must wear a seat belt, if the driver's seating position is fitted with a seat belt. The only exemption is if the vehicle is reversing or the driver is exempt under another Rule.

265 Wearing of seat belts by passengers 16 years old or older

This rule specifies that a passenger 16 years old or older must: occupy a seating position that is fitted with a seat belt; and, where fitted, wear a seat belt while travelling in a motor vehicle that is *moving, or is stationary but not parked*.

266 Wearing of seat belts by passengers under 16 years old

This rule species that the driver of a motor vehicle is responsible for ensuring that a passenger of a motor vehicle that is *moving, or is stationary but not parked*, who is under 16 years old, must occupy a seating position where a seat belt is fitted and subsequently wear the seat belt. However, this rule does not apply to buses carrying more than 12 people. Therefore, drivers are only responsible for ensuring passengers under 16 years of age wear seat belts when the carrying capacity of the vehicle is 12 people or less.

267 Exemptions from wearing seat belts

This rule identifies the possible exemptions from wearing a seat belt. Exemptions may relate to persons who are engaged in door to door delivery of goods and persons who for medical reasons cannot wear a seat belt. In addition, ARRs may be overridden by local jurisdiction legislation about seat belt use.

Summary of seat belt requirements

- Drivers of motor vehicles, including buses, must wear a seat belt, unless they are reversing (or are exempt under ARR 267).
- Individuals who are 16 years or older are required to occupy seating positions that are equipped with seat belts, if such seats are available, and wear the belt, properly fastened and adjusted, when travelling as a passenger in a motor vehicle that is moving or is stationary, but not parked.
- While those aged 16 years or older are responsible for their own seat belt wearing behaviour on all buses, the responsibility of bus drivers to ensure minors (aged under 16 years) wear restraints or seat belts depends on the size and seating capacity of the bus.

  For example, if the vehicle has 12 seats or less, the driver is responsible for ensuring that:

  – a suitable restraint is available for all children under one year of age; and
  – restraints or seat belts, where available, are worn by all passengers under 16 years of age when the vehicle is moving or stationary–though not parked. Failure to do so can result in a $500 fine.

  However, if the vehicle has more than 12 seats (and thus is classified as a bus by the ARRs), the bus driver is not obliged to ensure passengers, regardless of age, wear seat belts if fitted.

4.3.2 Other relevant Traffic Acts and Codes

Some jurisdictions identified that additional Traffic Codes or Acts may be relevant in the consideration of implementing one or more of the countermeasures under investigation. These Acts and Codes may or may not supersede the regulations outlined in the ARR. Therefore, the introduction of seat belts or changes to policies relating to three-for-two seating and standees may result in the need for amendments to such Acts and Codes.

Responsibility of seat belt use

Victorian authorities indicated that as of 1 December 1999 the *Road Safety (Traffic) Regulations 1988 (the Old Regulations*) have been superseded by the ARRs (1999). Therefore, the responsibility on drivers and passengers to ensure that seat belts are worn where fitted, in Victoria is in agreement with the ARRs.

The recently amended *Western Australian Road Traffic Code (2000)* includes the following regulations in relation to the use of seat belts in WA.

Drivers Duties

Regulation 232: *A person shall not, while occupying a seat position with a seat belt fitted in a motor vehicle, travel upon a road as a passenger unless the person is wearing the seat belt, and it is properly adjusted and securely fastened.*

Regulation 233: *The driver of a motor vehicle shall not drive upon a road unless every passenger who has reached one year of age but is under 16 years of age who is occupying a seat position with a seat belt fitted in the motor vehicle, is wearing the seat belt and it is properly adjusted and securely fastened.*

Regulation 234:

(1) The driver of a motor vehicle shall not cause or permit a passenger to occupy a position which is not fitted with a seat belt unless every seat position with seat fitted is occupied by another person.

(2) The driver of motor vehicle with 2 or more rows of seats shall not cause or permit a passenger to occupy a front seat position unless that passenger (a) occupies a position that is fitted with a seat belt or (b) is restrained in an approved child car restraint.

Regulation 235: *A person shall not drive a motor vehicle on a road unless every passenger under 12 months is wearing a child restraint and the restraint is properly adjusted and securely fastened.*

Passengers' Duties

Regulation 236:*A person shall not, while occupying a seat position with a seat belt fitted in a motor vehicle, travel, upon a road as a passenger unless the person is wearing a seat belt, and it is properly adjusted and securely fastened.*

Regulation 237:

(1) A person who is travelling upon a road as a passenger in a motor vehicle fitted with one or more seat belts shall not occupy a position which is not fitted with a seat belt unless every seat position with a seat belt fitted is occupied by another person.

(2) A person who is travelling upon a road as a passenger in a motor vehicle with 2 or more rows of seats shall occupy a front seat position unless the person (a) occupies a position that is fitted with a seat belt or (b) is restrained in an approved child car restraint.

All of the above regulations have specific circumstances under which the provisions will not apply. However, Regulation 284 provides a general exemption from seat belt provisions to a number of classes of drivers and vehicles (eg. emergency workers). The driver of a bus is currently exempt from Part 16 Divisions 1 – 4 (seat belt provisions for drivers and passengers).

In essence this ensures that the driver of a bus is exempt from:

- wearing a seat belt;
- ensuring that a child between one and 16 years of age wears a seatbelt;
- ensuring that passengers occupy positions with a seat belt if available;
- ensuring that passengers under 12 months of age wear an approved child car restraint.

Amendments to address drafting anomalies in the *Road Traffic Code 2000* are currently being prepared, including removal of the exemption for bus drivers from Regulation 232. The Western Australian response indicated that it may be appropriate for drivers of a bus to be exempt from ensuring seat belt compliance by the passengers, however, it is not the intent to exempt the driver themselves from wearing a seat belt (where fitted).

Three-for-two seating practices and standees

A number of jurisdictions made reference to the legislation relating to allowing three children to occupy two adult seats and the conditions associated with children travelling as standees on school buses.

Queensland Transport indicated that in addition to the ARR, two sections of the *Transport Operations (Passenger Transport) Standard 2000* are relevant to the transportation of children by school bus in Queensland.

Based on information supplied by Queensland Transport, these sections read as follows:

12 Operational safety of vehicles

(1) A driver of a relevant vehicle must operate it safely.

(2) Without limiting subsection (1) the driver must ensure—

(a) the vehicle is not overloaded; and

(b) if the vehicle is used for long distance scheduled passenger services or tourist services, it does not carry standing passengers; and

(c) if the vehicle is a bus that carries standing passengers—

(i) the bus is specifically designed and constructed for the purpose; and

(ii) no passenger stands for more than 20 km; and

(iii) when carrying standing passengers, the bus does not travel on a road notified by the chief executive, by gazette notice, as a road on which the bus must not carry standing passengers.

(2) In subsection (1)—"overloaded", for a vehicle, includes carrying more than the maximum number of passengers—

(a) for which the vehicle is designed; or

(b) specified or recommended by the vehicle's manufacturer.

13 Seating

(1) A driver of a relevant vehicle must take reasonable steps to ensure that no more than 1 passenger sits in any adult seat in the vehicle.

(2) However if the vehicle is a bus, 3 primary school or pre-school children may sit in a bench type bus seat designed for 2 adults if—

(a) the seat is not required to be fitted with seat belts; and

(b) the placement and construction of the seat allows; and

(c) no child sits in the seat for more than a total of 90 minutes while any 2 other children sit in the seat.

NSW authorities indicated that buses in NSW used to carry out public passenger services, including school services, must comply with the *Passenger Transport Act 1990 and Passenger Transport (Bus Services) Regulation 2000*. Clause 15 of Part 2, Division 2 of this Act is relevant to the carriage of children on buses. Based on information provided by NSW DoT, this clause reads:

15 Overloading

(1) the driver of a bus must not:

(a) carry at any one time in a single–decked bus (or on either deck of two-decked bus) a greater number of passenger seated than the number authorized to be carried seated in the single-decked bus (or on that deck of two-decked bus), or

(b) carry at any one time in a single-decked bus (or on the lower deck of a two-decked bus) a greater number of passengers standing than the number authorised to be carried standing.

(2) In calculating the number of passengers being carried, the following persons are not to be taken into account:

(a) any child apparently under the age of 5 years who is being held on the lap of a seated passenger,

(b) of the children apparently under the age of 12 years (whether seated or standing), every third such child.

(3) For the purposes of subclause (2)(b), the following children are to be ignored:

(a) children who are seated on single seats,

(b) Children who are seated on multiple seats that are designed (either by means of fixed armrests or seating places countered for individual passengers) so as to be impracticable for use by more than the number of passengers for whom they are designed.

Tasmania authorities indicated that while the ARRs have been adopted in the jurisdiction, the *Tasmanian Passenger Transport Regulations 2000* also makes reference to the seating of children in school buses. Representatives indicated that Schedule 1 of the regulation specifies operational capacity, seating capacity and standing capacity for vehicles used in the transportation of children on buses. Vehicles are inspected prior to entering service and each of the above capacities are determined and recorded as part of the vehicle's accreditation status. In addition, Tasmania referred to the Vehicle & Traffic (Vehicle Standards) Regulations 2001, stating that Regulations 155 to 166 covering bus construction and fittings and Regulations 104 to 107 covering flashing lights and warning signs were also relevant. However, these regulations cover pre ADR vehicles and in all cases, ADRs take precedence.

Northern Territory representatives indicated that there are two specific pieces of legislation which deal with buses in the NT. These are the Motor Vehicles Act (including the Motor Omnibus Regulations) and the Commercial Passenger (Road) Transport Act (including Commercial Passenger Regulations). However, NT representatives indicated that various issues, such as three-for-two seating for primary school children, or student standees, are practices which have been developed and agreed to by contractors and the NT Department, and are not detailed in legislation nor regulations.

4.3.3 Would ARRs, Traffic Acts or Codes require amendment?

Based on the information provided:

- If seat belts were installed in school buses, legislative or regulatory changes would be required to clarify the responsibilities of both the drivers and the passengers for correctly wearing seat belts where fitted, including determining the age of passengers for whom bus drivers are expected to be responsible for ensuring seat belts are worn.
- If the policy allowing three-for-two seating was abolished, various state and territory passenger transport regulations that currently permit three children to occupy two adult seats would need to be amended accordingly.
- Similarly, if the policy allowing students to travel as standees on school buses was abolished, various state and territory passenger transport regulations would also need to be amended accordingly.
- In comparison, it appears that any decision to mandate the installation of high-backed seats and/or improve rollover protection regimes in buses would not result in any changes or amendments to road law or passenger transport regulations. Nor would the introduction of these initiatives result in any changes to current three-for-two seating practices or passenger standee policies.

5. CAPACITY AND COST IMPLICATIONS

One of the objectives of this investigation was to determine the capacity and cost implications that may be expected if one or more of the five countermeasures under investigation were introduced. In order to meet this objective the following information was sought:

- The composition of bus fleets, particularly school bus fleets, in each jurisdiction.
- The estimated carrying capacity, current usage/travel patterns and associated passenger demand levels.
- The current subsidy or funding assistance provided for various bus services.

Further, a sample of manufacturers and outfitting agencies were contacted in an effort to obtain information pertaining to the costs associated with installing seat belts, improving compartmentalisation via high-backed seats and improving rollover protection of existing buses and the costs associated with replacing the bus fleet to meet current ADR requirements.

5.1 Background to cost procedure

This section provides details of the estimation process used to cost the following three options to enhance internal bus safety:

Option 1: The cost to retrofit the existing fleet of buses used to transport children to and from school with high-backed seats and seat belts (and to replace those vehicles that cannot be retrofitted with new ADR compliant vehicles).

Option 2: The cost to replace vehicles in the existing fleet that do not meet current rollover protection standards, and to retrofit seat belts to buses that do meet these standards. This ensures that buses offer both rollover protection and seat belts.

Option 3: The cost to replace the entire fleet of buses used to transport children to and from school with ADR compliant vehicles offering rollover protection, high-backed seats and seat belts.

In addition, the complexities involved in calculating the financial and capacity implications associated with a decision to end policies providing for three-for-two seating and standees in jurisdictions, where this is taken up, were explored.

5.1.1 Assumptions and cautionary words

A number of assumptions have been made in order to determine preliminary cost implications associated with the countermeasures under investigation. These include assumptions about fleets operating in individual jurisdictions, costs provided by bus manufacturers and outfitting agencies, and assumptions about buses meeting (or failing to meet) relevant ADRs. These assumptions are detailed throughout the following sections and need to be taken into account when considering the potential financial implications associated with introducing one or more of the countermeasures under investigation.

