

**ENCOURAGING THE PURCHASE OF SAFER  
VEHICLES - PART C**

**SAFETY CHARACTERISTICS OF THE WEST  
AUSTRALIAN FLEET**

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**for**

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### **Abstract**

Road safety research shows that there could be substantial benefits arising from encouraging the purchase of safer vehicles. To assist in the development of effective strategies an analysis of the trends with the crashworthiness of the West Australian light vehicle fleet was undertaken. Estimates were made of the proportion of vehicles in the WA fleet with safety features such as airbags and the trends with uptake of these features over the past decade.

Compared with Europe, the USA and Japan, the West Australian fleet appears to be well behind in the uptake of airbags. There are also concerns about the poor crashworthiness of some models of small car that became popular in the mid-1990s.

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### **Keywords**

PASSENGER VEHICLE, OCCUPANT, INJURIES, AIRBAG,  
CRASHWORTHINESS

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## Executive Summary

A methodology has been developed to estimate the uptake of key safety features in the West Australian (WA) vehicle fleet. Information about models on WA registration records was combined with data about safety features on models (derived from a popular buyer's guide to vehicles) to derive an estimate of the proportion of vehicles on the road with these safety features. The data has been analysed by year of manufacture, as shown on registration records. The records are based on a snapshot of the fleet as at November 2001.

Assumptions were made about the uptake of optional safety features and about the proportions of variants for each model. Subject to these assumptions, and a lack of data for a wide range of commercial vehicles, the following trends are evident from the analysis:

- The estimated proportion of WA vehicles with a driver airbag has steadily risen from 5% in 1993 to 91% in 2001. This compares with 100% uptake in Europe, Japan and the USA.
- The estimated proportion of WA vehicles with dual front airbags has steadily risen from 1% in 1993 to 41% in 2001. This compares with 100% uptake in Japan and the USA and around 60% uptake in Europe (non-luxury cars)
- The estimated proportion of WA vehicles with side (thorax) airbags is low, with just 1% for year of manufacture 2001. Luxury vehicles are better with 21% listed as having side airbags. For non-luxury cars the uptake is around 30% in Europe, 10% in the USA and 20% in Japan. The rate, overseas, for head protecting side airbags (curtains) is about half the rate for side airbags (Australian data was considered to be unreliable for this feature but the uptake is evidently less than 1%).
- The estimated proportion of WA vehicles with ABS brakes rose from 9% in 1993 to 43% in 2001. Uptake overseas was not available but is likely to be similar.

An analysis of crashworthiness derived from Used Car Safety Ratings (analysis of real-world crashes) suggests that there was a slight overall improvement between 1992 (3.7) and 1998 (2.99). However, the serious injury rate for small cars increased (became worse) between 1994 and 1995 and, by 1998, still remained above the minimum value of 4.23 (in 1993) for this group over the study period. This could be due to the popularity of some small car models that have poor crashworthiness ratings. For example, it is estimated more than 50% of small cars on the WA register that were manufactured in 1995 have a serious injury rate greater than 6.

An analysis of the limited number of ANCAP crash-tested vehicles suggests that there has been a major improvement in crashworthiness for small cars since 1998. It is too early to determine whether these improvements will be reflected in the Used Car Safety Ratings (the ANCAP tests do not cover all aspects of crashworthiness). Also, given that the average age of West Australian cars is around 10 years, it will be a considerable time before a major proportion of the WA fleet is made up of these safer small cars.

The crashworthiness of recent designs of small cars should be monitored to establish whether recent dramatic improvements in ANCAP crash test ratings are reflected in real world crash outcomes. Due to the inherent delay in producing Used Car Safety Ratings this may not be possible for a few more years. However a tentative analysis

suggest that, by 2010, there is potential for the number of car drivers killed or seriously injured to reduce by about 20%, simply due to the steady uptake of safer small cars in WA. This rate of improvement could be accelerated by encouraging the replacement of 1990s small cars by more recent models.

Opportunities for improving the safety of the WA fleet include:

- Encouraging the "early retirement" of less-safe small cars manufactured during the 1990s. (There is a dilemma that would result from discouraging used car purchasers from buying these vehicles because the price would drop and the demand may remain - but from a different group of purchasers).
- Encouraging greater uptake of safety features such as dual airbags, side airbags and curtain airbags on all types of new vehicles.
- Encouraging new vehicle purchasers to consider the results of ANCAP crash tests.
- Encouraging vehicles with lower than average aggressivity - this may partly address the problem of incompatibility between small and large vehicles and further improve the serious injury rate for small cars.

It is recommended that the composition of the West Australian fleet continue to be monitored to determine crashworthiness trends and the uptake of safety features.

## **Introduction**

There is a wide range of safety features and products available for motor vehicles that can assist in avoiding accidents or making them less severe. Some of these features are only available on luxury vehicles and these vehicles tend to do well in crashworthiness ratings based on real world crashes. The Swedish insurance organisation Folksam has estimated that at least 30% of fatal and serious injuries could be avoided if the average crashworthiness of the fleet was raised to that of the best vehicles currently available.

There would be benefits in Australia arising from making some of these safety features more widely available (that is, encouraging vehicle manufacturers to make them available as standard or optional equipment) and encouraging vehicle purchasers to buy vehicles with these features.

In addition, there is now considerable information about the relative safety of vehicle models available from the New Car Assessment Program (NCAP) and the Used Car Safety Rating (UCSR) program.

An information package that focuses on safety issues will assist in influencing the purchase of safer new vehicles, particularly fleets. To assist in the preparation of such a package an analysis has been conducted of safety features that are likely to be available in the current West Australian light vehicle fleet. The results of the analysis are set out in this report.

## **Sources of data**

The Department of Transport provided electronic data showing the number of each model of light vehicle on the West Australian register by year of manufacture.

Glass's Guide was used to establish the safety features available for each model. The Australian Greenhouse Office Fuel Consumption Guide was used to establish vehicle categories (large car, 4WD etc). This in turn was based on the motor industry's VFACTS database.

Lists of vehicles covered by Used Car Safety Ratings (UCSR) and the Australian New Car Assessment Program (ANCAP) were also prepared.

## **Data Limitations**

In the absence of a universally applied coding system for vehicle models considerable effort was required to match the registration records with those of Glass's Guide. Adding to the complications was the lack of "variant" information on the registration records. For example the 1999 Toyota Corolla has three registration record categories: hatchback, sedan and wagon with a total of 2269 vehicles. Glass's Guide lists 20 variants for Corollas manufactured in this year, which spans a new model. Of these 11 variants had a driver airbag as standard, 5 had an optional driver airbag and 4 had no airbag available. A methodology for estimating the way in which the 2269 vehicles should be allocated amongst the 20 variants needed to be developed, as did a method of estimating the uptake of optional features. These are discussed in the next section.

Although Glass's Guide purports to provide information about a wide range of features a somewhat random check of Glass's records against manufacturer's specifications

and actual vehicles revealed that some were not too reliable. Appendix A sets out an analysis of the Glass's data which is based on number of variants, not number of vehicles on the road. It is provided to give a pessimistic indication of the uptake of the safety-related features covered by Glass's. It was decided, however, that for the analysis of the WA registration records only the most reliable features would be covered. These are: driver airbag, passenger airbag, side airbags and ABS brakes.

The registration records contained a total of 5606 "models" for the years 1990 to 2001. In view of the model matching task it was decided to limit the analysis to models with more than 50 vehicles registered in any one year. This trimmed the list down to a total of 1635 models but still represented 96% of the fleet.

The vehicle categories derived from the AGO booklet were subsequently found to contain some odd classifications and therefore the vehicle type results should be treated with some caution. It appears that the VFACTS data used by the AGO is based on unmoderated submissions by vehicle manufacturers and these manufacturers are reluctant to use the categories "small", "medium" and "large". Instead they use the more desirable marketing categories of "Prestige" and "Sports".

## Methodology

### Data Model

Five database tables were created to analyse the data. These are shown in the following diagram.

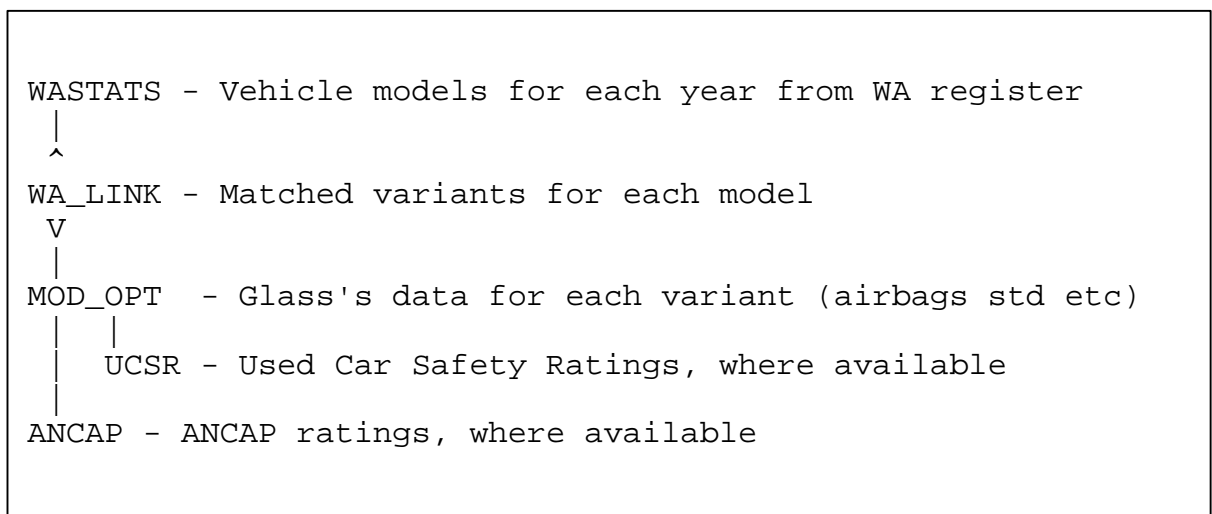


Figure 1. Data Model

## Matching Glass's Data

A computer program was developed to step through each WA STATS record and find potential matching model variants in the MOD\_OPT table, based on model name and year range. Alternative search functions were also available. Matches were manually selected from the list of candidate records and a WA\_LINK record created for each match. This record included an indication of whether the variant had various safety features as standard or optional equipment.

