# WHAT WE KNOW ABOUT THE KEY COMPONENTS OF THE SAFE SYSTEM APPROACH

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## 1. A BRIEF STATEMENT OF THE ISSUE

Austroads has accepted that the greatest road safety gains are to be achieved through adopting a Safe System approach. This paper summarizes the key research findings from previous Handbook papers relating to the key components of the Safe System framework.

## 2. AN EXTENDED ASSESSMENT OF THE ISSUE

Austroads' Safe System may be described in terms of the following propositions:

- crashes will continue to occur, prevention efforts notwithstanding
- the challenge for the proposed Safe System in the event of a crash, is to ensure that the impact forces released in the event of a crash are within the boundaries of human tolerance and that no fatalities will occur (and that serious injuries will be reduced)
- the key task of the Safe System is to manage the road infrastructure, vehicles, and speeds in order to minimize the probability of any death arising from a road crash
- the Safe System approach will give a continued role to countermeasures aimed at producing safer road user behaviour, but only in a support context.

It is proposed that the Safe System framework will be used to support three key road safety streams and associated countermeasures[1]:

- safer roads, including:
  - improved risk analysis of the road network and its crash-related safety performance;
  - identification of the most effective treatments including those offered by ITS;
  - a review of current safety standards (including those relating to speed limits, clear zones and roadside hazard control) to develop appropriate safety benchmarks for both new works and remedial treatments
- safer speeds, including:
  - speed reductions as a complementary measure to road-based improvements, especially in treating high-risk sections of the road network where there are no immediate engineering options
- safer vehicles, including:
  - promotion of vehicle crashworthiness ratings
  - safer fleet vehicle purchasing policies.

- Safer road users will also be developed, with strategies including:
  - compliance with road rules
  - graduated licensing schemes for young drivers
  - alcohol interlock programmes to reduce recidivist drink driving
  - strengthened sanctions to control unlicensed driving
  - improved assessment of fitness to drive in the face of medical conditions and functional declines
  - information and education to support driving and travelling.

Many of these safety options have been treated in previous Handbook papers. The research findings from these papers are presented in the following section.

# 3. A REVIEW OF THE RESEARCH

## 3.1 Improved risk analysis of the road network and its crash-related safety performance

*Road safety audits*[2]

One means to provide crash risk analyses of the road network is through road safety audits. Audits may be defined as "a formal examination of a future road or traffic project or an existing road, in which an independent, qualified team reports on the project's crash potential and safety performance"[3]. While audits of existing stretches of road take into account actual crash histories, audits at the various design stages are necessarily restricted to the identification of crash risk rather than actual crash occurrence.

Austroads commissioned ARRB Transport Research to undertake a major investigation to determine the economic value of road safety audits[4]. Looking first at audits at the various design stages, the evidence indicates that:

- over 90% of all implemented recommendations had benefit-cost ratios (BCRs) exceeding 1.0
- around 75% of all implemented recommendations had BCRs exceeding 10
- the majority of design audit findings required only very low-cost responses (65% of recommendations had a cost less than $1,000). Of these low-cost responses 85% had BCRs exceeding 10.

Looking at existing road audits:

- over 78% of all proposed actions had BCRs exceeding 1.0
- approximately 47% of all proposed actions had BCRs exceeding 5.0
- over 50% of all proposed actions had a cost less than $5,000. 87% of these actions had BCRs exceeding 1.

It should be noted however that both sets of analyses indicated great variation in potential safety benefits, both within an individual audit and between different audits. This variation was attributed to the differences in the types of deficiencies identified and to the different remedial actions subsequently required.

*Black spot programs*[5]

In essence[6], black spot treatments entail the application of road engineering measures aimed explicitly at reducing crash numbers and/or crash severity:

- at a specific site or section of road
- along a route with high crash numbers
- area-wide, encompassing a collection of roads and streets that collectively have high crash numbers
- through mass action, whereby a known remedy is applied to a wide spread of locations with common problems.

Black spot programs require monitoring of the road network in terms of crash levels, to identify those sites in greatest need of treatment.

