IMPROVEMENTS IN NCAP RESULTS FOR AUSTRALIAN VEHICLES

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Paper Number 98-S11-O-11

ABSTRACT

Since 1993 Australian NCAP has been crash testing vehicles and publishing results to provide new vehicle consumers, when making a purchasing decision, independent advice on occupant protection. During the life of the program there have been significant improvements in the occupant safety performance of some vehicles while other models have shown only small improvements.

This paper reviews the performance of those vehicles crash tested in the Australian NCAP (ANCAP), highlighting models that have shown significant improvements in performance. An analysis of crash test data, known changes to vehicle specification and change in price for the vehicle, is undertaken to review the improvements in occupant protection offered and any associated increase in costs.

In 1997 Australian NCAP calculated an expected community benefit to cost ratio of 3.3 for improvements in occupant protection in passenger cars. This was based on assumptions contained in earlier work including an estimated increase in cost of $200 per vehicle for improvements in occupant protection and the expected reduction in social costs of crashes. This analysis is reviewed in light of the actual improvements in occupant protection in the new car fleet since the start of NCAP in Australia

INTRODUCTION

As the Australian new car market is dominated by a small number of passenger cars in the Large / Medium and Small Car categories the ANCAP has conducted three programs for testing each of these categories.

This paper reviews the process used by ANCAP to select vehicles for testing and the results of the test conducted for each of the three Large / Medium Car and Small Car programs. The results are reviewed in terms of the impact on improvements in occupant protection in the new car fleet since the start of NCAP in Australia.

VEHICLES SELECTED FOR NCAP

Selection Criteria

The vehicle selection procedure for NCAP must be compatible with the NCAP mission:

"To facilitate improvements in motor vehicle occupant protection through consumer education and buying power influenced by crash testing popular motor vehicles sold on the Australian market and publishing the relevant performance of the total occupant protection section."

Based on the NCAP mission and the goals of influencing buying decisions of new car buyers and manufacturing strategies of vehicle manufactures to increase the level of passive safety in passenger cars the following selection criteria are used:

1. sales figures (or projected sales) : to target those cars that are the most popular,
2. model : to account for standard or deluxe models which may contain airbags,
3. body configuration : to select the body configuration that is the most popular or to allow for direct comparisons across different manufacturers vehicles,
4. market segment : to target individual segments of the market to allow comparison of results,
5. cost : to make the most cost effective use of NCAP funds.

The selection procedure allows long term planning, ie. a test program up to 12 months in advance and addresses different sections of the vehicle market based on sales volumes.

Makeup of Australian New Car Fleet

Until recently the Australian new car fleet has been dominated by four vehicles, General Motors - Holden Commodore, Ford Falcon, Mitsubishi Magna and Toyota Camry. These four cars account for approximately 40% of new cars sold in Australia each year. The Large / Medium Car category accounted for approximately 45 % of all new passenger cars sold in Australia in 1998.

Table 1 below has details on sales volumes for 1993, 1995 and 1997 for the different segments as grouped by ANCAP.

The next main group of car sales is in the Small Car category which in 1997 accounted for 42% of the new car market. There are a number of these models which consistently sell approximately 20,000 units per year and hence become the basis for any ANCAP Small Car Program. The largest increase in any vehicle category during this period was in this category which saw an increase in sales of 110,000 units from 1993 to 1997.

Table 1
Sales Volume of Australian New Car Market

ANCAP Categories	Sales in Calender Year		
	1993	1995	1997
Large / Medium	246,395	257,533	248,433
Small	118,146	145,506	228,178
Passenger 4WD	49,961	43,778	50,269
People Movers	6,481	7,065	6,702
Prestige / Luxury	20,064	35,973	33,710
Utilities	50,857	71,370	70,394

The ANCAP uses vehicle categories that align closely with the Federal Chamber of Automotive Industries (FCAI) market segments. The FCAI segments of Micro, Light and Small are all combined into the NCAP Small Car category while the FCAI Medium and Upper Medium Segments are combined into the NCAP Large / Medium Car categories.

The ANCAP Small Car category contains passenger cars up to 1100 kg kerb weight while the Large / Medium Car category continues on from this with passenger cars up to approximately 1600 kg kerb weight.

Most cars in other market categories sell less than 10,000 units per year, with many makes selling less than 5,000 units per year. Additionally, more development work appears to be carried out in these categories and new or upgraded models are offered more frequently. Consequently the ANCAP has concentrated on crash testing the volume sellers in the Large / Medium and Small Car categories.