5.1.2 Costs for installing seats with seat belts

Costs associated with retrofitting seat belts to buses were sought from several bus manufacturers. However, the cost estimates provided by *Coachworks Pty Ltd* were deemed satisfactory and are consistent with the costs reported in the recent Queensland School Transport Safety Taskforce Report (2001). The prices obtained were based upon the cost per seat to install a seat with a seat belt in an existing bus, and the additional costs associated with providing seat anchorage requirements.

The cost associated with installing seat belts to buses that have suitable existing anchorage is estimated to be **$402 per passenger (including GST)**. This includes the cost of supplying and installing a suitable seat and the seat belt. For example, the cost of supplying and fitting seats and seat belts to a 48-seater bus with suitable anchorage requirements already in place would be approximately $19,376 (including GST). This cost is based on the assumption that the bus frame and under-bearings are suitable for retrofitting seat belts.

The additional cost to provide and fit appropriate anchorage where required is estimated at $100 per passenger. Therefore, the cost to supply and install a suitable seat with a lap-sash seat belt and provide suitable anchorage is **$502 per passenger (including GST)**. Based on this estimate, the cost to supply and fit seats with seat belts and anchorage to a 48-seater bus would be approximately $24,090. This cost is based on the assumption that the bus frame and under-bearings are suitable for retrofitting seat belts.

#Note: For the purposes of this study, the additional costs associated with modifying the walls and strengthening the floor of existing buses which may be required before fitting seats have not be estimated. This would require further information about the age and make of individual buses in the relevant fleets. However, as a rough guide, consultation with bus manufacturers indicates that required wall and floor modifications could cost approximately $4,000 per bus.

5.1.3 Costs for purchasing new buses

The cost of purchasing two different sized buses offering rollover protection and lap-sash seat belts were provided by representatives from Queensland Transport: one with a seating capacity of less than 25 seats, and one with a seating capacity of 25 to 70 seats. While the cost of purchasing a new bus will vary according to the particular make and model of the bus, the seating capacity and the safety features offered, for the purposes of this report, the following estimates have been applied:

- Small bus with seating capacity of less than 25 seats–**$100,000** (incl. GST).
- Large bus with seating capacity of 25 to 70 seats–**$260,000** (incl. GST).

5.1.4 Number of buses used in cost calculations

As previously reported, the variations in fleet composition and operating practices across jurisdictions result in considerable difficulties in comparing costs and capacity implications. Further to this, some jurisdictions could only provide detailed information for a proportion of the total number of buses that may be involved in the transport of children to and from school. However, some states are aware that additional buses may be affected by the introduction of one or more of the countermeasures and therefore, where provided, these additional buses have been included in the total number of buses for the purposes of cost calculations presented in following sections. Therefore, cost calculations do represent worst case scenarios (based on the information provided).

For example, Victoria provided detailed information for 1,604 government contracted buses, however it is anticipated that the introduction of one or more of the countermeasures would impact on a further 2,000 route service buses also used to transport children. Therefore, the cost calculations presented in the following sections have been based on a total of 3,604 buses for Victoria.

Similarly South Australia provided detailed information for 598 DECS owned and contract-operated school buses. Also, there are at least 200 additional buses operated by Catholic schools, independent schools, local councils and private operators for the purposes of school bus travel. Therefore, the cost calculations presented in the following sections have been based on a total of 798 buses for South Australia. *Note: this does not include a number of fare paying buses that carry school children in metropolitan Adelaide nor the number of buses providing disabled passenger services.*

Further, the ACT provided detailed information for 359 buses operated by two bus companies in the ACT. However, they advised that there are two other bus companies providing school services to children, which combined operate an additional 103 buses for the purposes of school bus travel. Therefore, the cost calculations presented in the following sections have been based on a total of 462 buses for the ACT.

Therefore, to assist the reader's understanding of the financial implications presented later in this section, Table 2 presents the estimated number of buses that have been included in each cost calculation. This may assist readers to understand the difference between the number of buses for which detailed information was provided compared to the additional number of buses which may be affected by introducing one of more of the countermeasures and for which limited information was provided.

Table 2: Estimated number of buses for application in cost calculations

State	Estimated number of buses affected
QLD	2,964
VIC	3,604
NSW	9,646
SA	798
WA	787
TAS	850
ACT	462
NT	138
Total	**19,249**

Note: the estimated number of buses effected does not include buses which are used for the purpose of transporting children with a disability. This is due to differences in vehicle design, costs and implications believed to be associated with buses used to transport children with a disability.

5.2 Option 1: Fitting the existing fleet with seats with seat belts

One option to implement both seat belts and higher backed seats is to retrofit the existing fleet of buses with high-backed seats with seat belts, and to replace those vehicles that cannot be retrofitted with new ADR compliant vehicles. This would mean the latter vehicles would also meet rollover protection standards.

Due to a lack of detailed information on the age, make and model of each individual bus, and the fact that ADR 68/00 which relates to seat anchorage requirements does not apply to all categories of buses (only MD3, MD4 and ME), it is not possible to accurately determine how many buses have appropriate anchorage points to allow retrofitting to occur. Inspections of each bus would be required to ascertain whether anchorage is already installed, and if so, if the anchorage is suitable. Therefore, for the purpose of this report, the costs provided are based on all seats in buses that can be retrofitted to include the installation of anchorage points (at $502 per passenger). If the availability of suitable anchorage could be determined, it is anticipated that the cost of retrofitting seats and seat belts would reduce by up to $100 per seat.

As mentioned previously, the *Voluntary Modifications of Existing Buses and Coaches: Guidelines to Improve Occupant Protection* recommend that Toyota model buses do not have the required body strength or floor strength to successfully install anchorage points, high backed seats, and seat-belts. Therefore, for the purposes of this report, where bus make information was provided and Toyota buses identified, this make of bus has been removed from the retrofitting calculation, and costs associated with replacing all Toyota buses have been provided.

#Note: This investigation has only excluded Toyota buses which do not meet required standards for the fitment of seat belts. If this limitation is found to exist with other models of buses then the proportion of vehicles suitable for retrofitting may alter.

Table 3 presents the capital cost associated to retrofit seats with seat belts to the existing bus fleet, where retrofitting is suitable, and the additional cost of replacing buses where retrofitting is not appropriate to ensure all buses offer appropriate seats with seat belts. By default, the proportion of buses that would need to be replaced, based on this cost option, would also provide occupants with improved rollover protection. This option would result in retrofitting costs totaling more than $440 million with a further $250 million to replace those buses that are not suitable for retrofitting.

Table 3: Estimated cost of retrofitting seat belts into the existing bus fleet

State	Number of buses	% of fleet that can be retrofitted	Estimated cost to retrofit ($ M)	% that cannot be retrofitted	Estimated cost to replace ($ M)	Total ($ M)
QLD	2,964	84.6%	$51.5	15.4%	$59.6	$111.1
VIC	3,604	90.8%	$77.7	9.2%	$33.0	$110.7
NSW	9,646	100.0%	$275.5	0.0%	$0.00	$275.5
SA	798	73.2%	$10.6	26.8%	$21.3	$31.9
WA	787	57.2%	$10.1	42.8%	$34.6	$44.7
TAS	850	40.0%	$5.6	60.0%	$91.8	$97.7
ACT	462	90.0%	$9.5	10.0 %	$12.1	$21.6
NT	138	86.8 %	$2.8	13.2 %	$1.7	$4.5
Total	**19,249**		**$444.3**		**$254.1**	**$697.4**

DISCLAIMER: The above estimates relate to the costs associated with retro-fitting seats and seat belts, and does not include wall and floor modification costs.

5.2.1 Queensland

The cost to retrofit seat belts to Queensland buses is estimated at approximately $52 million. This is based on 2,964 dedicated buses.

Queensland's bus fleet has 456 Toyota buses that cannot be retrofitted with lap-sash seat-belts. Eighty-eight of these buses are large capacity buses, with over 25 seats per bus. A further 368 buses have 25 seats or under. Therefore, to replace these buses with new seat-belt and rollover compliant buses would cost approximately $60 million.

5.2.2 Victoria

The cost to fit seat belts to Victorian buses is estimated at approximately $78 million. The cost associated with retrofitting the 1,604 DoI buses is approximately $35 million. There is an additional 2,000 route service buses that also carries school students operating in the metro and urban areas. The cost associated with these buses was calculated by multiplying the total of the DoI fleet by 125 per cent (the proportion of route service buses), which provides the total estimate for retrofitting the Victoria fleet at $78 million.

One hundred and forty seven buses in the Victorian DoI bus fleet are Toyota buses and therefore cannot be retrofitted with seat-belts. The cost associated with replacing the 147 buses has been estimated at approximately $14.7 million. Victoria stated that all of the 147 Toyota buses operating in Victoria are small, or under 25 seats. To account for the 2000 route service buses, this figure could be multiplied by 125 per cent to provide a more accurate estimation for replacing Toyota buses, this would increase the estimate to approximately $33 million.

5.2.3 New South Wales

The cost to fit seat belts to New South Wales buses is estimated at approximately $276 million. Due to the size of the NSW bus fleet, the cost associated with installing seat belts is based on the average bus in the fleet having 57 seats.

New South Wales supplied a list of the various makes and models of buses in the State Transit Authority (STA–government) bus fleet and the privately operated bus fleet. There were no Toyota buses provided in the list, therefore, it has been assumed that New South Wales would not need to replace any buses in the fleet; but, this would need to be investigated further.

5.2.4 South Australia

The cost to fit seat belts to South Australian buses is estimated at approximately $11 million. The estimated cost to retrofit the DECS owned and contract-operated school bus fleet is $8 million and it is estimated that 134 of the additional 200 buses, which carry school children to and from school can be retrofitted with seat-belts.

Of the South Australian DECS owned and contact-operated school bus fleets there are 160 Toyota models, that consequently cannot be retrofitted with seat-belts. This equates to a cost of approximately $16 million to replace all the Toyota buses, but this estimate could be larger when considering the additional 200 plus buses in South Australia. Therefore, the estimate has been increased to account for these 54 Toyota models, bringing the total to approximately $21 million.

5.2.5 Western Australia

The cost to fit seat belts to Western Australian buses is estimated at approximately $10 million. This is based on a total of 787 dedicated school buses operating in the Western Australia fleet.

Further to this, that there are a total of 346 Toyota buses in the Western Australia dedicated school bus fleet. Consequently, it is estimated that the cost to replace these buses would be approximately $35 million.

5.2.6 Tasmania

Due to the average age of the bus fleet in Tasmania, it has been suggested that around 60% of buses in the fleet would be too old for the successful retrofitting of seat belts. Representatives further indicated that up to 40% of the fleet may be able to be retrofitted with seat belts. This represents vehicles in the Metro and route service fleets, not the dedicated school bus fleet. Based on the information provided, and assuming that these buses are suitable for retrofitting (an assumption made in the absence of detailed information), the cost to retrofit 40% of the Metro and route service fleet would be approximately $6 million.

Further, the cost to replace dedicated school buses to provide these vehicles with appropriate seats and seat belts would be approximately $71 million. This cost has been calculated assuming that 50% of the buses have 25 or less seats and 50% have more than 25 seats (thus applying an average across both sizes).

5.2.7 Australian Capital Territory

The cost to fit seat belts to the number of buses in the ACT used to carry children to and from school is estimated at approximately $10 million. The cost associated with retrofitting the buses for which detailed information was provided (a total of 359) is approximately $7 million. The total costs were then multiplied by 28.7 per cent to account for the other 2 bus companies operating in the ACT (which operate a further 103 buses collectively), to give the total estimated cost for retrofitting seat belts to school buses in the ACT at $10 million. The only information known in relation to the other two bus companies was the number of buses in the fleet; 57 buses and 47 buses.

Representatives from the ACT estimated that Toyota model buses make up approximately 10 per cent of the fleet. Consequently, it is estimated that the cost to replace these buses would be approximately $12 million.

5.2.8 Northern Territory

The cost to fit seat belts to Northern Territory buses is estimated at approximately $3 million. This is based on 138 dedicated school buses and route service buses in the Northern Territory fleet. Further, it has been estimated that there are 17 Toyota buses in the Northern Territory bus fleet. Consequently, it is estimated that the cost to replace these buses would be approximately $1.7 million.

5.3 Option 2: Replacing for rollover protection and retrofitting seats with seat belts

An alternative approach to retrofitting seat belts to existing buses and replacing those that are not suitable for retrofitting is to consider replacing vehicles that do not meet current rollover protection standards. The next step would be to retrofit seat belts to existing vehicles that do meet current standards (and that are suitable for retrofitting).

Based on investigations into the rollover strength of buses and discussions with a reputable bus manufacturing company, it has been suggested that buses built prior to the implementation of the relevant ADR on rollover strength (ADR 59/00), would not be suitable for upgrading to meet a desired rollover standard. This is due to changes in both the construction and the material strength in the manufacturing of buses since 1992.