From the very outset black spot programs have been rigorously evaluated, whether at jurisdictional or national level. To give three recent examples:

- The 1992-96 program in Victoria showed a reduction of 26.4 per cent in casualty crash numbers and a reduced casualty crash cost of 29.6 per cent at treated sites[7]. Over its full life, the Program will return benefits worth 4.1 times the program costs (rising to 5.1 times if seven high-cost treatments funded by the program for additional, non-safety reasons were excluded). These findings are in broad agreement with previous evaluations of the program[8] [9]
- The 1996/97-2001/02 Federal black spot program showed reductions of 31.2 per cent and 48.2 per cent at metropolitan and other sites, respectively, during the first three years[6]. The overall benefit-cost ratio was 14:1. Again, these positive outcomes were in general accordance with earlier evaluations[10]
- As at March 2003, NZ’s programme has been credited with achieving reductions of 34% in injury crashes at the treated sites. This reduction corresponds to an estimated saving of approximately $3 billion (at June 2002 prices), using the willingness-to-pay values of statistical life and injury.

As might be expected, the specific measures of effectiveness vary from study to study, according to the criteria used for selecting sites, the suitability of the treatments selected, the balance of treatments implemented, the pre-treatment crash levels and the duration of the post-treatment periods used in gathering ‘after’ crash data.

## 3.2 Identification of the most effective treatments including those offered by ITS[5]

Two major evaluations of black spot programs in Australia[7] [6] have provided information on the effectiveness of individual treatments in reducing crashes. Treatments that produced a significant change in casualty crashes at either urban or rural level in at least one of the studies, are listed in Table 1.

Table 1: Casualty crash reductions attributable to the TAC Victorian or to the Federal black spot programs.

| Treatment | Casualty crash reduction (%) | | | |
|---|---|---|---|---|
| | TAC program in Victoria, 1992-96 | | Federal black spot program, 1996/97-2001/02 | |
| | Urban | Rural | Urban | Rural |
| TYPE OF TREATMENT | | | | |
| 1. Intersection treatments | 27.8 | 26.9 | | |
| 2. Pedestrian facilities | 8.8* | 46.4* | | |
| 3. Route treatments | 22.6 | 30.8 | | |
| 4. Treat road features | 3.5* | 15.3* | | |
| | | | | |
| TREATMENTS | | | | |
| Roundabout | 72.3 | 67.4 | 69.9 | 75.1 |
| Signal remodel – controlled right turn | 25.8 | 5.7* | 42.9 | 37.3 |
| New signals | 34.6 | 7.0* | 47.1 | 76.0 |
| Other intersection improvements | 17.4 | 11.5* | | |
| Pavement re-sealing (route) | 56.2 | 30.4* | 37.5 | -26.7* |
| Roadway delineation | 59.6 | 25.7 | -7.0* | 33.4 |
| Curve realignment | -43.43* | 74.9 | | |
| Shoulder sealing | 15.6 | 38.4 | 12.8* | 28.8 |
| Pavement widening | 30.9 | 37.0* | | |
| Signs | | | 15.8* | 53.8 |
| Lighting | 11.2* | | -26.9 | 63.2 |

NOTE: * indicates that a change was not statistically significant. Other changes were significant;

Looking just at the results of the Victorian program, intersection treatments (roundabouts, signal re-modelling, new signals, etc) and route treatments (pavement resealing, road delineation, shoulder sealing, etc) had the biggest impact on crash levels. Equivalent grouped data were not available for the national study but it appears that the intersection treatments were the best performed.

Table 1 also suggests that general program benefits were greater in rural areas, compared to urban results.

The benefits of the individual treatments in reducing crash numbers varied across the two studies in terms of exact measurement and sometimes in terms of direction of change. However overall, there was reasonable consistency in the results:

- roundabouts – showed crash reductions at least at the 70 per cent level
- introduction of fully controlled right-turn phases at intersection signals – in three of the four instances showed reductions in excess of 25 per cent
- new signals – which in three of the four instances showed reductions of 35 per cent or more
- pavement re-sealing – in all four instances showed reductions exceeding 25 per cent (although in two instances the reductions were not significant)
- roadway delineation – in three of the four instances showed reductions of 25 per cent or more

- shoulder sealing – which in all instances showed reductions of 13 per cent or more (although in one instance the reduction was not significant).

It needs to be stressed that the above comparisons need to be treated as indicative only, with specific measurements likely to be influenced by many considerations (the criteria used for selecting sites, the severity of the initial problem, the suitability of the treatments selected and the completeness of implementation, the duration of the post-treatment periods used for collecting 'after' crash data, the impact of other factors operating during the 'after' period, etc).