Some models, such as light commercials, could not be matched with the Glass's data. Nearly all cars and people movers were able to be matched.

## Assumptions about optional equipment

Where Glass's Guide indicated that a particular safety feature was optional for a variant it was necessary to make some assumptions about the proportion of those variants that had the particular feature. After discussions with some industry people it was apparent that there is no good data about these proportions for vehicles. Based on those discussions it was therefore decided to assume that 10% of purchasers would take up a safety feature if it was an optional extra. This figure is ballpark only and would vary between models and between types of safety features. Hence for each safety feature in each WA\_LINK record a value was assigned: 1=standard equipment, 0.1 = optional equipment and 0 = not available. The database table was set up so that the optional value could be varied if better information became available.

## Assumptions about proportion of variants

As indicated above, most models have more than one variant (matching MOD\_OPT record). For each model it was necessary to allocate the total number on the register between all of matched variants. It was decided to do this allocation based on the Glass's price as a first pass. The formula used was to take the price of the cheapest variant and to reduce the fraction of more expensive variants based on a linear interpolation of their price. Industry discussions and a rudimentary analysis of price versus number registered suggested that the sales quantity of a variant that was double the price of the cheapest variant would be about 5% of the cheapest variant's sales. Where the price was more than double that of the cheapest variant it was assumed that the fraction remained at 5%.



Figure 2. Variant Numbers

The resulting "sales fractions" for each variant were normalised so that the sum of the proportions of all variants for a model equalled one.



## Estimating number of safety features for each model

For each variant within a model the safety feature fraction (1, 0.1 or 0) was multiplied by the sales fraction. For each model the values of these products were summed to give an estimate of the fraction of that model with a particular safety feature. This value was multiplied by the number on the register to derive an estimate of the number of vehicles of that model with the particular safety feature.

For example: The 1998 Nissan Pulsar Sedan had 1217 vehicles on the register. There were 5 matching variants, ranging in price from \$11,900 to \$17100. Three variants had an airbag as standard and two as optional.

Table 1. Example of Estimated Uptake of Features

Variant	Price	Assumed Sales Fraction	Driver Airbag	Assumed Uptake	Product of sales & uptake	Assumed Number Regist.
A	15100	0.06	Std	1	0.06	73
B	17100	0.02	Std	1	0.02	24
C	13500	0.24	Opt	0.1	0.024	29
D	11900	0.43	Opt	0.1	0.043	52
E	13400	0.25	Std	1	0.25	304
Total	-	1.0	-	-	$\Sigma$ 0.397	$\Sigma$ 482

Hence it is estimated that 482 out of 1217 (40%) of 1998 Pulsar sedans have a driver airbag.

Similar methods (to account for numbers of vehicles on the register and the assumed sales fraction for each variant) were used for estimating the serious injury rate from UCSR data and an ANCAP score.

## Results

A total of 523,975 registered vehicles manufactured between 1990 and 2001 were successfully matched with Glass's data. This represents 73% of the fleet. The unmatched vehicles either had too few vehicles on the register (4%) or were not available in the Glass's data (23% - mostly less popular commercials and four-wheel-drives). Subject to caution about the unmatched data and the assumptions made about uptake of optional safety features and sales fractions, the following sets out a snapshot of the West Australian light vehicle fleet as at November 2001.

Tables of data are provided in Appendix B.

## Uptake of safety features

### Driver Airbag

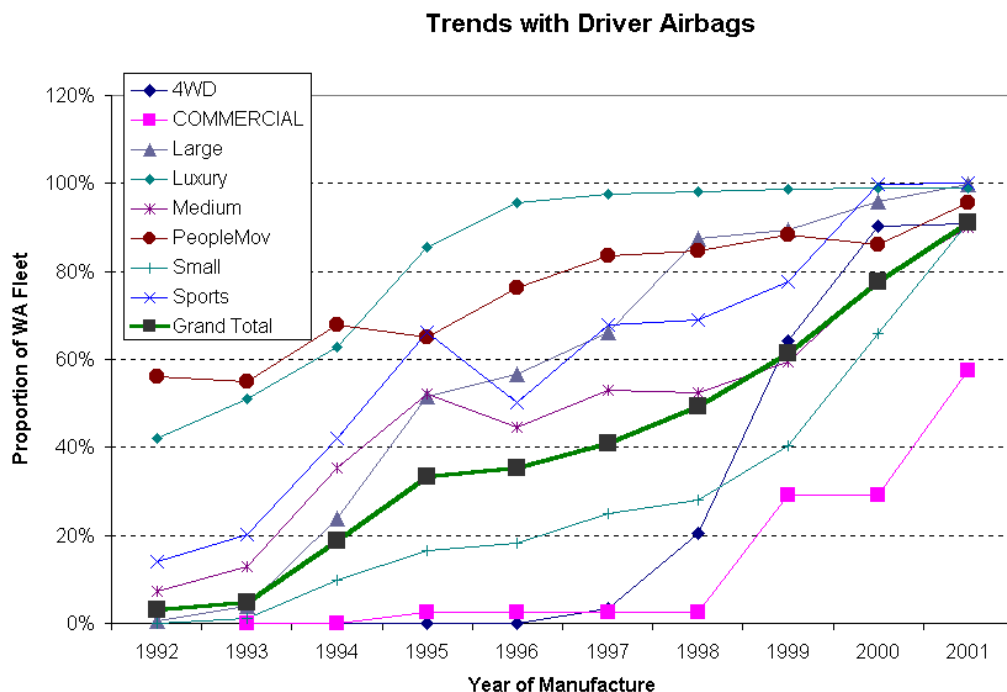


Figure 2. Estimated Uptake of Driver Airbag in WA

As expected, it can be seen that "luxury" vehicles tend to lead the way with uptake of driver airbags. By 1997 nearly all vehicles in this category had a driver airbag as standard equipment. People movers had a better than average uptake in the early 1990s. Large cars rose steadily through the decade. Small and medium cars and 4WD rose steeply from 1998. Commercial vehicles had a very low uptake until 2000 when the Commodore and Falcon utilities started to make a difference (note the sample is bias towards these two models due to a lack of matches with most other commercial vehicles).

The overall rate rose steadily from just 5% of WA light vehicles in 1993 to 91% in 2001. Commercials still have room for improvement .

### Overseas comparison

For comparison, all vehicles tested by overseas NCAP organisations had driver airbags. This covers US vehicles tested by the Insurance Institute for Highway Safety since 1995, EuroNCAP since 1997 and Japan NCAP since 2000,

## Dual Airbags

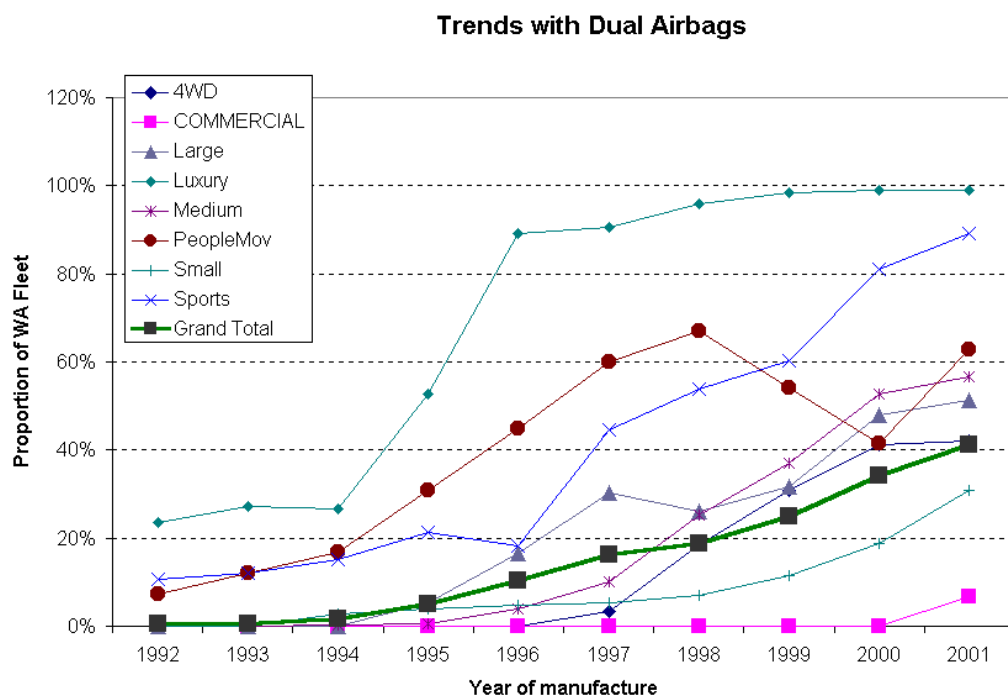


Figure 3. Uptake of dual airbags in WA

Overall uptake of passenger airbags remains low (41% for Year of Manufacture 2001). Luxury and Sports categories have a high uptake but sample sizes are small for both categories. Small cars and commercials have room for improvement.