1. Buses built prior to 1992 were constructed with longitudinal rails with vertical joiners, whereas after the implementation of ADR 59/00, buses where constructed with a full hoop style design. It is recognised that the hoop design is a superior construction method for buses in meeting rollover specifications.
2. The second difference is the material strength. Prior to 1992 non-rollover frame buses were built with an average 1.6 mm thick, 350 grade steel. However, buses built since 1992 now have 2.8 mm thick, 450 grade steel.

Based on these changes, it is assumed that, regardless of the modifications that may be able to be made to buses built prior to 1992, such modifications would not offer structural integrity comparable to that provided by current rollover design standards. Therefore, without detailed information pertaining to the specific design, structure and engineering criteria of buses operating in Australian fleets, a very rough estimate of the cost implications to meet both rollover protection standards and fit seat belts is provided below. Once again, these costs reflect the capital costs required to meet both rollover standards and seatbelt requirements simultaneously.

There are two separate aspects related to achieving both rollover protection standards and seatbelt fitment in all school buses federally. The first aspect is that regardless of whether seat belts can be fitted to buses built prior to 1992, these buses would not meet rollover standards. Therefore, buses built prior to 1992 would need to be replaced with new buses. The second aspect is that the remaining buses (of which the majority would already meet rollover standards) would need to be retrofitted with seat belts.

A cost estimate for each jurisdiction to meet both rollover standards and seatbelt fitment follows. For all states the cost to replace the buses that do not meet rollover protection is based on the proportion of buses operating with:

- less than 25 seating capacity in each jurisdiction was multiplied by $100,000;
- 25 or more seating capacity in each jurisdiction was multiplied by $260,000.

The individual proportions used for each jurisdiction are as follows:

- Queensland: 76% large buses and 24% small buses.
- Victoria: 89% large buses and 11% small buses.
- New South Wales: 100% large buses (as average seating capacity reported at 57 seats).
- South Australia: 65% large buses and 35% small buses.
- Western Australia: 47% large buses and 54% small buses.
- Tasmania: 50% large buses and 50% small buses (as no information on size of fleet provided, an average across the two bus sizes has been applied).
- Australian Capital Territory: 90% large buses and 10% small buses.
- Northern Territory: 96% large buses and 3% small buses.

Table 4 presents the capital costs required to replace existing pre-1992 vehicles to meet rollover standards and to retrofit seatbelts to those that already meet current rollover standards (where appropriate). This option would result in bus replacement costs totaling more than $2,160 million with a further $250 million to retrofit seats with belts to those buses that already meet current rollover standards.

Table 4: Estimated costs associated with replacing buses that do not meet rollover standards and retrofitting seat belts to remaining buses

State	Number of buses	% of fleet that do not meet rollover standards	Estimated cost to replace ($ M)	% that could be retrofitted	Estimated cost to retrofit ($ M)	Total ($ M)
QLD	2,964	66%	$432.8	34%	$20.8	$453.6
VIC	3,604	57%	$221.8	43%	$36.8	$258.6
NSW	9,646	50%	$1,253.9	50%	$137.7	$1,391.6
SA	797	67%	$40.6	33%	$4.8	$45.4
WA	787	60%	$52.3	40%	$34.9	$87.2
TAS	850	60%	$91.8	40%	$5.6	$97.4
ACT	462	50%	$56.5	50%	$5.3	$61.8
NT	138	38%	$13.4	62%	$1.7	$15.1
Total	**19,249**		**$2,163.1**		**$247.6**	**$2,410.7**

DISCLAIMER: The cost to retrofit buses with seat belts, this calculation has not taken into consideration the inability to retrofit Toyota buses. Further information relating to the year of manufacture would be required. These additional costs would need to be factored in separately.

5.3.1 Queensland

Based on the age of each individual bus as listed in the data spreadsheet supplied by QT, it is estimated that almost 2,000 buses in the Queensland fleet would need replacing as they would not meet rollover strength.

Therefore, the cost to replace the 2,000 buses that were manufactured prior to 1992 (and therefore would not meet rollover standards) would cost approximately $433 million. Additionally, the cost to retrofit the remaining 1,000 buses would be approximately $21 million. This results in the cost estimate for Queensland being approximately $460 million to meet both rollover standards and seat belt requirements

5.3.2 Victoria

Victoria supplied information relating to the number of buses manufactured in each year, based on this information it is assumed that approximately 57 per cent of buses will need to be replaced as they were built prior to 1992. The estimated cost to replaces these vehicles with rollover and seat belts standards buses is approximately $222 million. Additionally, the estimated cost to retrofit the remaining buses would be approximately $37 million. This results in the cost estimate for Victoria being in the region of $ 259 million.

5.3.3 New South Wales

The information provided by representatives from New South Wales consisted of the average year the bus fleet was manufactured, as well as the average seating capacity. Individual vehicle information is unknown at this stage, therefore the cost estimate for New South Wales is based on the assumption that at least 50 per cent of buses were built prior to 1992 (based on NSW suggesting that the average age of the fleet is 11.4 years).

It is estimated that to replace the buses that were built prior to 1992 would cost approximately $1,254 million dollars. The estimated costs associated with retrofitting the buses that already meet rollover standards would be approximately $138 million. This results in the cost estimate to meet both rollover and seatbelt specifications in the region of $1,392 million.

5.3.4 South Australia

Based on the age of each individual bus as listed in the data spreadsheet supplied by South Australia, it is estimated that approximately 67 per cent of buses in the south Australian fleet would need replacing as they would not meet rollover strength. This cost estimate to replace these buses is approximately $40.6 million. The estimated cost to retrofit the remaining 33 per cent of buses that already meet rollover protection will be approximately $5 million.

This results in the cost estimate for South Australia to meet both rollover and seatbelt specifications to be approximately $45 million.

5.3.5 Western Australia

Individual vehicle information is unknown at this stage, therefore the cost estimate for Western Australia is based on the assumption that at least 60 per cent of buses were built prior to 1992 (based on WA suggesting that the proportion of buses built prior to 1996 was approximately 78 per cent).

To replace 60 per cent of the Western Australia bus fleet with rollover and seatbelt compliant buses would cost approximately $83 million. To retrofit the existing 40 per cent of buses that are believed to already meet rollover standards would cost approximately $4 million. This results in the estimated cost for Western Australia to have a bus fleet that meets both rollover and seat belt specifications to be in the vicinity of $87 million.

5.3.6 Tasmania

Representatives from Tasmania suggested that 40 per cent of their existing fleet would already meet rollover protection standards and the remaining 60 per cent would require replacing. To replace the proportion of buses in Tasmania that do not meet rollover standards would be approximately $92 million. The estimated cost to retrofit the fleet that already meets rollover specifications would be approximately $6 million. This results in the cost estimate for Tasmania to meet both rollover and seatbelt specifications in the region of $97 million.

5.3.7 Australian Capital Territory

The information provided by representatives from the ACT consisted of the average year the bus fleet was manufactured. Individual vehicle information is unknown at this stage, therefore the cost estimate for the ACT is based on the assumption that at least 50 per cent of buses were built prior to 1992 (based on the ACT suggesting that the average age of the fleet is 11 years).

To replace 50 per cent of the ACT bus fleet with rollover and seatbelt compliant buses would cost approximately $57 million. To retrofit the existing 50 per cent of buses that are believed to already meet rollover standards would cost approximately $5 million. This results in the estimated cost for the ACT to have a bus fleet that meets both rollover and seat belt specifications to be in the vicinity of $62 million.

5.3.8 Northern Territory

Based on the age of each individual bus as listed in the data spreadsheet supplied the Northern Territory, it is estimated that approximately 53 buses in the Northern Territory would need to be replaced as they would not meet rollover strength. A cost estimate to replace these buses is approximately $13 million. The estimated cost to retrofit the remaining 85 buses that already meet rollover protection will be approximately $2 million. This results in the cost estimate for the Northern Territory bus fleet to meet both rollover and seatbelt specifications to be approximately $15 million.

5.4 Option 3: Replacing the existing bus fleet with new buses (rollover and seat belts)

Table 5 provides an indication of the capital costs associated with replacing all the existing buses with new buses that offer higher backed seats, greater occupant protection via compartmentalisation, improved rollover protection and seat belts. These estimates show that the capital costs, if the entire fleet were replaced tomorrow, could total more than $4,635 million.

Table 5: Estimated costs for purchasing new buses

State	Number of buses	Estimated cost ($ M)
QLD	2,964	$654.5
VIC	3,604	$876.5
NSW	9,646	$2,507.9
SA	797	$162.9
WA	787	$137.1
TAS	850	$153.0
ACT	462	$112.7
NT	138	$30.6
Total	**19,249**	**$4,635.2**

#Note: The costing procedure and seating capacity proportions for individual states and territories applied in this calculation are consistent with those used in Section 5.3.

While these costs provide the worst case scenario, in terms of replacing the fleet with new vehicles, they do not account for changes in carrying capacity that would occur as a by product of introducing seat belts. These additional costs have been considered in the following section.

5.5 Cost implications associated with reduced carrying capacity

If legislation decreed that all school buses required the installation of seat-belts, there would be the further implication of reduced carrying capacity due to the loss of standing passengers and the loss of seating three children to two seats, depending on particular legislation in each state.

An estimate of the potential costs associated with reduced carrying capacity is depicted in Table 6. These are based on varying criteria, dependant upon the relevant information supplied by each jurisdiction. In the main these relate to the additional number of buses required to carry the same passenger load. Based on the jurisdictions for which information is provided, costs associated with reduced carrying capacity are estimated to total around $1,785 million. Below this table is a summary of how each cost was derived.

Table 6: Estimated costs for reduced carrying capacity

State	Estimated cost ($ M)
QLD	$177.8
VIC	$244.9
NSW	$915.0
SA	$3.5
WA	$116.5
TAS	-
ACT	$21.2
NT	-
Total	**$1,785.9**

DISCLAIMER: The costs associated with student displacement and route issues have not been taken into account.

Queensland

It is extremely difficult to estimate the cost implications of reduced carrying capacity in Queensland. It is known that approximately 121,000 seats are available on Queensland buses, and the bus fleet carries an estimated 150,000 to 160,000 school students daily. Taking this into consideration, there are approximately 29,000 to 39,000 students that could potentially no longer have space on a bus to transport them. Furthermore, this does not take into consideration the number of non-student passengers carried by the non-dedicated bus fleet in Queensland that will no longer be carried, seated or standing.

Potentially, if transport is required for at least 39,000 students, 684 additional buses (based on an average of 57 seats per bus) would be required to meet the carrying capacity requirements in Queensland. This could cost up to $178 million (684*$260,000). However, this does not take into consideration how many bus routes would be affected and whether having 684 additional buses would cover all of these routes.

Victoria

Victorian authorities suggested that they would need to upgrade at least 65 buses to larger carrying capacity buses, and they would require an additional 1,000 buses to compensate for the reduce carrying capacity. This estimate accounts for additional buses needed to service both the contracted school bus fleet and the route service fleet. Representatives from Victoria further suggested that approximately 80 per cent of these 1,000 buses would need to be large carrying capacity buses and the remaining 20 per cent smaller buses. An approximate cost estimate for Victoria based on the above information is $17 million for the upgrade of 65 buses to larger buses, and $228 million for the additional 1,000 buses required in Victoria. This is a total cost of approximately $245 million to compensate for reduced carrying capacity.

New South Wales

New South Wales authorities suggested that there would be a 25 to 48 per cent reduction in carrying capacity with the loss of standing and the loss of three-for-two seating. It was estimated from this figure that NSW would require between 2,411 to 4,630 new buses to cover the reduction in carrying capacity in NSW. This is estimated at between $626 million (2,411*$260,000) and $1,204 million (4,630*$260,000) for new buses. This potentially equates to an average of $915 million (3,520*$260,000) for new buses in NSW.

South Australia

South Australian authorities in DECS estimated how many displaced passengers there would be as a consequence of reduced carrying capacity. DECS estimated at July 2002 there would be 679 displaced passengers, and 216 school bus routes would be effected. An additional 26 small buses would be required to compensate for reduced carrying capacity. This has been estimated to cost approximately $2.6 million (26*$100,000) for new buses, which could be multiplied by 33.5 per cent to account for the additional 200 plus buses that have not been considered in this calculation. This would bring the total for new buses to approximately $3.5 million.

DECS have further suggested that additionally, cost estimates could increase to include up to $1 million to provide larger buses, additional travel allowances and running costs in their school transport system for the other effected routes. It is noted that similar costs may be evident in other jurisdictions.