New road treatments based on the most recent technology have not been included in the analyses in Table 1. As a specific example, recent studies conducted on the effectiveness of flexible wire barriers overseas and within Australasia have produced strongly positive results, indicating a reduction in the incidence of fatal run-off-road crashes of around 90%[11]. In addition, new ITS possibilities – especially countermeasures based on vehicle-road interactions – have not been included, due to their relative recency and the lack of firm evaluation data. More comprehensive identification and assessment of new treatments is an early priority for the Safe System approach.

### 3.3 Speed reductions[12]

The precise causal role of speed in road crashes is difficult to determine. However as a broad estimate, if the average speed on New Zealand's rural roads was reduced by just 4 km/h, the number of all deaths would decrease by about 15% and the total number injured by about 8% – meaning that about 45 deaths and 480 reported injuries would be saved. Applying the same scenario to the Australian situation, each year around 255 deaths and 1760 serious injuries (hospitalisations) would be saved.

Although the association between speed and crash risk is now well established, jurisdictions are regularly called upon to defend policies aimed at producing lower travelling speeds. Evidence to support lowered speed limits include:

- Between 1987 and 1988, 40 states in the United States of America raised the speed limit on interstate highways from 55mph (88km/h) to 65mph (104 km/h). This resulted in an increase in average car speeds of about 3mph (5km/h). Over the same period there was an increase in deaths on these roads of between 20 and 25%[13]
- During the 1973 fuel crisis, the New Zealand Government reduced rural speed limits from 55 mph (88 km/h) to 50 mph (80 km/h), leading to an 8-10 km/h reduction in average rural speeds[14]. The drop in speed led to a significant drop in injuries compared with urban roads, which were unaffected by the speed-limit change. On main intercity roads deaths dropped by 37%, serious injuries by 24% and minor injuries by 22%. The corresponding reductions for urban areas were 15%, 9% and 4%
- In Australia the speed limit on Melbourne's rural and outer freeway network was increased from 100 km/h to 110 km/h in 1987 and then changed back to 100 km/h in 1989. Compared to a control area where the speed limit remained the same, the injury crash rate per kilometre travelled increased by 24.6% when the speed increased and decreased by 19.3% to the initial levels when the speed decreased[15]
- A review of the studies on speed-limit changes from several countries (South Africa, Belgium, Finland, France, Great Britain, Germany, USA, and New Zealand) where a speed limit was reduced or a new limit was introduced found a reduction in road crashes ranging from 8% to 40%[16]

- Patterson et al.[17] examined the effect of changes in speed limits on rural interstate deaths in the USA. Deaths in the groups of states that raised their speed limits to 75 mph and 70 mph rose by 38% and 35%, respectively, relative to fatality levels in the states that did not change their speed limits.

There is a consistent finding from the research that increasing the speed limit increases crash, injury, and fatality rates and that decreasing the speed limit reduces these rates. Further, this association has been quantified, based on evaluations of increases and decreases in speed limits in Sweden, Denmark and the USA[18]. The savings estimates are based on the following probabilities:

- the probability of a personal injury accident in the road system reported by the police is proportional to the square of the speed ($v^2$);
- the probability of a fatal accident resulting from a personal injury accident is also proportional to the square of the speed ($v^2$), which means that the number of fatal accidents is proportional to the fourth power of the speed ($v^4$).

A central factor in these relationships is stopping distance, which is critical in determining whether or not a crash occurs. There are two components to stopping distance – the distance travelled by the vehicle during the reaction time of the driver, and the distance travelled once the brakes are applied. The reaction time of the driver is generally the same regardless of travelling speed – therefore, the greater the speed, the greater the distance travelled during the driver's reaction time. The stopping distance of a vehicle once the brakes are applied is roughly proportional to the square of the pre-braking speed[19], although in reality the formula is much more complicated.
Upon seeing the hazard at the faster speed, a driver will travel further before applying the brakes and will travel further once the brakes are applied (see Figure 1)[20].