### Overseas comparison

Table 2. Uptake of Dual Airbags Overseas (models tested by NCAP)

Test Organisation	Large/Med. Cars	Luxury Cars	People Movers	Small Cars
IIHS	100%	100%	100%	100%
EuroNCAP	66%	100%	100%	59%
Japan NCAP	100%	-	100%	100%

## Side Airbags

Trends with Side Airbags

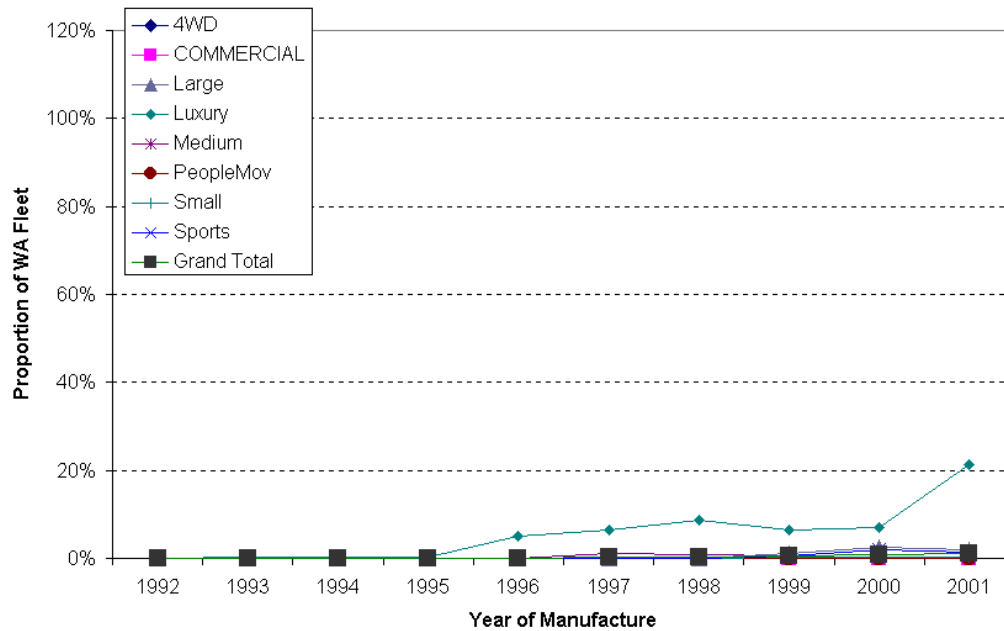


Figure 4. Uptake of side airbags in WA

Caution is needed when using the Glass's data for side airbags. However, the analysis does indicate that uptake of side airbags remains poor. Even luxury vehicles have a poor uptake (note that most "luxury" vehicles are manufactured in Australia).

### Overseas comparison

Table 3. Uptake of Side (Thorax) Airbags Overseas (models tested by NCAP)

Test Organisation	Large/Med. Cars	Luxury Cars	People Movers	Small Cars
IIHS	13%	93%	0%	10%
EuroNCAP	45%	88%	17%	24%
Japan NCAP	34%	-	20%	13%

Table 4. Uptake of Head-Protecting Side Airbags Overseas (models tested by NCAP)

Test Organisation	Large/Med. Cars	Luxury Cars	People Movers	Small Cars
IIHS	0%	29%	0%	0%
EuroNCAP	24%	63%	0%	14%
Japan NCAP	17%	-	0%	0%

## ABS Brakes

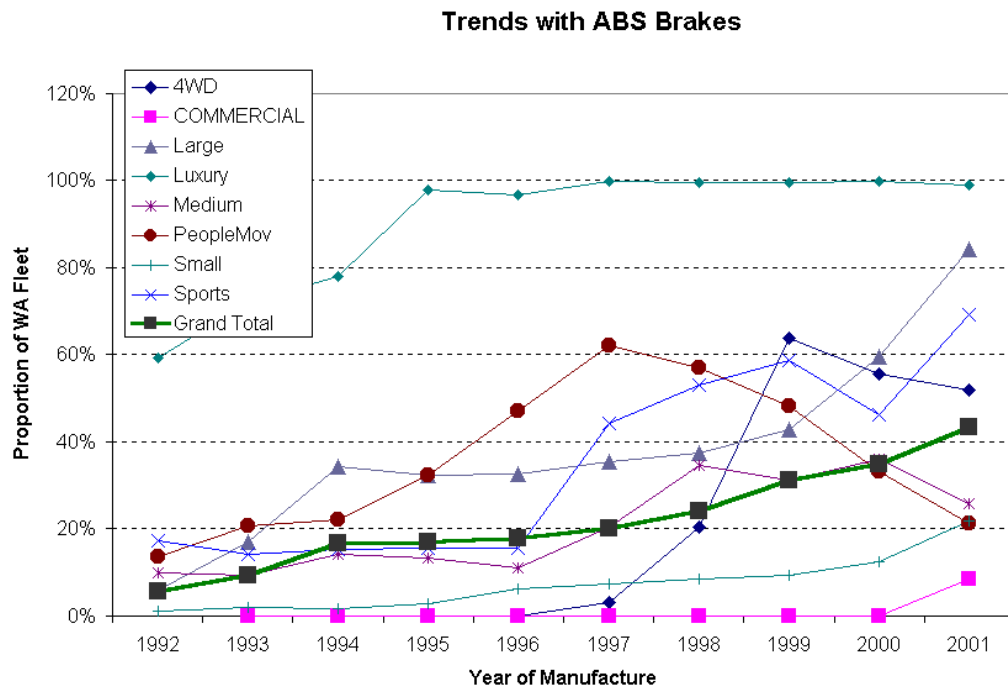


Figure 5. Uptake of ABS brakes in WA

Luxury vehicles had a 100% uptake by 1997. By 2001 large cars were doing well with 84% uptake. People movers have decreased since 1997, due possibly to cheaper competition for vehicles such as the Honda Odyssey. Small cars, medium cars and commercials also have room for improvement.

The overall rate was 43% for year of manufacture 2001.

Data for overseas NCAP-tested vehicles is not available.

## Type of vehicle

Concerns have been expressed about the increasing number of 4WDs on the roads. The analysis covered the popular 4WDs such as the Landcruiser, Patrol, Pajero, CR-V and RAV4.

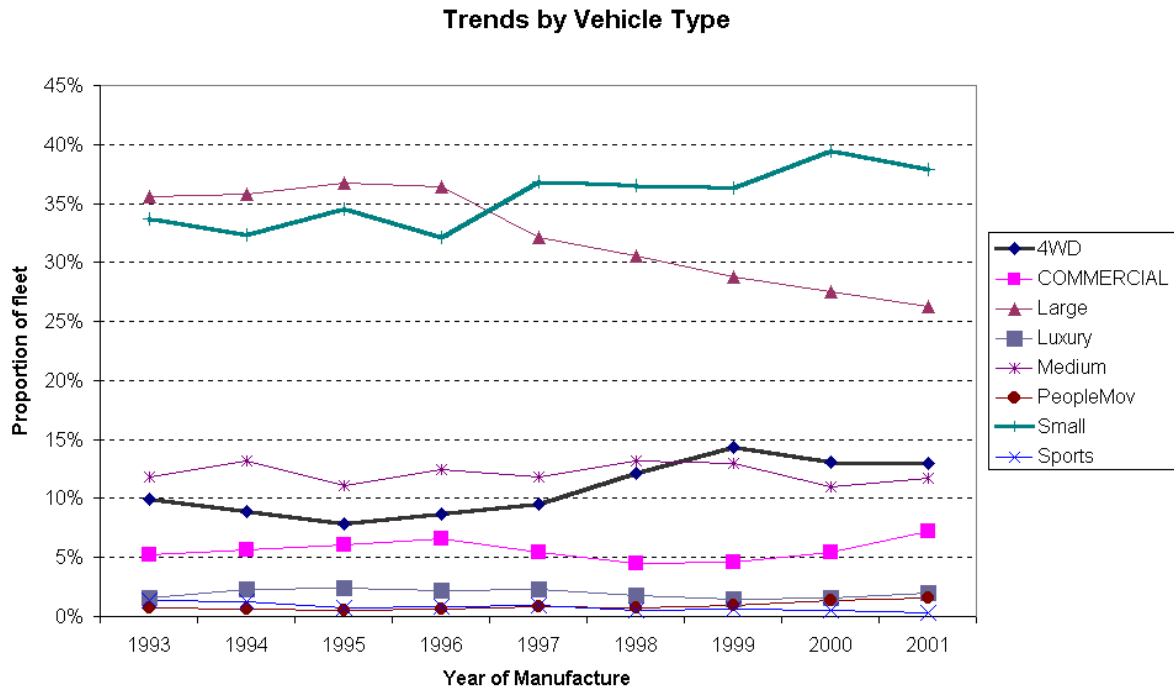


Figure 6. Proportion of WA fleet by vehicle type

Between 1995 and 2001 the proportion of 4WDs increased from 8% to 13%. This is somewhat less than expected and may be unique to West Australia. Large cars decreased during the evaluation period while all other categories generally rose. Small cars are clearly the highest proportion of the market.