Three programs have been conducted on each of these categories while other categories have had only a single program conducted, ie people movers and commercial utilities. The ANCAP are just starting a second program on passenger four wheel drives.

RESULTS OF NCAP TESTS

Coverage of Australian New Car Fleet

To analyse ANCAP results to determine if there has been any improvements in front seat occupant protection, the Life Threatening Injury Risk (LTIR) value is calculated from results published by ANCAP during 1993, 1995 and 1997 for large / medium cars and for small cars.

Due to the high coverage of the Australian new car fleet by the models tested by ANCAP (between 60 % and 70 % as shown in Table 2) it is assumed that range of models tested are representative of the entire fleet

Table 2
ANCAP Coverage of the Australian New Car Market

Calendar Year	Total Sales	ANCAP tested	Coverage
1993	555,306	334,067	60 %
1995	488,372	309,038	63 %
1997	540,353	395,243	73 %

Life Threatening Injury Risk

The Life Threatening Injury Risk (LTIR) is the probability of sustaining a life threatening injury), ie AIS 4 or greater, and is obtained by combining the results of both HIC and chest compression for both full frontal and offset crash tests.

LTIR was calculated separately for driver and passenger. This showed a reduction in LTIR for those cars tested by ANCAP over this period. The average LTIR for Large / Medium cars (called L / M in the following tables), Small cars and a total for each of the three years are summarised in Table 3 below;

Table 3
Average LTIR of the Australian New Car Fleet

Year	L / M		Small		Total	
	D	P	D	P	D	P
1993	54	49	54	46	54	47.5
1995	26	28	49	27	37.5	27.5
1997	25	21	34	26	29.5	23.5

From these results it is obvious that there has been improvement in the level of occupant protection offered by new cars available for sales in Australia. It is interesting to note that this type of analysis shows more improvement in the Large / Medium Car category than the Small Car category.

Using a fleet weighted average technique based on models tested by ANCAP will present a picture of the level of occupant protection offered in the new car fleet as the Australian new car market is dominated by the small number of models represented in ANCAP tests.

The LTIR fleet weighted averages were calculated from VFACTS data which shows the number of units sold in that calendar year, ie 1993, 1995 and 1997.

A fleet weighted LTIR for a model can be calculated using:

Fleet LTIR = (model sales / ANCAP volume) x LTIR (1.)

where:
model sales = total sales of the test model throughout the calendar year
ANCAP volume = the total sales of all ANCAP test models throughout the calendar year

Table 4
Fleet Weighted LTIR of the Australian New Car Fleet

Year	L / M		Small		Total	
	D	P	D	P	D	P
1993	42	39	19	15	61	54
1995	24	26	20	11	44	37
1997	18	15	17	15	35	30

This method also shows there has been substantial improvements in the level of occupant protection offered by the Australian new car fleet over this period.

It is interesting to note that a fleet weighted analysis shows there has only been improvements in the Large / Medium Car category, not the Small Car category. This is because the Australian market is dominated by 4 models in the Large / Medium Car category while the Small Car category has a larger number of lower selling vehicles, with a wider range of LTIR, which results in a low fleet weighed LTIR.

This leads to two questions;

What is the cost of the improvements in occupant protection?

How are the improvements achieved?

COST OF IMPROVEMENT

The costs of improvements in occupant protection are part of the overall cost of a new car and therefore can be gauged by considering the total cost of the Australian new car fleet. This will be determined using sales volumes for cars tested by ANCAP and calculated using total cost for volume of cars sold.

The cost of cars fluctuates throughout the year and with options. To achieve a consistency for comparisons the new model price contained in "The Red Book" has been used and the most popular variant has been chosen, ie for large car this will be a sedan with automatic transmission and for a small car this will be a variant with manual transmission.

Where ANCAP has tested both an airbag and non-airbag model the additional cost for the airbag is included.

The average cost of a new car for both car categories and the total are calculated and recorded in Table 5 below.

Table 5
Average Cost of New Australian Cars

Year	L / M ($)	Small ($)	Total ($)
1993	25745	17910	22606
1995	29000	20087	25997
1997	29703	17407	24402

An interesting point that Table 5 highlights is the decrease in average cost of a new small car which may be due to the influence of Korean made cars on the new car market. The highest selling car in this category is the Hyundai Excel which accounts for 17 % of all small cars and outsells its nearest rival by almost 2 to 1. This has resulted in a lower average cost for 1997 new cars when compared with 1995 new car costs.