Western Australia

It has been estimated that Western Australia would require an additional 223 large capacity buses and 586 smaller capacity buses to compensate for reduced carrying capacity. This results in a total cost of approximately $117 million dollars (223*$260,000 + 586*$100,000).

Tasmania

Tasmania allows passengers to stand on buses and also three children to sit in two seats. However, the proportion to which the fleet is fully utilised, the number of children carried and the number of seats available is unknown. Therefore, the cost implications for the expected reduced carrying capacity are unknown for Tasmania.

Australian Capital Territory

The cost associated with reduced carrying capacity for the ACT is difficult to calculate with the supplied information. To gain a very rough estimate, it is possible to multiply the number of buses in the fleet by the estimated proportion of travel which the fleet is fully utilised, 17.7 per cent. This would indicate an estimated 81 additional buses required due to reduced carrying capacity. Therefore costs for new buses to meet carrying capacity demands could be as high as $21 million (81*$260,000). Three-for-two seating is not permitted in the ACT, therefore the estimate would relate only to the elimination of standing passengers and is based upon the information provided.

Northern Territory

Based on the information supplied, the cost implications associated with reduced carrying capacity are difficult to calculate for the Northern Territory.

5.6 Current subsidy arrangements

In order to identify how changes in carrying capacity will impact subsidy or funding arrangements should one or more of the countermeasures be implemented, each state was asked to provide information pertaining to the current funding provided for various school bus services.

Queensland

Under School Transport Assistance Scheme (STAS) Queensland Transport funds the operation of bus services travelling to and from school for eligible students in Queensland. In 2002/03 the current STAS subsidy was in the vicinity of $120 million, providing funding for approximately 140,000 children. The Department also funds concessional top-ups through general operator funding. In addition, the Queensland Catholic Education Commission (QCEC), on behalf of itself and the Association of Independent Schools (Queensland) Inc (AISQ) provides some additional financial assistance to non-government school students who have high bus fare travel costs.

Overall, Queensland Transport estimates that two-thirds of the children accessing school buses received full or part assistance. Therefore, if there was an increase in the number of buses required to carry the same passenger load, it is estimated that the scale of subsidy and school transport funding arrangements would need to increase in order to offset additional fleet costs, to carry the same number of children. The additional costs could be met by government funding, user funding, a combination of government and user funding and/or increased non-state funding schemes.

Victoria

The DoI in Victoria indicated that it provides full funding for the free school bus system, estimating the cost of the program in 2001/02 at $122 million.

A total of 73,000 eligible children travel on the free bus system at no charge. Students who use public transport, including route buses, and who meet the DE&T eligibility criteria for transport assistance have their fares reimbursed under the Conveyance Allowance scheme administered by DE&T.

Victorian authorities indicated that the impact on the cost of the system will be significant if additional buses are required. They noted that any increased costs would need to be met by Government, as there are no plans to introduce a school bus user contribution for eligible travellers using the free school bus system.

New South Wales

The NSW Department of Transport, under the School Student Transport Scheme (SSTS), provides subsidised travel for eligible school students, who are residents of NSW, between their normal place of residence and the school attended. In 2001/02, the cost of the Scheme was estimated at $406.1M (as per Budget Papers).

In 2001/02, 674,800 (as per Budget Papers) eligible students were provided with subsidised school travel under the SSTS. The NSW DoT estimated that during 2001/02 the student population in NSW was around 1,109,700. Based on this estimate, 61% of the NSW student population were provided with subsidised travel under SSTS.

New South Wales indicated that the introduction of seat belts in school buses may reduce the carrying capacity anywhere between 25% to 48%, as standing passengers would no longer be able to be conveyed on any journey and school children under the age of 12 years, would no longer be able to sit three to a seat designed for two adults. Therefore, it is estimated that a corresponding increase in subsidy arrangements may also occur of between 25% to 48% to compensate for the reduction in carrying capacity plus increased administrative costs. However, while this decision would be subject to Government policy, the costs involved for such an initiative would be of a significant nature and may impact upon on all users.

South Australia

DECS in South Australia provides fully funded (no fares) transport assistance in the form of dedicated school bus services and/or conveyance allowances for students who are disadvantaged by distance (reside five km or greater from the nearest appropriate government school) as well as for students with disabilities. DECS provides school transport assistance for eligible students throughout the State, and most of this assistance applies to students who reside and attend schools in the country or outer areas of metropolitan Adelaide. DECS special transport assistance mainly applies to students with disabilities who attend special schools, classes or centres in metropolitan Adelaide.

Western Australia

The objective of the student transport assistance program is to provide students with reasonable access to their nearest appropriate school. For students living in non-public transport areas, this is accomplished by providing free bus travel or by paying a conveyance allowance to parents to transport their child to and from school by private vehicle.

Students are eligible for transport assistance if they live more than 4.5 kilometres from the nearest appropriate school (which is defined as the nearest Government school or private school by religion or ethos).

During 2001/2002, the following assistance was provided:

- Free travel on 787 fully subsidised contract school buses; or free travel on inter-town public bus services, which assisted approximately 25,000 school children at the cost of $52 million; and
- Conveyance allowance for private vehicle use, which assisted 1,000 school children at the cost of approximately $1.3 million.

The above figures do no include students travelling on intra-town public transport services either in country towns or metropolitan Perth (Transperth).

Tasmania

Student transport in Tasmania is provided by a mix of general access urban bus services, general access rural bus services, student only fare paying and student only free to the user bus services. The annual expenditure (excluding CSO payments) is in the order of $24 million.

The free to the user services are contracted to the government and paid on a combined seating capacity and distance formula. Fares paid by student range from free through 30c, 96c (on a multi-trip basis) to $1.20 per trip.

Tasmania's bus service is an open system with any student free to use any service to facilitate travel to their school of choice. No student is required to have or show an authority to travel, except students who are eligible to travel free on fare paying services.

States and Territories provide substantial subsidies for various school bus services. An end to three-for-two seating and standee policies will significantly reduce capacity and require an increase in the number of buses to maintain capacity. To the extent that subsidies cover fleet operating costs, those subsidies will need to rise in proportion to the increase in fleet operating costs.

Australian Capital Territory

Under the School Transport Program the ACT Department of Urban Services funds free school bus travel for eligible students. This concession is available to families who hold a Centrelink Health Care Card and the student resides more than 1 kilometre from the primary school and 2 kilometres from a high school or college.

The program has an annual budget of $700,000 and provides support to approximately 3,000 students.

Northern Territory

The Public Transport Program of the Department of Infrastructure, Planning and Environment is the major fund provider of school transport services in the Northern Territory. The cost of contracted school transport services was $6.6 million for the 2001/02 financial year.

Current bus contract rates in the Northern Territory are based on the distance travelled per service, and these rates vary across the territory. There is a significant subsidy of public transport in the Northern Territory, with revenue being approximately 25 per cent of expenditure. The Department of Employment, Education and Training contribute to the cost of bus travel for those students who are entitled to free bus services (distance criteria to travel for free required).

Representatives from the Northern Territory Government indicated that neither the current network or program budget would have the capacity to absorb additional contract costs which may flow from any policy changes which may result in modifications to existing buses, purchasing new buses, or additional buses, to cover the reduction in carrying capacity. Further to this, the current budget does not have the capacity to fund infrastructure changes which could flow from more school buses for existing route services.

Therefore, it was indicated that if a decision to implement one or more of the countermeasures under investigation was made, consideration of reducing the overall public service across the Northern Territory, securing additional NTG budget allocation, and/or raising bus fare revenue would be required. It was noted that each of these approaches may lead to various unintended consequences–for example, encouraging a shift to private vehicle travel–which could reduce the net road safety outcomes of the proposed countermeasures.

Summary of subsidy schemes

Overall, States and Territories provide substantial subsidies for various school bus services. These subsidy schemes vary across jurisdictions in terms of the amount of subsidy provided the number of students eligible for subsidy or concessional travel and the conditions. If there was an increase in the number of buses required to carry the same passenger load, as would be the case if seat belts were introduced, and/or if three-for-two seating and standee policies were abolished, the scale of subsidy and school transport funding arrangements would need to increase in order to offset additional fleet costs required to carry the same passenger load. Therefore, consideration would need to be given as to who would meet additional costs. Most jurisdictions suggested that these costs would need to met by government.

6. IMPLEMENTATION ISSUES

To examine phasing in options and issues associated with implementation of each of the five countermeasures, information relating to the current implementation of these initiatives and barriers or issues for future implementation was requested from jurisdictions.

A number of jurisdictions provided feedback relating to the steps associated with implementing one or more of the countermeasures and the potential barriers or difficulties to be confronted.

6.1 Queensland

Queensland Transport suggested that the logical order would be to upgrade the existing bus fleet to rollover strength first, then remove standees and/or three-for-two seating (and introduce extra buses as required), and finally install seat belts as required.

Queensland Transport indicated that in order to proceed with one of more of the countermeasures, the following steps may be required:

1. Research fleet and passenger profiles
2. Consult with industry and other government agencies
3. Develop a submission to government with the recommended policy direction and general financial parameters
4. Develop an implementation pricing strategy focussing on stages of implementation
5. Establish manufacturing capability
6. Develop an implementation prioritisation process
7. Return to government and request funding based on the outcomes of the research

Queensland indicated that the length of time for implementation of each or all of the countermeasures would be determined by available funding and industry and manufacturing capacity. That is, the more funding available, the faster the possible implementation. Also, the current or potential manufacturing capacity of the bus building industry, and the capacity of the bus operators to meet additional costs for non-government funded services, is a major issue.

The recent *School Transport Safety Task Force Final Report* (2001) recommended that all school buses operating in non-urban areas in Queensland should be replaced with buses with improved rollover strength, should be fitted with seat belts, and no standees by 2017. However, the Queensland bus building industry does not have the capacity to supply new buses at this rate. In fact, the Queensland bus building industry advised the Task Force that there is currently the capacity to build 60 buses per year. Therefore it would take between 33 and 40 years (depending on bus size and seat configuration) to replace the school bus fleet in Queensland with a fleet of rollover strength buses fitted with seat belts of sufficient numbers to rule out standees. This does not take into account the buses currently being built by the industry for purposes other than school transport.

Queensland Transport indicated several barriers to the installation of seat belts buses including:

- the significant level of funding required for implementation;
- the availability of new or near new vehicles meeting ADR59/00 for the installation of belts;
- the practical/legal issues such as what to do with a child standing on the side of the road if all seats are taken, can standees be carried on seat belted buses, and how to make children wear the belts;
- the issue of carrying small children (normally in booster seats) in lap-sash belts designed for adults; and
- cash fare revenue (for non-government funded services) will not support seat belted services with reduced loads. This would result in either a decrease in services, or an increased cost to passengers (with a potential decrease in patronage) unless government tops up the revenue for operators.

The main barrier to installation of high backed seats (other than cost) is that the current ADRs do not allow seats above 1.0m in buses without seat belts being fitted as well. Also, the installation of these seats may lead to reduced seating capacity in some vehicles.

Barriers to banning standees and three-for-two seating include the cost to both the government and to fare paying passengers, unavailability of sufficient additional buses, and practical/legal issues such as what to do with the extra child waiting on the side of the road.

6.2 Victoria

The Victorian DoI indicated that if seat belts and higher backs seats were approved and funding was obtained, implementation of these features would be phased in at the time vehicles are replaced. The DoI authorises approximately 100 school contract bus upgrades each year (which equate to around 6% of the fleet) therefore it would take approximately 16 years to fully modify the existing school bus fleet.

In relation to the removal of children travelling as standees, the DoI indicates that Victoria already requires that, wherever possible, all bus travellers are seated while travelling. Further, in speed zones over 80 km/h the DoI's policy is to ensure that all students are seated.

In relation to the removal of three-for-two seating, this requires changes to the current practice adopted in a number of jurisdictions. This may be viewed as a by-product of installing seat belts rather than separate initiatives.

6.3 New South Wales

While these proposals are primarily intended for school buses, they will also impact on regular route services both within rural and metropolitan areas, therefore, consideration needs to be given to the impact on general service buses.

Overall, the most significant implication of the adoption of any proposal to introduce seat belts in school buses or all buses is the reduction in carrying capacity. To compensate for the reduced carrying capacity, more buses will be required to service essentially the same demand and ultimately, lead to increased costs in administering the School Student Transport Scheme which is estimated to be $427.2 million this financial year.

Other issues such as increased traffic and emissions and adjustments to timetables to ensure that waiting times are minimised while still providing frequent and timely services, particularly in metropolitan areas, are real issues which must be fully considered to ensure that public transport remains an attractive and viable option.