Table 2. Market Share by Vehicle Type

Vehicle Type	% in 1995	% in 2001
Four wheel drive	8%	13%
Commercial	6%	7%
Large	37%	26%
Luxury	2%	2%
Medium	11%	12%
People Movers	1%	2%
Small	35%	38%
Sports	1%	<1%

## Used Car Safety Ratings

Data prepared for publication of Used Car Safety Ratings includes a serious injury rate. This is the number of serious injuries (to drivers) per 100 drivers involved in analysed crashes (from Victoria, NSW and Queensland). The serious injury rate is used to derive a crashworthiness rating for each vehicle model.

Serious injury rates have been combined with variant information and estimated proportions on the WA register, to derive serious injury rates by vehicle type and year of manufacture for the WA fleet. A total of 290,000 vehicles were matched in the way. The rating is based on real world crashes and therefore data for recent vehicle models is not available. In this figure the lowest rates are the safest vehicles.

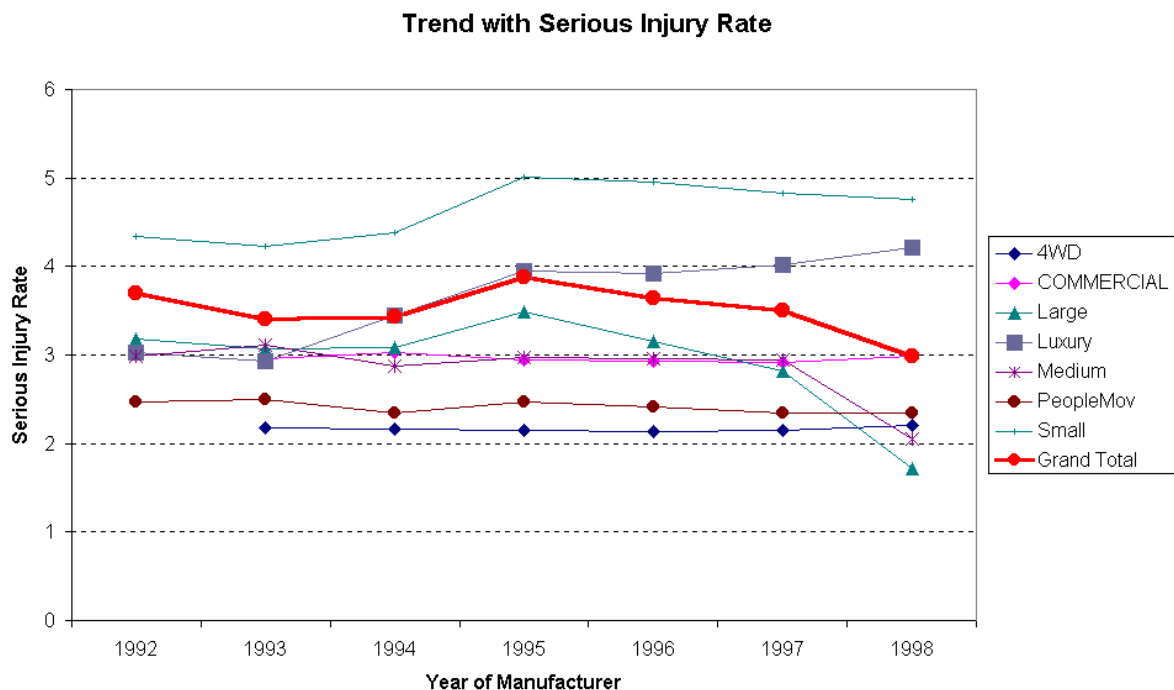


Figure 7. Estimated serious injury rates by vehicle category for the WA fleet

The rate for small cars rose (became less safe) between 1993 and 1995 and then gradually fell to 4.7%. This is more than twice the rate for most other vehicles. More than 50% of small cars on the WA register that were manufactured in 1995 have a serious injury rate in excess of 6% (Charade 6.3%, Festiva 6.1%, Barina 6.1, Excel 6.5% and Mazda 121 6.5%). These models became very popular during the 1990s.

4WDs, people movers and commercials remained roughly constant over the period. Large and medium cars dropped (became safer) from 1996. This improvement appears to correspond with the increasing uptake of airbags. These categories are now slightly better than 4WDs. The steady increase in the luxury car rate to 4.2% in 1998 is probably due to the popularity of the Holden Statesman (94-98) that has a serious injury rate of 4.4% despite a standard driver airbag. Note however, that the 95% confidence interval for the Statesman serious injury rating is quite large at 2.9%.

## ANCAP Crash Test Ratings

ANCAP adopted the European test and assessment protocols in 1999. From this time test scores are available for models tested in Australia and Europe.

The ANCAP star rating is derived from a frontal offset crash test at 64km/h and a moving barrier side impact crash test at 50km/h. Each test scores a maximum of 16 points, based on injury measurements and "modifiers" (to take account of deformation and other factors that may increase injury risk). Offset and side impact scores are combined to give an overall score out of 32.

*Caution is needed because only a very limited number of models have been tested by ANCAP. Overall only 55,000 vehicles were matched from WA registration records. Sample sizes for luxury and sports categories were too small to produce meaningful data.*

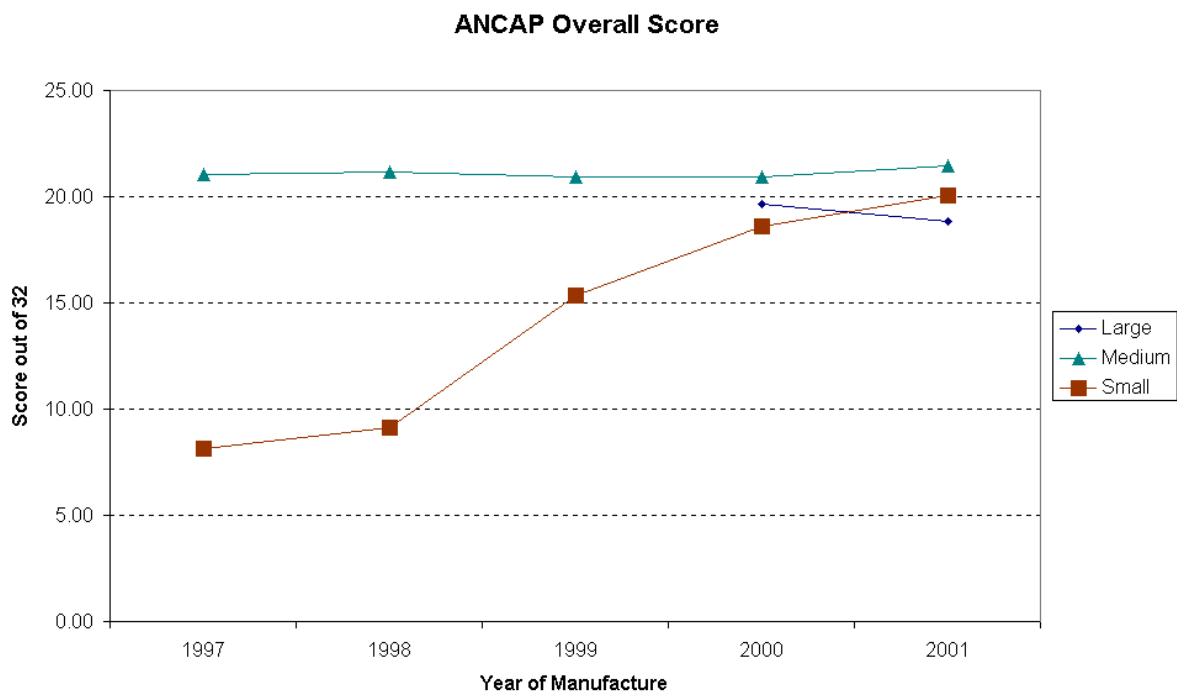


Figure 8. ANCAP overall score for WA fleet

There has been a major improvement in the overall score for small cars in WA since 1998. This appears to match the trend for uptake of driver airbags. Other vehicles have remained roughly constant over the period - this may simply reflect the small number of model changes during this time for these other categories.

## Predicting future trends

Unfortunately there is no meaningful overlap of ANCAP crash test ratings and Used Car Safety Ratings for the same vehicles model. This is because UCSR are based on real accident data that is several years old and ANCAP only commenced testing to the EuroNCAP protocol late in 1999.



In the absence of data that correlates UCSR with ANCAP scores it is difficult to predict future trends with serious injury rates - in other words, projecting Figure 7 into the current decade.

The ANCAP assessments conducted by VDR include a calculation of the risk of life-threatening injury to the driver. This is based on head injury criterion (HIC) and chest deceleration. A brief analysis of recent ANCAP test data indicates a moderate correlation between this injury risk and the overall score.