To take into account inflation, the average weekly wage will be used and the cost of the cars in terms of the average weekly wage will put the increase in price into perspective.

Table 6
Australian Average Weekly Wage

Year	1993	1995	1997
Wage	522.30	554.50	591.40
% Increase	0	6.2	13.2

Table 6 has the Australian average weekly wage for all employees as at November for each year and the corresponding increase over the 1993 figure.

The cost of a new car can then be expressed in terms of the number of weeks required to purchase (Figure 1);

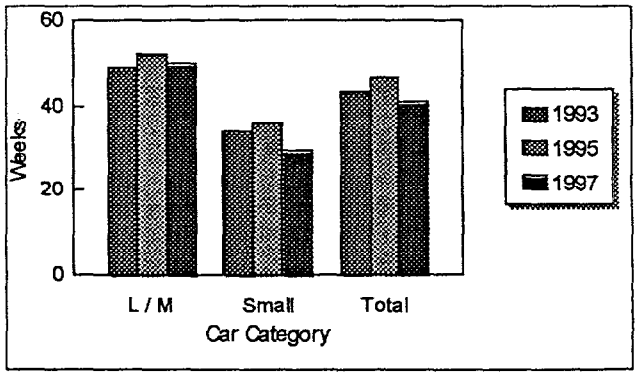

Figure 1. Weeks to purchase a new car

From the above graph it can be seen that the affordability of a new passenger car in Australia has not changed very much from 1993 to 1997. For example, to purchase a large cars in 1993 required 49.3 weeks while in 1997 it required 50.2 weeks, ie an extra week.

However, the cost of a new small car actually decreased from 1993 to 1997 (after an increase in 1995) from 34.3 weeks to 29.4 weeks.

The overall cost of purchasing a new car also had a slight decline from 43.3 weeks in 1993 to 41.3 weeks in 1997. A major factor in this was obviously the decrease in cost of small cars and the increase in sales of small cars. While the volume of large car sales remained fairly static at approximately 250,000 units the small car sales increased by 90 % from 118,000 units (1993) to 228,000 units in 1997.

While the overall level of occupant protection offered in the Australian new car fleet has improved the affordability of new cars has also increased.

SAFETY IMPROVEMENTS

There have been obvious improvements to occupant protection in Australian passenger cars during the life of the NCAP. These include improvements in the restraint systems to existing floor pans and body shells through the addition of items such as airbags, webbing grabbers and pretensioners with model upgrades.

When manufacturers have designed a new car they have taken the opportunity to introduce leading edge automotive safety technology. Consideration of the two main sellers in the Australian new car market, General Motors Holden Commodore and Ford Falcon will highlight this.

General Motors - Holden Commodore

1993: The 1993 Commodore (6 cylinder VP Executive), as one of the two largest passenger car sellers in the Australian car market was included in the initial ANCAP tests in 1993. This test was a 56 km/hr full frontal test which resulted in a Driver HIC of 1690 and chest compression of 52 mm, while the passenger HIC was 2410 with chest compression of 45 mm.

1995: In 1995 the upgraded model, VR Commodore was tested. The VR was a face-lift for the Commodore which included seat belt webbing grabbers as standard equipment and both driver and passenger airbags were offered as options. The model tested by ANCAP was fitted with a driver airbag.

1997: In 1997 a new model, the VT Commodore, was released. This was a completely new vehicle with an increased wheelbase and increase in width over the previous model. To improve the occupant protection the VT Commodore's front structure was improved. Also a driver airbag was included as standard and both front seats have lap sash seat belts fitted with both webbing grabbers and pretensioners.

Table 7
ANCAP Full Frontal Test Results for Commodore

Year	Driver		Passenger	
	HIC	Chest (mm)	HIC	Chest (mm)
1993	1690	52	2410	45
1995	1170	41	1110	45
1997	441	38	710	44

As seen from Table 7 the improvements in occupant protection technology that were designed and manufactured into the successive models of Commodore resulted in improvements in ANCAP test results.

Ford Falcon

1993: As the other of the two largest selling cars in Australia the Ford Falcon was included in the initial ANCAP in 1993. The Falcon tested, a 6 cylinder EB Series 2, was fitted with seat belt webbing clamps and performed slightly better than the Commodore as seen from the summary of the HIC and chest deformation measurements in Table 8.