6.4 South Australia

DECS in South Australia indicated that there may be risk and liability issues in relation to children not wearing seat belts at all times during the school bus journey. They further highlighted that there may be problems securing and retaining the services of some school bus drivers if these issues are not satisfactorily resolved prior to implementation. There is also concern that if seat belts in school buses are not worn correctly, this may cause distraction and more supervisory work for drivers and the potential to cause harm in the instance of a crash.

The State Government would have to carefully consider the costs/substantiated benefits and impacts on current and future budgets of any new internal school bus safety measures.

Subject to Government approval and availability of funding, DECS indicated that bus manufacturers and outfitting agencies would probably be asked to submit implementation plans for evaluation by Government agencies to determine the most feasible and cost-effective plan for fitting seat belts to a high number of school buses and to ensure an acceptable value for money outcome.

A number of additional issues/concerns were raised by representatives from South Australia including the following:

- In addition to the costs and reduced carrying capacity implications mentioned earlier in this report, DECS suggested that an estimated amount of $500,000 may be required just to cover the associated costs of carrying out a program of fitting seat belts to (598) school buses mostly located in country and near metropolitan areas of the State (viz, employing drivers, meals/overnight accommodation, moving buses, providing back-up route buses).
- The Minister for Education and Children's Services has entered into 287 service contracts with private operators to provide school bus services for an approved fee per contract. If seat belts were legislated as mandatory, the terms and conditions of the contracts would need to be varied and the matter of seat belt costs will be an issue. That is, the Government/DECS would have to pay the costs for department owned school buses and private operators would have to pay for their contract buses.
- Disability Standards for Accessible Public Transport come into effect from 15 October 2002. In SA, a number of private bus operators operate dual-purpose school/public transport businesses. While, the Disability Standards exempt a dedicated school bus service, any operator who provides public transport services will have to fully comply with the Standards, which apply to conveyances, premises and infrastructure. If unjustifiable hardship is proven the Human Rights and Equal Opportunities Commission may grant an exemption from the Standards. Consequently, this legislative requirement will impact on providers and operators of public bus services across Australia.
- There is risk that the implementation of seat belts on a variety of bus models and makes may discover modification and structural problems that were not anticipated. Therefore, the overall program may take a long time to complete and result in significant additional costs. During this time, normal school bus services and business must function.

- Seat belts must be maintained in sound condition and good working order, and accordingly appropriate inspections and maintenance standards must be developed and implemented. Therefore, the introduction of seat belts on school buses will incur additional recurrent costs for DECS and private bus operators for monthly, three-monthly and 12-monthly bus inspections required by SA legislation.

6.5 Tasmania

Tasmanian authorities indicated that due to the age of the vehicles operating in Tasmania, installation of seat belts and changes to bus rollover strength requirements would require the majority of the bus fleet to be replaced with new vehicles. Concerns were raised that the expected cost benefit ratio of adopting one or more of the countermeasures would be low, given that no child has ever been killed in an on-board accident in a school bus in Tasmania.

In relation to the practice of three-for-two and standees, Tasmania indicated that these practices are driven by cost and additional funding would obviously be required if additional buses were necessary.

6.6 Northern Territory

Representatives from the Northern Territory indicated that an implementation strategy for each of the countermeasures is difficult to outline. The development of national standards for Accessible Public Transport demonstrates some of the challenges which can be experienced in introducing major changes to transport polices, fleets and infrastructure across Australia.

Issues that would need to be considered include:

- the ability to retro-fit the existing buses, and the requirement to purchase new buses that are able to be retro-fitted with seat belts;
- fleet capacity implications to cover services while the buses are being modified;
- possible changes in vehicle sizes and carrying capacity for particular services;
- time-tabling and passenger transfer arrangements; and
- infrastructure requirements–size and design of stops and bus interchanges.

Additional issues to consider include the environmental impact of additional fleet vehicles across Australia (emission levels including greenhouse gasses and road congestion).

6.7 Remaining jurisdictions

The remaining two jurisdictions have indicated that additional information relating to implementation options and barriers associated with introducing one or more of the counter measures may not be able to be provided.

6.8 Summary of implementation issues

Once again, as the nature of school bus travel and operating practices differ across jurisdictions, views relating to implementation also vary. However, based on the advice regarding potential implications associated with introducing one or more of the countermeasures examined in the investigation, the following common points can be made:

- The length of time to replace the entire fleet with new ADR compliant buses offering rollover protection, seat belts and improved compartmentalisation through higher backed seats, would vary dependent on the number of buses currently replaced on an annual basis, the level of funding that could be provided and the capabilities of the bus building industry to manufacture the required number of buses. Jurisdictions varied considerably in their estimation of the length of time it would take to comply with the potential introduction of these countermeasures.
- Manufacturing and outfitting agencies would be required to develop implementation plans to outline the rate at which the bus building industry could manufacture new buses and/or retrofit seat belts. This information would assist jurisdictions to develop more accurate implementation plans.
- Based on the advice provided, if it was decided to implement one or more of the countermeasures under investigation, it is probable that safety features would be implemented or phased in as vehicles in the fleet required replacement. Decisions to implement would also impact on general route bus services operating in both rural and metropolitan environments.
- The implementation of seat belts would require not only the development of implementation plans, but would also require strategies outlining the ongoing maintenance procedures to ensure seat belts are maintained in sound condition and good working order. Additionally, a schedule of vehicle inspections would be required and maintenance standards developed and implemented. The costs associated with such maintenance programs would be additional to those costs depicted in this investigation.
- It was also suggested that the implementation of seat belts would require further investigation into the liability issues associated with wearing, or not wearing seat belts at all times. The responsibilities of drivers, parents and passengers, and the implications of breaching these responsibilities, would need to be clearly identified in legislation. Associated with this is the issue of whether a child is safer if left standing on the side of the road, waiting for another bus because no belted positions remain, in comparison to a driver allowing a child to board the vehicle to travel unbelted or standing.
- Many jurisdictions noted that the potential to abolish three-for-two seating practices and standees policies are by-products of the fitment of seat belts. The expected cost implications of these by-products are considerable. The repercussions associated with the removal of these practices could include increases in traffic congestion and vehicle emissions due to greater fleet sizes and additional administrative costs associated with changes to bus timetables, route adjustments and passenger transfers. It is also conceivable that the increased number of buses on the road could negatively impact on the involvement of children involved in pedestrian crashes in the vicinity of a school bus during school commuting hours.

7. SUMMARY OF RESEARCH FINDINGS

7.1 Research evidence and crash data

Based on research evidence and crash data, this investigation has found that the risk of being struck by passing traffic, as a pedestrian, when crossing the road before or after alighting from the bus presents a considerably greater risk to children than travelling as a bus passenger during school commuting hours.

There is varying evidence about the safety implications of fitting seat belts to school buses, allowing standees to travel in a moving vehicle, allowing three children to occupy the seating capacity intended for two adults, and the need for higher seat backs offering improved compartmentalisation. Furthermore, there is conflicting evidence regarding the effectiveness, safety implications and cost of fitting seat belts on school buses. There are also conflicting views associated with permitting standees to travel on vehicles and permitting three children to occupy the seating capacity of two adults. There is a lack of evidence to suggest that seated travel is significantly safer than travelling as a standing passenger in a moving bus or that three-for-two seating practices compromise passenger safety.

Overall, the debate is well-documented over the safety of school buses, the benefits of compartmentalisation, the cost of installing seat belts and other countermeasures relative to the safety gains that are likely to result. However the research is mixed and the evidence is largely inconclusive due to the low number of crashes associated with school buses.

7.2 Australian situation

At present, in Australia:

- Three-point (lap-sash) seat belts are not widely available on school buses, with the exception of coach style vehicles which, depending on the year of manufacture, are required under the Australian Design Rules (ADRs) to be fitted with lap-sash seat belts.
- Consistent with the application of seat belts, high-backed seats are not generally provided in school buses, except when coach-style vehicles are used to transport children for school services.
- All states in Australia currently permit carriage of passengers who have to stand on route service buses, provided buses are designed with allocated standing areas. However, the number and conditions permitting standees vary between jurisdictions.
- With the exception of the Australian Capital Territory, all Australian jurisdictions permit the three-for-two seating policy for scheduled runs (and some special runs in dedicated school bus services). This policy generally applies only to children aged 12 years or younger.
- The extent of rollover protection offered by buses varies between jurisdictions and where provided, is done so in accordance with ADRs depending on the size of the bus and when the bus was constructed.

Based on the information provided relating to the composition of the bus fleet involved in the transportation of children in each jurisdiction this study has found that:

- The nature of school bus fleets differs considerably between jurisdictions. Some jurisdictions operate dedicated school buses while others do not. Further, the number of buses, the average age and the average seating capacity of these buses vary across jurisdictions. For example, the average age of fleets varied from 9 years to in excess of 20, years and the average seating capacity ranged for 32 to 57.

- Some jurisdictions noted if one or more of the countermeasures under investigation were to be introduced, they may need to be introduced beyond just dedicated school bus fleets. Therefore, these jurisdictions noted that consideration is required of the result on other buses if one or more of the countermeasure were introduced.
- Some jurisdictions provided information relating to buses designed and operated primarily for the transport disabled passengers. However, because of the difference in design and construction of these buses (i.e. they are constructed or fitted with hoists and standards to transport passengers in wheelchairs) and subsequent carrying capacities, these buses have not been included in the costing procedures applied in this investigation.
- Based on the information that was available, and the need to provide an overview of school buses operating at a national level, this investigation does not differentiate between the types of buses operating within the school bus fleet and those operating within the general service route fleet. While it is acknowledged that some buses are designed differently, and thus provide different types of safety features depending on the primary purpose of the vehicle, such differentiation would require access to very detailed information of the bus fleets operating in each jurisdiction. The availability of such information would provide for a more rigorous costing and capacity regime to be applied to determine the financial implications associated with implementing one or more of the countermeasures examined in this investigation.

7.3 Legislative and regulatory issues

As a result of investigating the legislative and/or regulatory changes that may be required, if one or more of the countermeasures under investigation were introduced, a number of changes were identified. The key amendments to vehicle design and construction standards and to relevant road rules and traffic acts are summarised as follows.

7.3.1 Australian Design Rules (ADRs) and Australian Standards (AS)

Installing three-point lap-sash seat belts and fitting higher backed seats:

- A number of the ADR's detailed in this report pose limitations on the installation and use of seat belts (see ADR68/00, ADR 4/03, ADR 66/00) and some standards may require review or amendment if one or more of the five countermeasures or actions is introduced. For example, under current regulations route buses are exempt from requiring seat belts (see ADR68/00). Further, ADR 4/03 requires all omnibuses manufactured on or after 1 January 2000 to have seat belts fitted to all seating positions where seat belt anchorages are fitted. Despite this, the ADR does not appear to provide other requirements relating to the fitment of seat belts in buses. References to seating height or other occupant protection requirements (such as seat padding, etc) are not provided in this ADR, nor has an amended version of ADR 68/… been drafted to accommodate these changes. This amendment means that there may be omnibuses in Australia manufactured after 1 January 2000 that have seatbacks less than 1.0 metre in height yet are fitted with seat belts. Therefore, there appears to be a deficiency in the requirements provided for installation of seat belts to these types of omnibuses. If seat belts were to be considered for installation in school buses amendments to one or more ADRs would be required.

Limiting school buses to carrying one child to each single seat

- The ADRs provide design and construction standards for seats, with the intent that one seat is provided per person. Therefore limiting school buses to carry one child to each single seat should not effect the ADRs nor require any amendments. Further to this, representatives from Queensland Transport have indicated that there has been recent approval of the use of McConnell Educator 2/3 seats and seat belts under ADR 68/00. These seats offer three-for-two seating capacity with seat belts.

Prohibiting bus passengers from standing on a moving bus

- While ADR 58 /00 allows buses to be designed and constructed for standing passengers, the practice of permitting passengers to travel as standees on moving buses is based on jurisdictions' individual traffic regulations and passenger transport acts. Therefore, should a decision be made to restrict standees from travelling on moving buses, then relevant traffic regulations would need to be amended to prohibit children travelling as standing passengers on moving school buses.

Review of bus design standards such as rollover strength

- ADR 59/00 provides the design and construction standards for the rollover strength of buses. However, while one jurisdiction representative suggested that this ADR may need to be amended since it only applies to buses with more than 16 passengers, another suggested that there is no need to review this ADR at this time. All ADRs are currently being reviewed with a view to harmonisation with European regulations. However, ADRs that are applicable to buses are unlikely to change. Another jurisdiction suggested that while the current ADRs are sufficient to carry across to school buses, it may be preferable to draft a new ADR covering the design and construction of these vehicles if the standards are different to other buses.