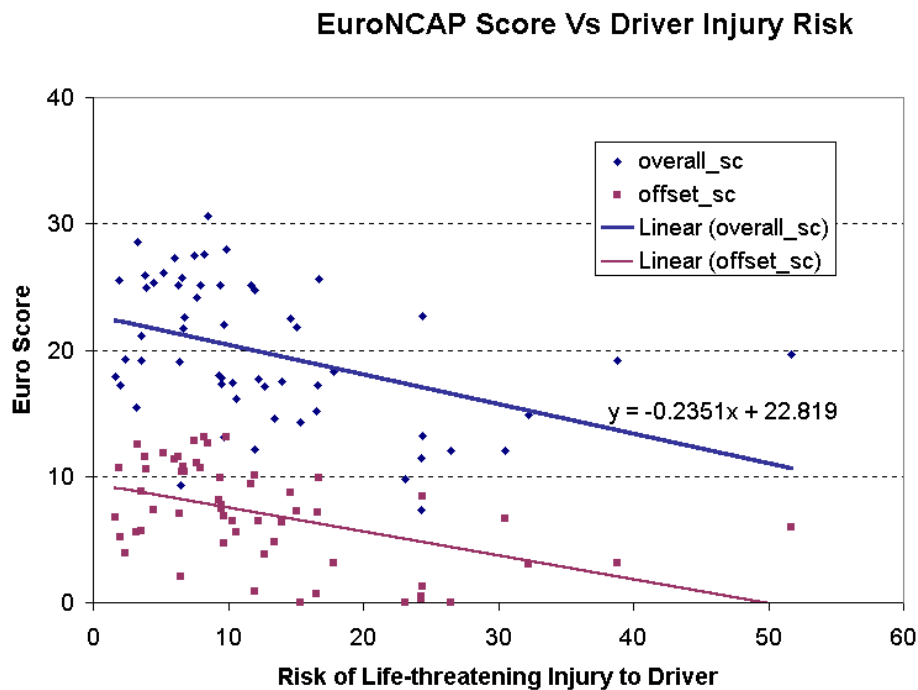


Figure 9. EuroNCAP score Vs risk of life threatening injury to the driver.

There is considerable scatter in the graph but it does suggest that the improvement in the NCAP overall score observed in small cars between 1998 and 2001 (figure 10) should be associated with a corresponding large reduction in the risk of life-threatening injury. A conservative approach is to assume that the risk of life threatening injury will halve when the NCAP score goes from 10 to 20. If this improvement is reflected in serious injury rates, as measured under the UCSR, then serious injury rates can be expected to halve for the recently tested small cars.

The average serious injury rate for small cars manufactured in 1998 was 4.76% (Figure 7). Given that small cars made up about 37% of the fleet for that year of manufacture, it is estimated that serious injuries sustained in small cars accounted for about 60% of all serious injuries to drivers [ proportion of small cars 37% ) x (serious injury rate for small cars 4.76%) / (serious injury rate for all cars 2.99) ]. The potential reduction in overall serious injuries to drivers of cars in WA is therefore about 30% - a remarkable improvement to road safety, particularly since car drivers make up about half of all fatal or seriously injured road casualties.

Of course it will take a considerable time for the composition of the small vehicle fleet to change so that the majority of vehicle kilometres driven in WA are in the better performing current generation of small cars. The average age of the vehicle fleet is

about 10 years so, on current trends, by 2010 no more than 50% of the WA fleet will be vehicles built in 2000 or later. Newer vehicles tend to travel higher annual kilometres than older vehicles. It is estimated that by 2006 about half the annual kilometres driven will be in vehicles manufactured in 2000 or later. By the end of the decade this will improve to perhaps 70% (Paine 1995).

This *tentative* analysis suggests that, by 2010, there is potential for the number of car drivers killed or seriously injured in WA to reduce by about 20%, simply due to the steady uptake of safer small cars. This rate of improvement could be accelerated by encouraging the replacement of 1990s small cars by more recent models.

## Conclusions

A methodology has been developed to estimate the uptake of key safety features in the West Australian vehicle fleet. Information about models on West Australian registration records was combined with data about safety features on models (derived from a popular buyer's guide to vehicles) to derive an estimate of the proportion of vehicles on the road with these safety features. The data has been analysed by year of manufacture, as shown on registration records. The records are based on a snapshot of the fleet as at November 2001.

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- The proportion of WA light vehicles with side (thorax) airbags is low, with just 1% for year of manufacture 2001. Luxury vehicles are better with 21% listed as having side airbags. For non-luxury cars the uptake is around 30% in Europe, 10% in the USA and 20% in Japan. The rate, overseas, for head protecting side airbags (curtains) is about half the rate for side airbags (Australian data was considered to be unreliable for this feature but the uptake is evidently less than 1%).
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An analysis of the limited number of ANCAP crash-tested vehicles suggests that there has been a major improvement in crashworthiness for new small cars since 1998. It is too early to determine whether these improvements will be reflected in the Used Car Safety Ratings (the ANCAP tests do not cover all aspects of crashworthiness). Also, given that the average age of West Australian cars is around 10 years, it will be a considerable time before a major proportion of the WA fleet is made up of these safer small cars.

The crashworthiness of recent designs of small cars should be monitored to establish whether recent dramatic improvements in ANCAP crash test ratings are reflected in real world crash outcomes. Due to the inherent delay in producing Used Car Safety Ratings this may not be possible for a few more years. However, a tentative analysis suggests that, by 2010, there is potential for the number of car drivers killed or seriously injured in WA to reduce by about 20%, simply due to the steady uptake of safer small cars. This rate of improvement could be accelerated by *encouraging the replacement of 1990s small cars by more recent models*.

Opportunities for improving the safety of the fleet include:

- Encouraging the "early retirement" of less-safe small cars manufactured during the 1990s. (There is a dilemma that would result from discouraging used car purchasers from buying these vehicles because the price would drop and the demand may remain - but from a different group of purchasers).
- Encouraging greater uptake of safety features such as dual airbags, side airbags and curtain airbags on all types of new vehicles.
- Encouraging new vehicle purchasers to consider the results of ANCAP crash tests.
- Encouraging vehicles with lower than average aggressivity - this may partly address the problem of incompatibility between small and large vehicles.

It is recommended that the composition of the West Australian fleet continue to be monitored to determine crashworthiness trends and the uptake of safety features.

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NRMA (1997) *Supporting Information for the Nomination of Used Car Safety Rating Program for the 1997 Windscreens O'Brien Awards*, Submission by NRMA, RTA, RACV and FORS.

Paine M. (1995) *Cash for Clunkers: Reducing Emissions by Early Scrappage of Australian Motor Vehicles*, report prepared for NRMA Limited, March 1995.

## Appendix A - Summary of analysis of Glass's Guide safety feature information

The following tables and graphs set out the results of an analysis of data from Glass's Guide. *Note that this is based on number of models for each year and not on the number of vehicles on the road.* Also it is evident that some vehicle types have a larger number of variants than others. For this reason "luxury" cars tend to contribute a disproportionate amount to the overall statistics - this should be remembered when interpreting the graphs and data for "all models".

Data for four-wheel-drives and commercial vehicles was very limited - only popular models are listed and these represent only a small fraction of all models for these categories.

The analysis was confined to : ABS brakes, dual airbags, side airbags (front thorax), cruise control and electrically adjustable external mirrors. Data on other features may not be reliable enough for analysis.

SUMMARY OF ANALYSIS OF SAFETY FEATURES BY MODEL  
NUMBER OF MODELS FOR EACH YEAR

VEHICLE TYPE		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
ALL	N:	473	877	1098	1147	1216	1179	1121	1157	1143	1019
COMMERCIAL	N:	7	8	9	10	9	9	9	11	10	9
Large	N:	41	89	108	116	123	139	113	138	144	127
Luxury	N:	131	256	292	311	327	322	281	319	347	319
Medium	N:	62	153	203	198	177	160	187	162	180	153
OFF-ROAD	N:	7	7	7	8	8	9	12	13	14	13
PeopleMov	N:	23	32	39	43	44	44	47	47	61	37
Small	N:	131	232	301	316	382	368	362	354	314	290
Sports	N:	68	97	129	137	137	119	101	104	62	69
Van	N:	3	3	10	8	9	9	9	9	11	2

SUMMARY OF ANALYSIS OF SAFETY FEATURES BY MODEL  
PERCENT OF MODELS WITH FEATURE

-----ABS BRAKES-----		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
ALL	STD	41	41	44	46	50	53	55	59	64	71
	OPT	4	10	16	18	16	17	16	16	13	10
COMMERCIAL	STD	0	0	0	0	0	0	0	0	0	0
	OPT	0	0	0	0	0	0	0	9	10	33
Large	STD	27	35	42	45	48	48	63	60	77	87
	OPT	2	9	29	32	29	40	33	37	22	9
Luxury	STD	85	87	88	89	93	95	97	97	97	98
	OPT	2	2	2	2	0	0	0	0	0	0
Medium	STD	29	24	26	21	30	36	48	68	57	71
	OPT	16	33	38	41	38	34	30	22	31	19
OFF-ROAD	STD	0	0	0	0	0	11	33	38	36	38
	OPT	0	0	0	0	0	0	0	8	14	15
PeopleMov	STD	30	41	41	42	45	50	49	49	49	49
	OPT	9	6	3	2	2	2	6	6	8	11
Small	STD	11	9	17	23	29	30	31	30	32	39
	OPT	3	9	15	16	18	17	18	18	16	14
Sports	STD	46	38	44	45	41	52	47	47	65	75
	OPT	0	0	12	18	20	24	22	28	11	9
Van	STD	67	67	20	25	22	22	22	22	36	100
	OPT	0	0	0	0	0	0	0	0	0	0
-----DRIVER AIRBAG-----		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
ALL	STD	31	38	47	55	58	65	69	78	85	92
	OPT	4	12	21	23	24	22	19	14	8	5
COMMERCIAL	STD	0	0	0	0	0	0	0	18	20	22
	OPT	0	0	0	10	11	11	11	9	10	11
Large	STD	7	10	25	40	46	63	87	87	98	100
	OPT	0	9	33	35	33	28	12	12	2	0
Luxury	STD	70	80	90	93	96	96	97	97	97	98
	OPT	5	3	2	2	2	1	1	0	0	0
Medium	STD	10	25	33	41	46	50	64	88	89	96
	OPT	0	24	36	41	38	38	27	10	9	4
OFF-ROAD	STD	0	0	0	0	0	11	33	46	57	62
	OPT	0	0	0	0	0	0	0	0	7	8
PeopleMov	STD	83	75	82	79	82	89	89	91	93	92
	OPT	0	0	3	2	2	2	2	2	2	3
Small	STD	2	11	22	33	37	44	46	55	66	83
	OPT	9	19	30	34	36	36	35	30	22	13
Sports	STD	38	32	45	52	50	64	68	71	89	87
	OPT	0	9	18	21	23	18	16	17	3	3
Van	STD	0	0	70	88	89	89	89	89	91	100
	OPT	0	0	0	0	0	0	0	0	0	0