1995: In 1995 the upgraded EF Falcon was tested. The EF Falcon was fitted with a driver airbag as standard equipment and both front lap sash seat belts were fitted with webbing grabbers.

1997: In 1997 another upgraded model, EL Falcon was available. This model had no further occupant protection improvements over the EF model. A completely new model Falcon is due out in late 1998.

Table 8
ANCAP Full Frontal Test Results for Falcon

Year	Driver		Passenger	
	HIC	Chest (mm)	HIC	Chest (mm)
1993	1340	54	780	47
1995	910	59	1280	48

As seen from Table 8 the improvements in occupant protection technology that were designed and manufactured into the upgraded EF model Falcon resulted in improvements in ANCAP test results for the driver. This is expected to continue with the new model Falcon due for release late in 1998.

COST BENEFIT ESTIMATE

Previous Analysis

In 1994 an analysis of the occupant protection afforded by the vehicles tested by ANCAP up to that time was undertaken and included in the Report to Stakeholders. The analysis intended to determine if it was cost effective to improve the front seat occupant crash protection in the Australian new passenger car fleet to a level at least equal to world's best practice which was considered to be the USA new car fleet.

The potential benefit was defined as the likely savings in the social costs of passenger vehicle occupant trauma in full frontal and offset crashes in speed zones of 80 km/hr or less. Road trauma costs from Queensland, New South Wales, Victoria and South Australia were used.

The saving was calculated for each future year by multiplying the trauma costs by the injury risks of the improved Australian fleet for the year in question and dividing by the injury risk of the existing Australian fleet.

The costs associated with improving the NCAP performance of the Australian fleet to the achieved USA level were determined by adding the total cost of the NCAP program to the cost of improving the level of safety of the vehicles.

The analysis was based on the fleet weighted driver LTIR as this was higher than the passenger LTIR.

The analysis was conducted using an estimated cost per vehicle of $200 for improvements in occupant protection. A 7 % discount rate and 10 year introduction for new vehicles was used.

Under these assumptions, after one year a benefit cost ratio of 2.48 is achieved. The benefit cost ratio continues to improve and after 15 years reaches a value of 3.61.

A sensitivity analysis was conducted on the average cost per vehicle to implement US protection standards. The sensitivity analysis showed that even with conservative assumptions and a 35 year fleet improvement time span, manufacturers could spend up to $750 per vehicle and still produce a positive benefit to the community.

Updating for 1997 Results

The expected new vehicle fleet average driver LTIR in 1997 was 43 %, which has been exceeded by the new models sold in 1997. The benefit cost analysis prediction did not expect a new vehicle fleet average driver LTIR of under 35 % until 2000. The Australian vehicle manufacturers have reached this target 3 years earlier than predicted.

Recalculating the potential BCR using the values used previously and bringing the 2000 benefits forward, ie:

Annual cost to community
- if current fleet is unchanged, 1997, $1,163 million
- if fleet average LTIR reduced to US levels, 2000 value, $847 million

Reduction in annual cost through improved fleet occupant protection levels, $316 million

Cost to improve occupant protection levels, (adding costs previously used for 1993 up to 2000), $127 million

Then BCR aggregate = 2.5

It is estimated that an aggregate BCR of 2.5 has been achieved through improved occupant protection levels of the new passenger car fleet.

SUMMARY

Since the commencement of the New Car Assessment Program in Australia there has been improvements in the occupant protection levels for front seat occupants in new passenger cars offered for sale.

Several factors have contributed to this improvement;
1. ANCAP
2. Introduction of ADR 69/00 in 1995
3. Introduction of cars that were primarily designed for the US and European markets.

By considering the results of the ANCAP tests in terms of the new car fleet there has been an improvement in the overall level of occupant protection for purchasers of new cars in Australia. With the increase in levels of occupant protection there has been a small increase in relative cost of a new large car, while there has been a decrease in relative cost of a small car. This has resulted in an overall relative reduction in the cost of new cars.

By updating a prior analysis it is estimated that the improvement in front seat occupant protection has shown a cost to benefit ratio of 2.5.

One of the large contributors to the reduction in cost of new cars has been the increase in volume of sales of small cars. What impact this will have on the overall level of safety offered by the Australian car fleet is not known.

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