Relevance of Australian Standards

Most jurisdictions indicated that the only Australian Standards applicable to the five countermeasures under investigation involved were those called upon by the ADRs. Therefore, should, for example, retrofitting of seat belts be required for a bus that is presently in service, compliance with Australian Standards for seat belt manufacture would be required.

7.3.2 Australian Road Rules (ARRs), Traffic Acts and Codes

Part 16 of the ARRs, titled **Rules for persons travelling in or on vehicles** regulate the wearing of seat belts by drivers and passengers, the responsibility of bus drivers for minors travelling on school buses and those individuals that are exempt for wearing belt. In addition, there are a number Traffic Codes or Acts that regulate the operation of bus services at a jurisdictional level may be relevant in the consideration of implementing one or more of the countermeasures under investigation. These Acts and Codes generally contain policies relating to three-for-two seating arrangements and permitting standees to travel on moving buses, and may or may not supersede the regulations outlined in the ARRs.

This examination has found that the potential introduction of one or more countermeasures under investigation may result in the need for amendments to the ARRs and relevant traffic regulations and Codes as follows:

- If seat belts were installed in school buses, legislative or regulatory changes would be required to clarify the responsibilities of both the drivers and the passengers for correctly wearing seat belts where fitted, including determining the age of passengers for whom bus drivers are expected to be responsible for ensuring they are wearing their seat belts.

- If the policy allowing three-for-two seating was abolished, various state and territory passenger transport regulations that currently permit three children to occupy two adult seats would need to be amended accordingly.
- Similarly, if the policy allowing students to travel as standees on school buses was abolished, various state and territory passenger transport regulations and Acts would also need to be amended accordingly.
- In comparison, it appears that any decision to mandate the installation of high-backed seats and/or improve rollover protection regimes in buses would not result in any changes or amendments to road law or passenger transport regulations. Nor would the introduction of these initiatives result in any changes to current three-for-two seating practices or passenger standee policies.

7.4 Capacity and cost implications

One of the objectives of this investigation was to determine the capacity and cost implications that may be expected if one or more of the five countermeasures under investigation were introduced. The following three cost options were explored:

Option 1: The cost to retrofit the existing fleet of buses used to transport children to and from school with high-backed seats and seat belts (and to replace those vehicles that cannot be retrofitted with new ADR compliant vehicles).

Option 2: The cost to replace vehicles in the existing fleet that do not meet current rollover protection standards and to retrofit seat belts to buses that do meet these standards. This ensures that buses offer both rollover protection and seat belts.

Option 3: The cost to replace the entire fleet of buses used to transport children to and from school with ADR compliant vehicles offering rollover protection, high-backed seats and seat belts.

In addition, the complexities involved in calculating the financial and capacity implications associated with a decision to end policies providing for three-for-two seating and standees in jurisdictions where this is taken up were examined.

A number of assumptions have been made in order to determine preliminary cost implications associated with the countermeasures under investigation. These include assumptions about fleets operating in individual jurisdictions, costs provided by bus manufacturers and outfitting agencies, and assumptions about buses meeting (or failing to meet) relevant ADRs. These assumptions need to be taken into account when considering the potential financial implications associated with introducing one or more of the countermeasures under investigation.

Based on these assumptions and the costing procedure applied (as outlined in Section 5), the cost implications associated with each cost option explored can be summarised as follows:

7.4.1 Option 1: Fitting the existing fleet with seats with seat belts

This option explored the costs associated with retrofitting seats with seat belts to the existing bus fleet, where retrofitting is suitable, and the additional cost of replacing buses where retrofitting is not appropriate to ensure all buses offer appropriate seats with seat belts. By default, the proportion of buses that would need to be replaced, based on this cost option, would also provide occupants with improved rollover protection. This calculation included the costs associated with installing appropriate anchorage for all vehicles, regardless of the current anchorage available. However, this calculation did not include costs associated with wall and floor modifications that may be required to allow the seat belts to be retrofitted.

Based on the assumptions applied in the investigation, the capital costs associated with fitting seatbelts to vehicles where retrofitting is suitable were estimated to be in excess of $440 million. This cost would increase by a further $250 million to replace those buses that are not suitable for retrofitting to ensure seatbelts are provided in all buses used in the transport of children to and from school.

7.4.2 Option 2: Replacing for rollover protection and retrofitting seats with seat belts

An alternative approach to retrofitting seat belts to existing buses and replacing those that are not suitable for retrofitting is to consider replacing vehicles that do not meet current rollover protection standards and retrofit seat belts to those that do meet current standards (and that are suitable for retrofitting).

Based on investigations into the rollover strength of buses and discussions with a reputable bus manufacturing company, it has been suggested that buses built prior to the implementation of the relevant ADR on rollover strength (ADR 59/00), would not be suitable for upgrading to meet a desired rollover standard. Therefore, without detailed information pertaining to the specific design, structure and engineering criteria of buses operating in Australian fleets, a very rough estimate of the cost implications to meet both rollover protection standards and fit seat belts was calculated.

The capital costs required to replace existing pre-1992 vehicles to meet rollover standards were estimated at more than $2,160 million. This cost would increase by a further $250 million to retrofit seats with belts to those buses that already meet current rollover standards (where appropriate).

7.4.3 Option 3: Replacing the existing bus fleet with new buses (rollover and seat belts)

The final option explored the cost to replace the entire fleet of buses used to transport children to and from school with ADR compliant vehicles offering rollover protection, high-backed seats and seat belts. Based on the information provided and the cost estimates for new ADR complaint buses, the capital costs that could be incurred, if the entire fleet were replaced tomorrow, could total more than $4,635 million.

While these costs provide the worst case scenario, in terms of replacing the fleet with new vehicles, they do not account for changes in carrying capacity that would occur as a by-product of introducing seat belts.

7.4.4 Cost implications associated with reduced carrying capacity

If legislation decreed that all school buses required the installation of seat-belts, there would be the further implication of reduced carrying capacity due to the loss of standing passengers and the loss of seating three children to two seats, depending on particular legislation in each state.

Each jurisdiction indicated that the implementation of one or more of these initiatives would result in additional number of buses required to carry the same passenger load. Based on the information provided, the costs associated with this reduced carrying capacity are estimated to total around $1,785 million.

7.4.5 Current subsidy arrangements

Overall, States and Territories provide substantial subsidies for various school bus services. These subsidy schemes vary across jurisdictions in terms of the amount of subsidy provided the number of students eligible for subsidy or concessional travel and the conditions. Overall, if there was an increase in the number of buses required to carry the same passenger load, as would be the case if seat belts were introduced, and/or if three-for-two seating and standee policies were abolished, then the scale of subsidy and school transport funding arrangements would need to increase in order to offset additional fleet costs required to carry the same passenger load. Consideration would need to be given as to who would meet these additional costs.

7.5 Implementation issues

The comments provided by a number of jurisdictions relating to implementing one or more of the countermeasures and the potential barriers or difficulties likely to be confronted have been summarised.

- The length of time to replace the entire fleet with new ADR compliant buses offering rollover protection, seat belts and improved compartmentalisation through higher backed seats, would vary dependent on the number of buses currently replaced on an annual basis, the level of funding that could be provided and the capabilities of the bus building industry to manufacture the required number of buses.
- Manufacturing and outfitting agencies would be required to develop implementation plans to outline the rate at which the bus building industry could manufacture new buses and/or retrofit seat belts. This information would assist jurisdictions to develop more accurate implementation plans.
- Based on the advice provided, if a decision was made to implement one or more of the countermeasures under investigation, it is probable that features would be implemented or phased in as vehicles in the fleet required replacement. Decisions to implement would also impact on general route bus services operating in both rural and metropolitan environments.
- The implementation of seat belts would require not only the development of implementation plans, but would also require strategies outlining the ongoing maintenance procedures to ensure seat belts are maintained in sound condition and good working order. Additionally, a schedule of vehicle inspections would be required and maintenance standards developed and implemented. The costs associated with such maintenance programs would be additional to those costs depicted in this investigation.
- It was also suggested that the implementation of seat belts would require further investigation into the liability issues associated with wearing, or not wearing seat belts at all times. The responsibilities of drivers, parents and passengers, and the implications of breaching these responsibilities, would need to be clearly identified in legislation. Associated with this is the issue of whether a child is safer if left standing on the side of the road, waiting for another bus because no belted positions remain, in comparison to a driver allowing a child to board the vehicle to travel unbelted or standing.
- Many jurisdictions noted that the potential to abolish three-for-two seating practices and standees policies are by-products of the fitment of seat belts. The expected cost implications of these by-products are considerable. The repercussions associated with the removal of these practices could include increases in traffic congestion and vehicle emissions due to greater fleet sizes and additional administrative costs associated with changes to bus timetables, route adjustments and passenger transfers. It is also conceivable that the increased number of buses on the road could negatively impact on the involvement of children involved in pedestrian crashes in the vicinity of a school bus during school commuting hours.

8. CONCLUSION

This investigation has examined the costs and implications associated with the potential implementation of three-point lap sash seatbelts, the fitment of seats with higher backs, abolishing three-for-two seating practices and standee policies and improving the rollover strength of the current school bus fleet.

The known risks and benefits associated with the countermeasures under investigation have been documented in this report. The debate over the safety of school buses, the benefits of compartmentalisation, the cost of installing seat belts and other countermeasures relative to the safety gains that are expected to result is well-documented. However, the research is mixed and the evidence is largely inconclusive due to the low number of crashes associated with school bus travel.

The report provides a detailed picture of the composition of the bus fleet involved in the transportation of children in each jurisdiction and outlines the current adoption of these countermeasures. This highlights that the nature of school bus operations, and the level of detail available about these operations, differs considerably between jurisdictions. Any move to progress with the implementation of one of the countermeasures investigated would benefit from greater knowledge of fleet operations and further efforts to develop inventories of bus fleets operating both dedicated and non-dedicated services.

The Australian Design Rules (ADRs), Australian Standards, Australian Road Rules (ARRs) and Traffic Acts and Codes relevant to operation of school buses and the transportation of children on buses when travelling to and from school and the implications associated with introducing each countermeasure have been discussed. This discussion highlights that a decision to implement seat belts and/or higher seat backs would result in amendments to one or more ADRs. A decision to abolish three-for-two seating policies or standee practices would result in necessary changes to the Traffic Acts and Codes that regulate bus operations in individual jurisdictions.

Based on information supplied by jurisdictions, a preliminary analysis of the potential costs that could be expected if additional internal bus safety measures were implemented is presented. Three alternative cost options for upgrading buses are detailed for consideration. However, it should be noted that this analysis has applied a number of assumptions regarding the number and type of buses operating in bus fleets and the number which meet, or fail to meet, relevant ADRs. These assumptions need to be taken into account when considering the financial implications associated with introducing one or more of the countermeasures investigated. The provision of more detailed information regarding bus types and operating practices may see these assumptions modified.

Finally, the potential barriers or difficulties likely to be confronted by jurisdictions if one or more of the countermeasures was to be introduced have been detailed. The issues raised highlight that any decision to install seat belts, increase seat back height, improve rollover protection and prohibit three-for-two seating policies and/or abolish standee practices can not be entered into lightly. The impacts are widespread. They include issues relating not only to changes in carrying capacity and funding arrangements, but also to the ability of the bus building industry to construct and upgrade buses as required, the need for implementation and vehicle maintenance plans to be developed and for issues regarding liability and responsibility to be clearly defined. Further consultation with road authorities, industry representatives and other key stakeholders would be required to determine suitable options to address the issues raised.

In conclusion, this investigation has provided an analysis of the potential costs that could be expected if additional internal bus safety measures were implemented. This report is expected to assist jurisdictions in their consideration of school bus safety issues.

9. REFERENCES

ARRB Transport Research. (2001). *Feasibility Study for a Trial of Seat Belts on Contract Buses Operating in Non Public Transport Areas of Western Australia*. Unpublished Contract Report.

Austroads. (2002). *Review of the School Bus Safety Action Plan-Progress Report*. Unpublished.

Bleakly, K. (1994) *Voluntary Modifications of Existing Buses and Coaches: Guidelines to Improve Occupant Protection.*

Canada Safety Council (2000) Should school buses have seat-belts? October 3, 2000.

Centre of Transportation Studies and Research. (1989). *School Bus Accident Investigations.* New Jeresy: New Jersey Institute of Technology. Retrieved May 15, 1999 from the World Wide Web: http://www.stnonline.com/126.htm.

Farr, G.N. (1984). *School Bus Safety Study, Vol. 1*. Traffic Safety Standards and Research. Ontario, Canada: Transport Canada.

Henderson, M., & Paine, M. (1994). *School Bus Seat Belts: Their Fitment, Effectiveness and Cost. Prepared for the Bus Safety Advisory Committee*, New South Wales Department of Transport.