-----FRONT PASSENGER AIRBAG-----											
		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
ALL	STD	13	14	21	25	32	42	47	56	63	72
	OPT	0	1	5	8	13	16	19	18	14	11
COMMERCIAL	STD	0	0	0	0	0	0	0	0	0	0
	OPT	0	0	0	0	0	0	0	0	0	22
Large	STD	0	0	0	7	16	31	42	49	60	74
	OPT	0	0	0	16	29	34	45	41	28	10
Luxury	STD	35	40	51	59	74	85	91	93	94	97
	OPT	0	2	4	4	3	0	0	0	0	0
Medium	STD	0	0	5	7	13	23	33	56	51	65
	OPT	0	0	13	15	24	30	33	24	21	13
OFF-ROAD	STD	0	0	0	0	0	11	25	38	36	38
	OPT	0	0	0	0	0	0	8	8	14	15
PeopleMov	STD	43	44	56	53	57	61	64	64	66	62
	OPT	0	0	0	0	0	0	0	0	2	3
Small	STD	1	1	8	12	16	20	24	30	38	49
	OPT	0	0	3	5	12	18	22	24	23	25
Sports	STD	6	5	14	18	18	28	45	50	79	83
	OPT	0	2	8	13	13	19	24	25	5	3
Van	STD	0	0	10	13	11	11	11	11	27	100
	OPT	0	0	0	0	0	0	0	0	0	0
-----CRUISE CONTROL-----											
		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
ALL	STD	40	45	46	45	48	49	50	53	58	62
	OPT	4	5	5	5	4	5	5	6	6	5
COMMERCIAL	STD	0	0	0	0	0	0	0	0	0	0
	OPT	0	0	0	0	0	0	0	0	0	0
Large	STD	41	39	44	51	56	60	69	68	67	69
	OPT	0	11	14	13	14	19	20	21	27	24
Luxury	STD	62	69	69	68	77	86	91	91	94	94
	OPT	12	9	8	8	4	2	4	4	2	2
Medium	STD	53	49	62	59	64	56	60	64	63	73
	OPT	0	0	0	0	0	3	5	8	7	3
OFF-ROAD	STD	0	0	0	0	0	0	8	15	14	15
	OPT	0	0	0	0	0	0	0	0	0	0
PeopleMov	STD	17	34	41	37	41	43	45	45	48	46
	OPT	9	6	5	5	5	5	6	6	5	3
Small	STD	11	23	21	19	22	18	15	18	19	23
	OPT	0	2	2	2	2	1	1	1	2	3
Sports	STD	57	47	38	35	31	31	32	40	55	62
	OPT	0	0	8	7	8	13	13	13	0	0
Van	STD	0	0	0	0	0	0	0	0	0	0
	OPT	0	0	0	0	0	0	0	0	0	0

-----EXTERNAL MIRRORS ELECTRICALLY ADJUSTABLE-----

		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
ALL	STD	58	65	75	77	77	78	80	80	85	86
	OPT	0	1	1	1	0	0	0	0	0	0
COMMERCIAL	STD	0	0	0	0	0	0	0	0	0	0
	OPT	0	0	0	0	0	0	0	0	0	0
Large	STD	71	79	91	93	95	99	98	97	98	99
	OPT	0	0	0	0	0	0	0	0	0	0
Luxury	STD	67	68	78	81	83	85	91	93	96	97
	OPT	1	2	2	2	0	0	0	0	0	0
Medium	STD	65	86	96	94	93	94	96	99	100	100
	OPT	0	0	0	0	0	0	0	0	0	0
OFF-ROAD	STD	0	0	0	0	0	0	8	8	7	8
	OPT	0	0	0	0	0	0	0	0	0	0
PeopleMov	STD	87	84	87	81	84	86	89	91	93	95
	OPT	0	0	0	0	0	0	0	0	0	0
Small	STD	40	49	54	59	60	55	59	54	61	64
	OPT	0	0	0	0	0	1	1	1	1	1
Sports	STD	65	59	76	79	82	87	90	90	85	90
	OPT	0	0	0	0	0	0	0	0	0	0
Van	STD	0	0	80	100	100	100	100	100	100	100
	OPT	0	0	0	0	0	0	0	0	0	0

-----SIDE AIRBAG - FRONT SEAT, THORAX-----

		1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
ALL	STD	0	1	1	1	3	4	6	8	10	14
	OPT	0	0	0	0	0	0	2	3	4	3
COMMERCIAL	STD	0	0	0	0	0	0	0	0	0	0
	OPT	0	0	0	0	0	0	0	0	0	0
Large	STD	0	0	0	0	0	0	1	0	0	1
	OPT	0	0	0	0	0	0	0	8	13	9
Luxury	STD	2	5	4	5	9	16	24	26	31	36
	OPT	0	0	0	0	1	0	1	1	1	1
Medium	STD	0	0	0	0	0	1	1	1	1	5
	OPT	0	0	0	0	2	3	5	7	6	5
OFF-ROAD	STD	0	0	0	0	0	0	0	0	0	0
	OPT	0	0	0	0	0	0	0	0	0	0
PeopleMov	STD	0	0	0	0	0	0	0	0	0	0
	OPT	0	0	0	0	0	0	0	0	0	0
Small	STD	0	0	0	0	0	0	1	1	1	5
	OPT	0	0	0	0	0	0	1	2	2	2
Sports	STD	0	0	0	0	0	0	0	1	2	10
	OPT	0	0	0	0	0	0	0	3	6	6
Van	STD	0	0	0	0	0	0	0	0	0	0
	OPT	0	0	0	0	0	0	0	0	0	0