Henderson, M. (1996). *Standing in School Buses: The Strategic and Practical Issues*. Prepared for the New South Wales Department of Transport.

Irwin, J.D., & Faulks, I.J., (2000). *Seat belts and Buses: A Comment on the Issues*. Peer Reviewed Paper. Roadwise, Vol. 12, No. 2, pp11-18.

McCray, L., Barsan-Aneli, A. (2001). *Simulations of Large School Bus Safety Restraints – NHTSA.* Proceedings of 17th International Technical Conference on the Enhanced Safety of Vehicles, Amsterdam, 2001.

National Highway Traffic Safety Administration. (1997). *Traffic Safety Facts 1997*. Washington: U.S. Department of Transportation. Retrieved May 14, 1999 from the World Wide Web: http://www.nhtsa.dot.gov/people/ncsa/schbus97.html.

National Transportation Safety Board. (1987). *Safety Study–Crashworthiness of Large Post-standard School Buses.* Washington: Bureau of Safety Programs. NTSB Report/ss-87/01

National Transportation Safety Board (1989*). Crashworthiness of Small Post-standard School Buses*. NTSB Report/ss-89/02.

National Transportation Safety Board (1999) *Bus Crashworthiness Issues. Highway Special Investigation Report NTSB/SIR-99/01*. Washington: DC.

Queensland School Transport Safety Task Force (2001). *Final Repor*t. September 2001.

Yeager, A.L., (1985). *Critique of the Transport Canada Tests*. National Coalition for School Bus Safety.

APPENDIX A
REQUEST FOR DATA/INFORMATION RELATING TO SCHOOL BUSES

- Background

In a recent *Review of the School Bus Safety Action Plan* (ARRB TR, 2002) a range of actions or measures were proposed. A number of actions recommended that further studies be undertaken to determine the implications, costs and associated safety benefits of countermeasures including:

1. Installing 3 point (lap-sash) seat belts in school buses.
2. Fitting school buses with higher seatbacks (improving compartmentatlistion).
3. Limiting school buses to carrying one child to each single seat.
4. Ensuring that all children are seated while the bus is moving.
5. Initiating a review of bus design standards (including bus rollover strength).

- **Purpose**

The objectives of the current project are to investigate the costs and associated implications of implementing each countermeasure/action identified above, determine the economic value of each of the measures, identify the tasks involved in the implementation process and outline the length of time required to complete implementation.

- **Methodology**

To determine the feasibility of implementing these five vehicle-based countermeasures listed above, two clear stages have been defined.

This first stage is fundamentally related to collecting required data and information to conduct the feasibility. Information under the following core areas will be sought for each countermeasure/action:

- Legislative and/or regulatory issues
- Capacity and cost implications
- Associated risks and benefits
- Implementation issues

The second stage will seek to apply this information and knowledge to estimate the costs and implications associated with each of the vehicle-based actions under investigation and define steps for the implementation of these countermeasures.

- **Required Information**

In order to carry out the first stage of this investigation, a considerable amount of information relating to the cost and implications of the five actions/countermeasures is required. This section details the information we are seeking.

As the issues being investigated are the subject of discussion at the Australian Transport Council (ATC) meeting later this year the time frame set for this investigation is very tight. At present we are aiming to collect required information by the end of July 2002 . This will allow the review and estimation component to be completed by the end of August 2002.

We are contacting representatives from each state and territory road authority in an effort to collect as much information as quickly as possible. Please read the details of this request and consider what information you have access to and what you are able to collect. Where you feel that information should be sought from other key stakeholders–such as Department of Transport, Department of Education, etc–we would be very grateful if you could supply contact details for appropriate representatives. We will contact with these people *immediately* in an attempt to obtain as much of the required information as possible.

We appreciate that the data request is comprehensive and seeks a considerable amount of information in a short time frame. Please consider what help you can provide and if you have any concerns, please refer to the contact details provided at the end of this document.

• Legislative and/or regulatory issues

To determine what legislative and/or regulatory changes would be required if one or more of the countermeasures/actions identified, information pertaining to the current Australian Design Rules (ADRs), Australian Standards, Traffic Acts and Codes and ARR as relevant to operation of school buses and the transportation of children on buses when travelling to and from school is required.

Australian Design Rules (ADRs) and Australian Standards

- ? *Which ADRs are applicable to the design/construction of school buses?*

For example, there are a number of ADRs that relate to buses and particularly to the appropriate design and construction of seats, seat strength, seat belts, seat anchorages, rollover strength and impact-absorbing padding. A number of these pose limitations on the installation and use of seat belts (i.e. ADR68/00, ADR 4/03, ADR 66/00, etc) and some standards may require review or amendment if one or more of the five countermeasures/ actions is introduced. It is noted that ADRs apply across Australia, however we are interested in how these are interpreted by different jurisdictions and ideas or thoughts you may have regarding future review or amendment of these rules.

- ? *Which ADRs would be effected or would require review/amendment if the following actions/countermeasures were initiated.*
  - *The installation of seat belts*
  - *The fitment of higher backed seats*
  - *Limiting school buses to carrying one child to each single seat*
  - *Prohibiting bus passengers to stand on a moving bus*
  - *Review of bus design standards such as rollover strength*

Additionally, a number of Australian Standards apply to use and installation of seat belts in school buses, their design and the performance testing of individual components. Therefore:

- ? *Which Australian Standards are applicable to the design/construction of school buses in your jurisdiction?*
- ? *Would any Australian Standards need to be reviewed/amended if each of the above actions/countermeasures were initiated.*

Road rules, Traffic Acts and Codes

We require information on relevant Australian Road Rules and Traffic Acts and Codes that regulate the operation of school buses and the transportation of children on buses when travelling to and from school. For example:

- ? *What Australian Road Rules relate specifically to the carriage of children on school buses in your jurisdiction (granted that there is some variation in the adoption of Australian Road Rules by jurisdictions)?*
- ? *What sections or regulations contained within Traffic Acts and Codes for your jurisdiction regulate the transportation of children on school buses? Please provide these sections.*
- ? *Specifically, would sections/regulations require amendment if one of the five countermeasures/action were initiated? please identify which sections/regulations would be effected and what likely changes would be required?*

• Capacity and cost implications

Preliminary research specifically into the capacity and costs associated with installing seat belts has been undertaken by a number of Australian jurisdictions, namely Western Australia, Queensland and South Australia, and by overseas jurisdictions. These studies report that there are a host of safety, capacity and cost implications associated with fitting seat belts to school buses.

To determine the capacity and cost implications associated with initiating each of the five countermeasures/actions we require information regarding:

- Composition of bus fleets, particularly school bus fleets, in each jurisdiction.
- Carrying capacity, current usage/travel patterns and associated passenger demand levels.
- Subsidy or funding assistance provided for various bus services.
- Costs and modifications to vehicle design and construction

Fleet composition

We require the following information pertaining to the operation and size of the current fleet:

- **?** *How many and what type of buses operate in your fleet?*
  - *Estimated number of buses*
  - *Average vehicle age*
  - *Number of different types of vehicle makes and models*
  - *Design and safety standards offered by different types of buses*
    - *Type of seats in buses including seat height, padding and anchorage specifications where available*
    - *Estimated number and type of buses that have seat belts*
    - *Provision of other bus safety features offered (rollover protection, low floor, seat belts, padding requirements, etc)*

Carrying capacity

In Australia, many states allow three children to occupy the seating compartment allocated for two adult seats, with most permitting children to stand in moving buses. However, the fitment of seat belts has a flow on effect for the three-for-two seating policy and children travelling as standees. The fitment of seat belts would result in passengers no longer being permitted to sit in a an unbelted position nor stand in a moving vehicle, as allowing this would provide conflicting messages to children. Therefore, the abolishment of these polices will have significant capacity implications that will result in additional buses required to carry the same passenger load. Therefore, the capacity implications of fitting seat belts need to be calculated based on loss of some seating positions and the loss of standing passengers.

To the extent that is possible we require information relating to the following:

- **?** *What is the carrying capacity of the school buses servicing the fleet?*
  - *Type of service provided: dedicated or non-dedicated services*
  - *Type of operator: private or government operators*
  - *Estimated number of seats available, the number of standing passengers permitted and the total number of passengers permitted to travel on school buses*
  - *Estimated proportion of travel for which the current bus fleet is believed to be fully utilised (i.e. at capacity level)*
  - *Estimated total number of children the school bus fleet carries annually*
  - *Estimated number of routes provided and proportion of routes operating at full capacity*

Subsidy arrangements

In order to identify how changes in carrying capacity will impact subsidy or funding arrangements should one or more of the actions/countermeasures be implemented we require information on:

- ? *What subsidy or funding assistance is provided for various school bus services?*
  - *Which organisation/s provides transport funding or assistance for school bus related travel each year?*
  - *What proportion of the children that use school buses for transportation to and from school that does this funding assist?*
  - *What is the perceived impact on subsidy arrangements if there was an increase in the number of buses required to carry the same passenger load?*
  - *Could additional costs be managed by finding organisations or would costs flow to users?*

Costs and modifications to vehicle design and construction

The implications of a loss in seating positions resulting from removal of standees and three-for-two seating will translate to cost implications as the same number of vehicle will no longer be able to carry the same passenger load. Further, research documents that retrofitting seat belts and installing higher seatbacks to school buses will require modification to bus floors, seat anchorages, sidewalls and pillars and other structural changes. The increased loads associated with making these modifications could result in costs that are significantly greater than the cost of installing seat belts on new, appropriately designed school buses.

#Note: Data requirements for this section are listed in Section 1.4 Manufacturers/ outfitting agencies. Costing information costs associated with fitting, modifying and/or constructing buses to accommodate one or more of the five countermeasures/actions will be sourced directly from a sample of bus construction companies as it is expected these costs will be similar across Australia. Therefore, you are not required to supply costing information, unless you have available data that you feel may be of benefit to the project.

• Associated risks and benefits

To determine the associated risks and benefits, a review of documented research and studies completed on the use and installation of seat belts, compartmentalisation techniques (through high-backed seats), safety of three-for-two seating and standing passengers on school buses will be undertaken. Additionally, issues relating to rollover protection practices will be examined.

It is anticipated that this review of risks and benefits will draw on existing research completed by ARRB TR in recent school bus safety related projects[3]. However, where jurisdictions have access to additional documentation–which is believed to be directly relevant to the safety of one of the actions/countermeasures under investigation–it is requested that this is provided to ARRB TR for review.

[3] Refer to *Review of the School Bus Safety Action Plan–Final Report* (ARRB TR, 2002: unpublished, contract report) and *AP-R186A School Bus Safety in Australia – Technical Report* (Austroads, 2001).

• Implementation issues

To determine phasing in options and associated issues associated with implementation of each of the five countermeasures/actions information relating to the current implementation of these initiatives and barrier or issues for future implementation is required.

We require information relating to the following:

- ? *What phasing in options for the implementation of the five countermeasures/ actions are available in your jurisdiction?*
  - ◦ *Steps involved in developing an implementation strategy for each countermeasure/action*
  - ◦ *Estimated length of time required to implement each countermeasure/action*
  - ◦ *Estimation of the full implementation period*
  - ◦ *Barriers/issues requiring specific consideration in the implementation of one or more of the countermeasures/actions*

• Manufacturers and outfitting agencies

Determining costs implications

As previously mentioned, the ARRB project team will be sourcing costs associated with fitting, modifying and/or constructing buses to accommodate one or more of the five countermeasures/actions directly from bus construction companies, manufacturers and outfitting agencies. We will be contacting a sample of manufacturers by telephone in order to obtain following information:

- ? *What costs are associated with installing seat belts, improving compartmentalisation and improving rollover protection of existing school buses?*
  - ◦ *Individual cost details for seat belt assemblies, anchorages requirements and padding requirements (per component).*
  - ◦ *Costs for retrofitting seat belts and assemblies to existing buses (per bus)*
  - ◦ *Costs associated with other modifications required to allow retrofitting of seat belts – including perceived modifications to bus floors, sidewalls and pillars (per bus)*
  - ◦ *Costs of bus seats that are constructed with pre-fitted seat belts (per seat)*
  - ◦ *Costs associated with installing higher back seats in existing buses to improve compartmentalisation (per bus)*
  - ◦ *Costs associated with improving rollover protection of existing school buses (per bus)*
- ? *What costs are associated with replacing the current fleet in your jurisdiction with new, ADR68/00 compliant buses that are appropriately fitted with seat belts?*
  - ◦ *Cost of replacing each of the current types/sizes of buses that transport children to and from school (per bus)*

#Note: If you have information or internal documents that you feel benefit this investigation, it would be appreciated if these could be supplied.

APPENDIX B
RELEVANT SECTIONS FROM THE AUSTRALIAN DESIGN RULES (ADRS)

ADR 68/00 Occupant Protection in Buses

This ADR applies to omnibuses over 3.5 tonnes (MD3, MD4 and ME) which seat more than 17 persons (including the driver and crew), and in which all seats have a reference height (seat back height) greater than 1.0 metre. ADR 68/00 specifies that in vehicles with seat backs greater than 1.0 metre in height, all front and rear seating positions must be equipped with seat belts.

However, the ADR indicates that Route Service Buses are exempt from the requirements prescribed.

The ADR specifies the requirements for seat belts in buses including the strength of seats, seat-anchorages, seat belt anchorages and, child restraints anchorages, and the provisions for protecting occupants from impact with seat backs and accessories on seats and arm rests.

The most relevant sections of this ADR state that:

1. Each seat is to be fitted with a *Seat belt Assembly* (5.4.1).
2. The *Seat belt Assembly* for front-facing seats must be a lap-sash belt equipped with an *Emergency Locking Retractor* (5.4.2).
3. The *Seat belt Assembly* for rear-facing seats must be a lap-belt equipped with an *Emergency Locking Retractor* or a lap-sash belt equipped with an *Emergency Locking Retractor* (5.4.3).
4. Any *Head restraint* proposed to be used must be included in the *seat* (5.7.6).
5. All seat belt *Anchorages* must be designed so that *Seat belt Assemblies* can be replaced readily (5.7.7).
6. Any seat belt *Anchorage* may be designed to receive more than one *Anchor Fitting* (5.7.8).

ADR 66/00 Seat strength, seat anchorage strength and padding in omnibuses

This ADR applies to all omnibuses with more than 17 seats (including the driver) and crew and in which all passenger seats have a reference height (seat back height) greater than 1.0 metre. This specifies the requirements for the strength of seats, seat-anchorages and seat belt anchorages of certain omnibuses and for protecting occupants from accessories on the seats and arm rests. It further indicates that omnibuses complying with ADR 68/00 need not comply with this rule.

The most relevant sections of this ADR state that:

1. Vehicles and the seats must comply with the requirements of this rule, which incorporates ECE Regulation 80 requirements (66.2.1). This regulation specifies the uniform provisions concerning the approval of seats of large passenger vehicles and of these vehicles with regard to the strength of seats and their anchorage.

2. The scope of ECE Regulation 80 specifies (p5) that:

- Every passenger seat having a reference height of at least 1.0 metre intended to be installed facing forward and immediately in front of another forward-facing seat on a horizontal plane not differing by more than 6 cm from the floor level of the other forward-facing seat, and tested according to the requirements of paragraph 5.

- The seat anchorages provided in the vehicle and intended to be fitted with seats indicated in paragraph 1.1 or any other type of seat likely to be fitted on these anchorages and tested in according to the requirements of paragraph 6.1.

3. This regulation further specifies that:

- Every adjustment and displacement system provided shall incorporate a locking system, which shall operate automatically (5.1).

- Each type of seat may be checked by either test described in annex 4. Another suitable test may be used provided the equivalence with one of the prescribed tests is demonstrated. The test is to determine: (5.2).

  If the seat occupant(s) is (are) correctly retained by the seat(s) in front of them. This requirement shall be considered satisfied (5.2.1):

  – either in the case of the test described in paragraph 2 of annex 4, if the forward movement of any of the trunk and the head of the manikin does not pass beyond the transversal vertical situated at 1.6 m from the R point of the auxiliary seat (5.2.1.1).

  – or, in the case of the test prescribed in paragraph 3 of annex 4, if the maximum displacement of the central point of application of each force prescribed in paragraph 3.2.1 of annex 4 measured in the horizontal plane and in the longitudinal medium plane of the relevant seating position does not exceed 400 mm (5.2.1.2).

4. All fittings forming part of the back of the seat or accessories thereto shall be such as to be unlikely to cause any bodily injury to a passenger during impact. This requirement shall be considered satisfied if any part contactable by a sphere 165 mm in diameter presents a radius curvature of at least 5 mm (5.3).

5. The adjustment and locking device shall not be required to be in full working order the test (5.4).

6. The anchorages for the seats on the vehicle shall be capable of withstanding either the test described in annex 5, or if a seat is mounted on the part of the vehicle structure being tested, one of the test prescribed in annex 4. The seat need not be an approved seat provided that it satisfies the requirements of paragraph 5.2.1. (6.1, 6.1.1 & 6.1.2).

7. Permanent deformation, including breakage, of an anchorage or the surrounding area shall be permissible provided the prescribed force has been sustained for the prescribed period. (6.2).

8. When there is more than one type of anchorage on a vehicle, each variant shall be tested in order to obtain approval for the vehicle. (6.3).

9. Annex 4 Test procedures for seats and anchorages (refer to relevant appendix to be included in the final report).

10. Annex 5 Test procedures for the anchorages of a vehicle (refer to relevant appendix to be included in the final report).

ADR 4/03 Seat belts

This ADR specifies the requirements for seat belts to restrain vehicle occupants under impact conditions, to facilitate fastening and correct adjustment, to assist the driver to remain in his/her seat and thus maintain control of the vehicle in an emergency and to provide protection against ejection in an accident situation. This ADR was recently amended (1998) and now applies to all omnibuses manufactured after the 1st January 2000 (MD1 to MD4 and ME). For omnibuses complying with ADR 68/00 only the driver's seat belt is required to comply with clause 17 to 19.

Essentially this ADR indicates that all omnibuses manufactured after January 1st 2000 must be fitted with seat belts, for all seating positions for which seat belt anchorages are required (in accordance with ADR 5/..). ADR 5/.. indicates that seat belt anchorages are required for all positions in motor vehicles, including buses (light omnibuses that carry more than 12 people are the only exception to this requirements. These only require seat belt anchorages for front seat or unprotected passengers).

Despite this recent amendment, this ADR does not appear to provide other requirements relating to the fitment of seat belts in buses. No reference to seating reference height or other occupant protection requirements (such as seat padding, etc) are provided in this ADR, nor has an amended version of ADR 68/.., been drafted to accommodate these changes.

The most relevant sections of this ADR include:

1. Vehicle categories MD1 and MD2 must comply with clause 5.2 to 16 (5.1.1).
2. Vehicles categories MD3, MD4 and ME must comply with either: (5.3.1).
3. *Seat belt Assemblies* of a type determined by the *Anchorage* system must be fitted to each seating position for which seat belt *Anchorages* are required in accordance with ADR 5/.. (5.2).
4. A *Lap-Sash Belt* or *Harness belt* must: (5.3.1) incorporate an "emergency locking retractor" or an "automatic locking adjustment".
5. *Seat belt assemblies* must comply with AS 2596 (5.8.1), see previous section, and AS 2597 which provides specifications for the determinants of dynamic performance.

Seat belts assemblies must be designed so that with adjustment provided it is capable of being correctly fitted in agreement with AS 2596:1995. That is, *the adjustment device shall accommodate wearers in an appropriate position, such that in the driver's position, the belt shall adjust from the 5th percentile female to the 95th percentile male. In the case of other seating positions it must accommodate the 50th percentile six-year-old to the 95th percentile adult male* (6.2.3.1.100).

Like the AS 2596:1995, this ADR specifies the requirements for seat belts buckles, belt adjustment, general requirement for seat belt components, retractors, dynamic test requirements, retractor durability requirements, dynamic testing and dummy calibration.

INFORMATION RETRIEVAL

Austroads (2002), **Investigation of Internal Bus Safety Measures**, Sydney, A4, 81pp, AP-R213/02

KEYWORDS:

Buses – safety; buses – transport; buses – design.

ABSTRACT:

The recent report *Review of the School Bus Safety Action Plan* (AP-R207, 2002) detailed the implementation of a range of school bus safety measures by jurisdictions and also provided a methodology for refining and prioritising measures contained in the National School Bus Safety Action Plan.

This report examines the implications of implementing a set of five vehicle-based countermeasures outlined in AP-R207 including lap-sash set belts, higher seat backs, one child to each single seat, prohibiting standing passengers, and improving bus rollover strength.

The report outlines work undertaken to:

— investigate the costs and associated implications of implementing each of the five vehicle-based countermeasures or actions

— determine the economic value of each countermeasure or action

— identify the tasks involved and the timing options for implementation.

AUSTROADS PUBLICATIONS

Austroads publishes a large number of guides and reports. Some of its publications are:

AP-1/89	Rural Road Design		
AP-8/87	Visual Assessment of Pavement Condition		
Guide to Traffic Engineering Practice			
AP-11.1/88	Traffic Flow	AP-11.9/88	Arterial Road Traffic Management
AP-11.2/88	Roadway Capacity	AP-11.10/88	Local Area Traffic Management
AP-11.3/88	Traffic Studies	AP-11.11/88	Parking
AP-11.4/88	Road Crashes	AP-11.12/88	Roadway Lighting
AP-11.5/88	Intersections at Grade	AP-11.13/95	Pedestrians
AP-11.6/93	Roundabouts	AP-11.14/99	Bicycles
AP-11.7/88	Traffic Signals	AP-11.15/99	Motorcycle Safety
AP-11.8/88	Traffic Control Devices		
AP-12/91	Road Maintenance Practice		
AP-13/91	Bridge Management Practice		
AP-14/91	Guide to Bridge Construction Practice		
AP-15/96	Australian Bridge Design Code		
AP-17/92	Pavement Design		
AP-18/00	RoadFacts 2000		
AP-S22/02	Austroads Pavement Strategy 2001–2004		
AP-23/94	Waterway Design, A Guide to the Hydraulic Design of Bridges, Culverts & Floodways		
AP-26/94	Strategy for Structures Research and Development		
AP-C29/01	Austroads Strategic Plan 2001–2004		
AP-G30/02	Road Safety Audit – 2nd Edition		
AP-34/95	Design Vehicles and Turning Path Templates		
AP-36/95	Adaptions and Innovations in Road & Pavement Engineering		
AP-38/95	Guide to Field Surveillance of Quality Assurance Contracts		
AP-40/95	Strategy for Ecologically Sustainable Development		
AP-41/96	Bitumen Sealing Safety Guide		
AP-42/96	Benefit Cost Analysis Manual		
AP-43/00	National Performance Indicators		
AP-44/97	Asphalt Recycling Guide		
AP-45/96	Strategy for Productivity Improvements for the Road Transport Industry		
AP-46/97	Strategy for Concrete Research and Development		
AP-47/97	Strategy for Road User Costs		
AP-48/97	Australia at the Crossroads, Roads in the Community — A Summary		
AP-49/97	Roads in the Community — Part 1: Are they doing their job?		
AP-50/97	Roads in the Community — Part 2: Towards better practice		
AP-51/98	Electronic Toll Collection Standards Study		
AP-52/97	Strategy for Traffic Management Research and Development		
AP-53/97	Strategy for Improving Asset Management Practice		
AP-54/97	Austroads 1997 Bridge Conference Proceedings — Bridging the Millennia		
AP-55/98	Principles for Strategic Planning		
AP-G56/01	Assessing Fitness to Drive — 2nd edition		
AP-57 & 58/98	Cities for Tomorrow — Better Practice Guide & Resource Document		
AP-59/98	Cities for Tomorrow — CD		
AP-60/98	Guide to Stabilisation in Roadworks		
AP-61/99	Australia Cycling 1999-2004 — The National Strategy		
AP-62/99	e-transport — The National Strategy for Intelligent Transport Systems		
AP-64/00	Austroads 4th Bridge Conference Proceedings — Bridges for the New Millenium		
AP-G65.1/01	Road Condition Monitoring Guidelines: Part 1 — Pavement Roughness		
AP-G66/02	Asphalt Guide		
AP-G67/02	Travel Demand Management: A Resource Book		
AP-G68/01	Guide to Heritage Bridge Management		
AP-G69/02	Urban Road Design: A Guide to the Design of Major Urban Roads		
AP-G70/02	Austroads Guidelines for Environmental Reporting		
AP-G71/02	A Guide for Traffic Engineers — Roads-Based Public Transport and High Occupancy Vehicles		
AP-G72/02	Telecommunications in Road Reserves: Operational Guidelines for Installations		
AP-G73/02	Guide to the Selection and Use of Bitumen Emulsions		

These and other Austroads publications may be obtained from:

ARRB Transport Research Ltd	Telephone:	+61 3 9881 1547
500 Burwood Highway	Fax:	+61 3 9887 8144
VERMONT SOUTH VIC 3131	Email:	BookSales@arrb.com.au
Australia	Website:	www.arrb.com.au

or from road authorities, or their agent in all States and Territories; Standards New Zealand; Standards Australia & Bicycle New South Wales.