### UPTAKE OF ABS BRAKES (GLASS'S MODELS)

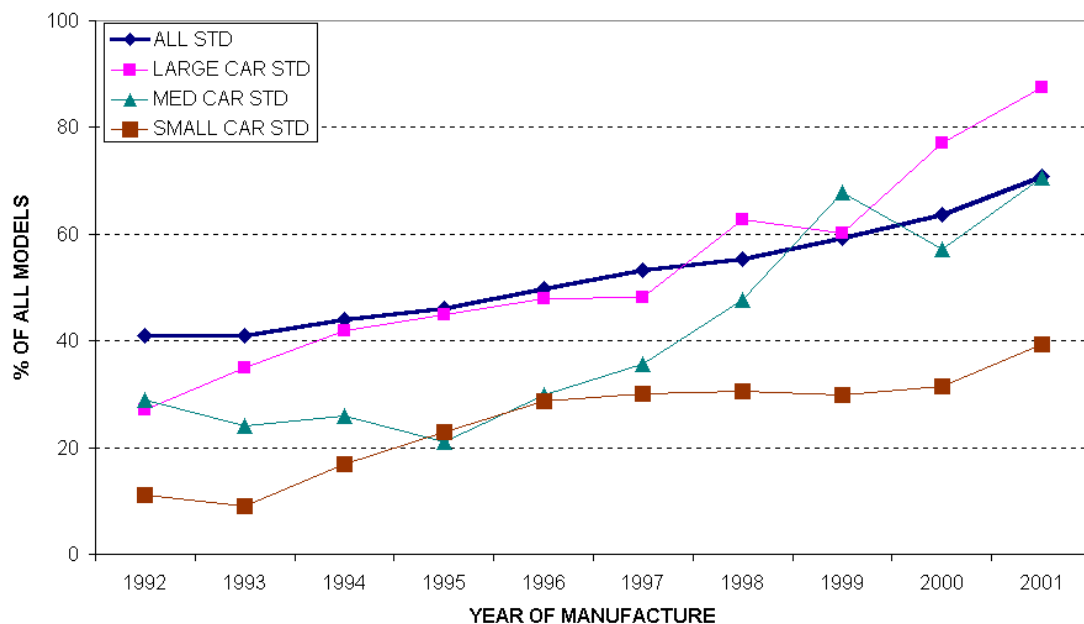


Figure A1. Uptake of ABS Brakes by Model

### UPTAKE OF DRIVER AIRBAG (GLASS'S MODELS)

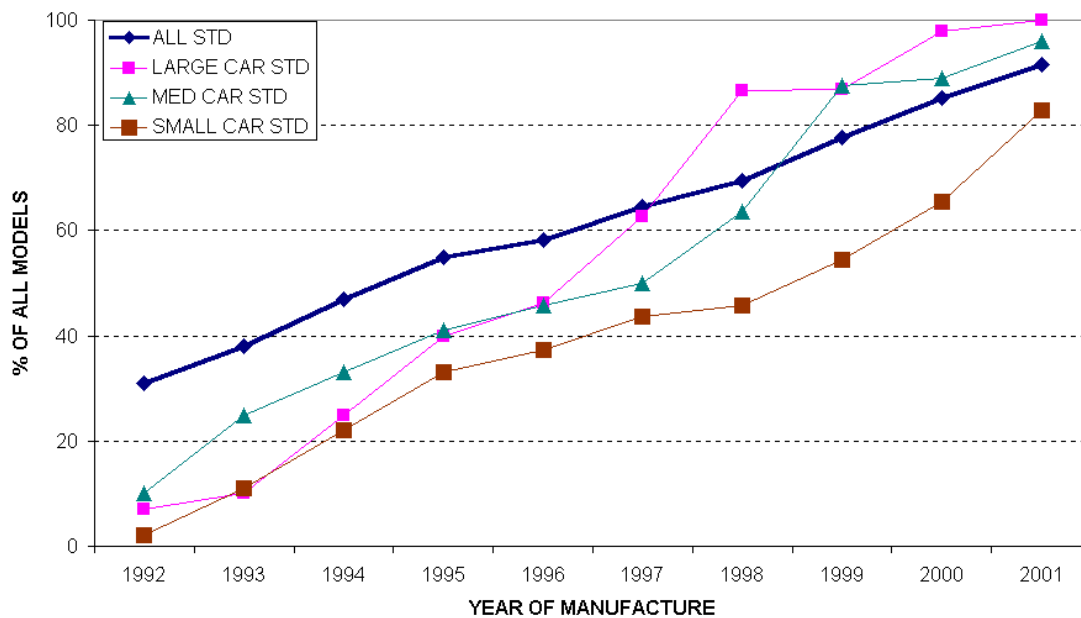


Figure A2. Uptake of Driver Airbag by Model



### UPTAKE OF DUAL AIRBAGS (GLASS'S MODELS)

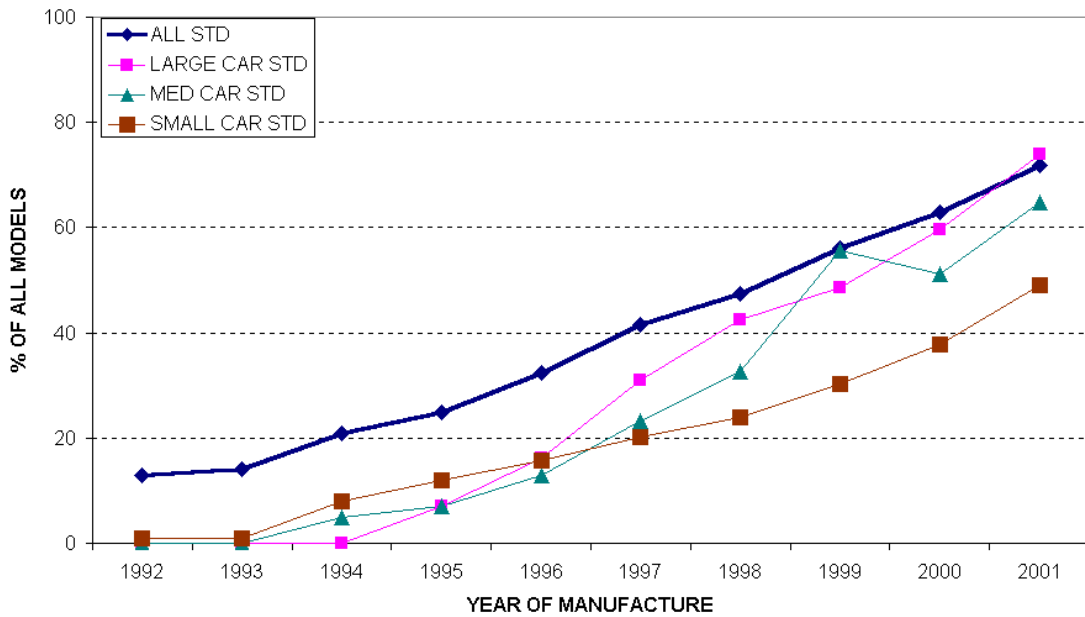


Figure A3. Uptake of Dual Airbags by Model

### UPTAKE OF CRUISE CONTROL (GLASS'S MODELS)

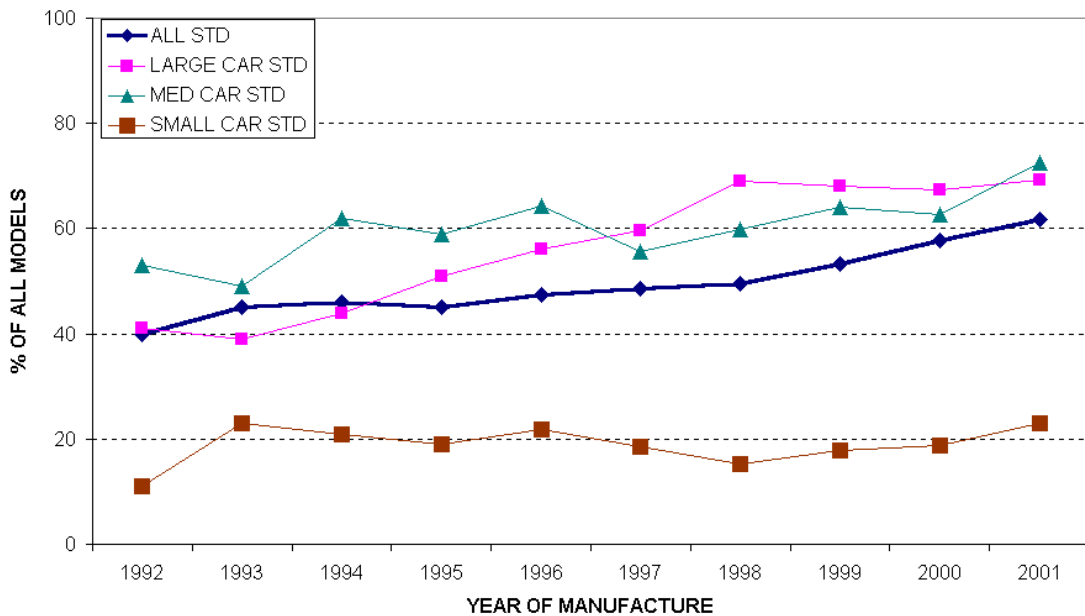


Figure A4. Uptake of Cruise Control by Model

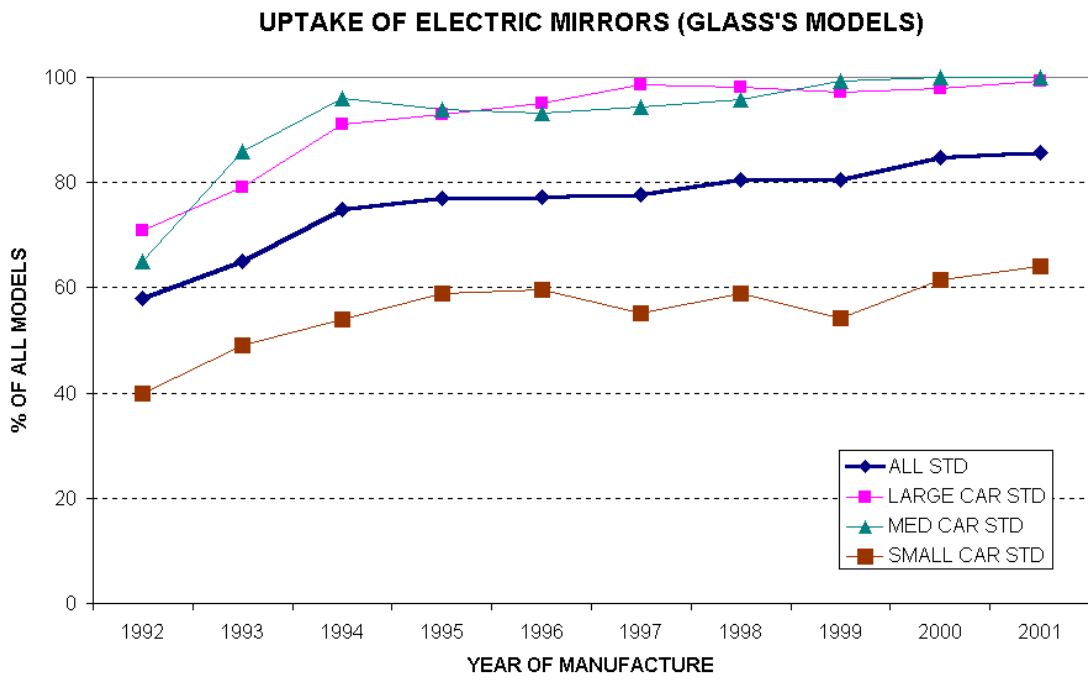


Figure A5. Uptake of Electric Mirrors by Model



## Appendix B - Tables of Results - Analysis of West Australian Fleet.

Table B1. Total Number of Matched Vehicles (from WA registration records)

Year of Manuf.	4WD	Commercial	Large	Luxury	Medium	People Mover	Small	Sports	Grand Total
1990				12	3131	169	3455	305	7072
1991			1967	162	3747	233	11309	367	17785
1992			12658	531	5027	422	13869	699	33206
1993	4405	2304	15769	700	5244	317	14937	620	44296
1994	4341	2762	17369	1110	6383	284	15731	598	48578
1995	3962	3067	18447	1194	5577	267	17317	350	50181
1996	4554	3463	19034	1139	6496	324	16762	448	52220
1997	5318	3014	17930	1298	6600	487	20546	535	55728
1998	7585	2809	19088	1137	8275	474	22850	305	62523
1999	7896	2513	15788	806	7116	509	19969	359	54956
2000	7663	3193	16082	887	6437	776	23046	320	58404
2001	5062	2805	10252	766	4586	626	14789	140	39026
All	50786	25930	164384	9742	68619	4888	194580	5046	523975

Table B2. Estimated Proportion of WA light vehicle fleet with Driver Airbag

Year of Manuf.	4WD	Comm.	Large	Luxury	Medium	People Mover	Small	Sports	All
1990				58.3%	11.9%	70.4%	0.1%	0.0%	7.1%
1991			0.0%	8.0%	8.6%	68.2%	0.1%	14.2%	3.1%
1992			0.5%	42.2%	7.2%	56.2%	0.1%	14.0%	3.0%
1993	0.0%	0.0%	4.0%	51.1%	12.8%	54.9%	1.3%	20.2%	4.8%
1994	0.0%	0.0%	23.9%	62.9%	35.3%	68.0%	9.9%	42.1%	18.7%
1995	0.0%	2.4%	51.6%	85.5%	52.1%	65.2%	16.6%	66.3%	33.5%
1996	0.0%	2.5%	56.6%	95.7%	44.4%	76.2%	18.3%	50.2%	35.2%
1997	3.3%	2.4%	66.2%	97.5%	52.9%	83.6%	25.0%	67.9%	40.9%
1998	20.4%	2.6%	87.6%	98.1%	52.5%	84.8%	28.1%	68.9%	49.3%
1999	64.1%	29.1%	89.3%	98.8%	59.4%	88.4%	40.4%	77.7%	61.3%
2000	90.4%	29.2%	95.9%	99.1%	78.2%	86.2%	65.8%	99.7%	77.7%
2001	90.8%	57.5%	99.7%	99.1%	90.0%	95.5%	91.0%	100.0%	91.0%
All	36.0%	13.8%	56.9%	84.4%	45.2%	78.3%	28.8%	45.5%	41.4%

Table B3. Estimated proportion of WA light vehicle fleet with dual airbags

Year of Manuf.	4WD	Comm.	Large	Luxury	Medium	People Mover	Small	Sports	All
1990				58.3%	0.0%	11.2%	0.0%	0.0%	0.4%
1991			0.0%	5.6%	0.0%	9.0%	0.0%	10.9%	0.4%
1992			0.0%	23.5%	0.0%	7.3%	0.0%	10.7%	0.7%
1993	0.0%	0.0%	0.0%	27.1%	0.0%	12.0%	0.0%	11.9%	0.7%
1994	0.0%	0.0%	0.0%	26.6%	0.3%	16.9%	2.7%	15.2%	1.8%
1995	0.0%	0.0%	5.4%	52.6%	0.6%	30.7%	3.9%	21.4%	4.9%
1996	0.0%	0.0%	16.6%	89.3%	4.0%	44.8%	4.7%	18.3%	10.5%
1997	3.3%	0.0%	30.4%	90.5%	10.2%	60.0%	5.3%	44.7%	16.3%
1998	18.4%	0.0%	26.2%	96.0%	25.1%	66.9%	7.1%	53.8%	18.7%
1999	30.9%	0.0%	31.8%	98.4%	36.9%	54.0%	11.5%	60.2%	24.9%
2000	41.2%	0.0%	48.0%	99.1%	52.7%	41.5%	18.7%	80.9%	34.3%
2001	42.0%	6.6%	51.4%	99.1%	56.7%	62.9%	30.9%	89.3%	41.1%
All	18.3%	0.7%	19.8%	71.5%	17.0%	40.6%	8.1%	28.5%	15.3%

Table B4. Estimated proportion of WA light vehicle fleet with side airbags

Year of Manuf.	4WD	Comm.	Large	Luxury	Medium	People Mover	Small	Sports	All
1990				0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1991			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1992			0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
1993	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%
1994	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	0.0%	0.0%
1995	0.0%	0.0%	0.0%	0.4%	0.0%	0.0%	0.0%	0.0%	0.0%
1996	0.0%	0.0%	0.0%	5.1%	0.1%	0.0%	0.0%	0.0%	0.1%
1997	0.0%	0.0%	0.0%	6.5%	1.2%	0.0%	0.0%	0.0%	0.3%
1998	0.0%	0.0%	0.0%	8.6%	0.8%	0.0%	0.0%	0.0%	0.3%
1999	0.0%	0.0%	1.1%	6.3%	0.6%	0.0%	0.3%	0.6%	0.6%
2000	0.0%	0.0%	2.6%	7.0%	0.0%	0.0%	0.1%	1.9%	0.9%
2001	0.0%	0.0%	1.9%	21.4%	0.0%	0.0%	0.2%	1.4%	1.0%
All	0.0%	0.0%	0.5%	5.4%	0.3%	0.0%	0.1%	0.2%	0.3%

Table B5. Estimated proportion of WA light vehicle fleet with ABS brakes.

	4WD	Comm.	Large	Luxury	Medium	People Mover	Small	Sports	All
1990				91.7%	6.8%	18.9%	1.5%	0.0%	4.4%
1991			0.1%	22.2%	3.3%	18.5%	0.6%	8.7%	1.7%
1992			6.0%	59.3%	9.8%	13.7%	1.2%	17.2%	5.8%
1993	0.0%	0.0%	17.1%	72.0%	9.3%	20.8%	2.0%	14.2%	9.4%
1994	0.0%	0.0%	34.3%	78.0%	14.2%	22.2%	1.8%	15.4%	16.8%
1995	0.0%	0.0%	32.5%	97.8%	13.3%	32.2%	2.8%	15.7%	17.0%
1996	0.0%	0.0%	32.6%	96.7%	11.0%	47.2%	6.3%	15.6%	17.8%
1997	3.3%	0.0%	35.5%	99.8%	20.3%	62.0%	7.2%	44.3%	20.1%
1998	20.4%	0.0%	37.6%	99.5%	34.5%	57.0%	8.4%	53.1%	24.1%
1999	63.7%	0.0%	42.7%	99.5%	31.1%	48.3%	9.4%	58.8%	31.2%
2000	55.5%	0.0%	59.6%	99.9%	36.1%	33.2%	12.4%	46.3%	34.8%
2001	51.9%	8.6%	84.1%	99.1%	25.9%	21.4%	22.0%	69.3%	43.4%
All	26.8%	0.9%	36.6%	91.1%	19.8%	35.0%	7.1%	26.0%	21.6%



Table B6. Estimated Average Serious Injury Rate of WA light vehicle fleet (based on Used Car Safety Ratings)

Year of Manuf.	4WD	Comm.#	Large	Luxury*	Medium	People Mover	Small	Sports*	All
1992			3.17	3.03	2.99	2.48	4.33	4.05	3.70
1993	2.17	2.95	3.06	2.94	3.11	2.50	4.23	4.13	3.40
1994	2.16	3.03	3.08	3.45	2.88	2.34	4.38	2.73	3.43
1995	2.15	2.94	3.48	3.95	2.98	2.47	5.01	4.43	3.88
1996	2.14	2.92	3.15	3.92	2.96	2.42	4.96	4.43	3.65
1997	2.15	2.91	2.82	4.02	2.94	2.34	4.83	0.98	3.50
1998	2.20	2.99	1.72	4.21	2.05	2.34	4.76	1.25	2.99
All	2.16	2.96	2.88	3.73	2.81	2.42	4.66	3.21	3.49

\* Large confidence intervals for most vehicles in these categories.

# Biased sample for commercial vehicles due to matching limitations.

Table B7. Sample Sizes (of WA fleet) for UCSR Analysis

Year of Manuf.	4WD	Comm.	Large	Luxury	Medium	People Mover	Small	Sports	All
1992			9321	308	3945	322	12757	361	27014
1993	4405	876	11508	344	4367	267	13426	362	35555
1994	4341	1227	13296	729	5902	248	15248	366	41357
1995	3749	943	15329	828	5252	197	16183	88	42569
1996	4093	1155	18079	676	5889	202	15374	35	45503
1997	4576	1041	17732	580	4930	187	16498	179	45723
1998	5494	1038	17385	487	6372	120	18041	110	49047

Table B7. Estimated Average ANCAP Overall Score of WA light vehicle fleet  
(weighted by number on WA register)

Year of Manuf.	Large	Medium	Small	All
1997		21.07	8.14	20.24
1998		21.19	9.13	19.40
1999		20.95	15.36	19.37
2000	19.67	20.94	18.61	19.59
2001	18.84	21.45	20.06	19.85
All	19.29	21.10	17.97	19.65

Table B8 Sample Sizes for NCAP Analysis

Year of Manuf.	Large	Medium	Small	All
1995			59	59
1996			11	11
1997		3437	234	3671
1998		5586	975	6561
1999		5883	2316	8199
2000	8193	4496	6874	19563
2001	7063	3661	6003	16727
All	15256	23063	16472	54791