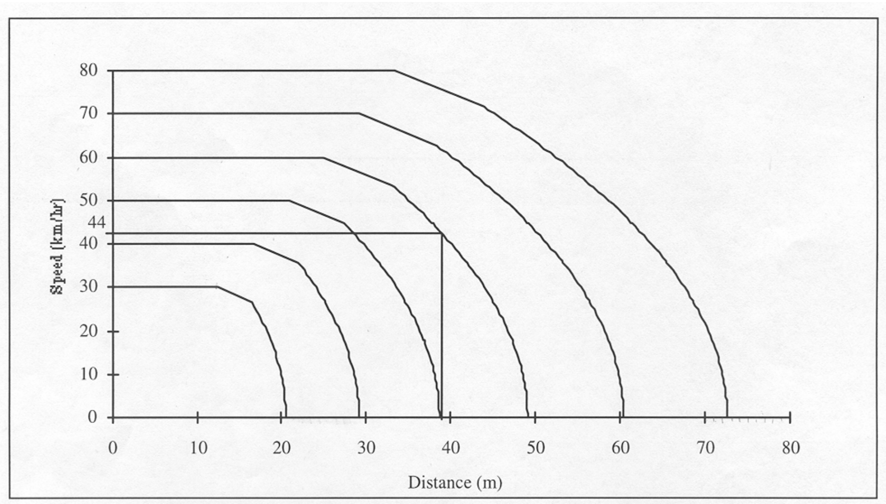


Figure 1: Speed versus distance for emergency braking from time=0

For example, assume that one car is travelling at 50 km/h and is being overtaken by a second car travelling at 60 km/h. If a child runs on to the road at a point just beyond the point at which the 50 km/h car can stop, the 60 km/h car will still be travelling at 44 km/h at the point of impact. A collision speed of 44 km/h means that a pedestrian has more than a 50% probability of being killed or severely injured.

Excessive and inappropriate speed has a twofold effect on the safety of our roads – it increases the risk of involvement in an injury crash and it affects the severity of the consequences of a crash. It is essential for road safety that drivers travel at speeds which are not excessive in terms of well-set speed limits nor inappropriate in relation to local conditions. Road and vehicle design, public education and enforcement all have a role in achieving these outcomes.

## 3.4 Improvements to graduated licensing schemes for young drivers[21]

'Graduated licensing is a system for phasing in on-road driving, allowing beginners to get their initial experience under conditions that involve lower risk and introducing them in stages to more complex driving situations.'[22] The available North American evaluations of graduated licensing are summarised in Table 2[23].

Table 2: Summary of evidence from North America to support graduated licensing schemes.

| Location | Chief characteristics of the graduated licensing scheme | Year started | Year evaluated | Results |
|---|---|---|---|---|
| Maryland | Parental supervision, driver education, night restrictions, crash-free/conviction-free for progress, age conditions. | 1979 | 1983 | 5% reduction in crashes for 16-17 yrs, (only one-half of whom were in the program). |
| California | Parental supervision of additional practice, lower tolerance of traffic infringements, age conditions | 1983 | 1988 | 5.3% in crashes for 15-17 yrs. |
| Oregon | Details not specified. | 1989 | 1991 | 16% reduction amongst males 16-17 yrs, no significant differences for females. |
| Ontario | Zero alcohol provisions, night restrictions, freeways and expressways restrictions. | 1994 | 1998 | 31% decline in young driver collision rates, compared to only 4% for all drivers. |
| Florida | Lengthened learning period, zero alcohol provisions, night restrictions, lower tolerance of traffic infringements. | 1996 | 1999 | 9% reduction in fatal and injury crashes for 15-17 yrs. |
| Kentucky | Details not specified. | 1996 | 1999 | 13.8% reduction in fatal crashes, 30.1% reduction in injury crashes for first group of 16 yr drivers in the scheme. |
| Nova Scotia | Most notably, adult supervision in the learner phase and night curfews during next stage. | 1994 | 2000 | 19.4% decrease in all crashes involving young drivers. |

Looking beyond North America, in 1987 New Zealand introduced a graduated licensing scheme which excluded young drivers from night-time driving, driving after drinking alcohol and driving with other young adults in the vehicle. Hospital in-patient morbidity data showed that following the introduction of the scheme, there was a 23 per cent reduction in injuries amongst 15-19 year-olds, a 12 per cent reduction amongst 20-24 year-olds and a 16 per cent reduction amongst those aged 25 and over. Given these changes and making allowances for other factors (including reduced exposure), it was estimated that the new licensing scheme was responsible for a minimum 7 per cent injury reduction amongst 15-19 year-olds[24].

A recent meta-analysis of graduated licensing schemes concluded that "overall, the evidence indicates that (graduated licensing) is effective in reducing crash rates of teenage drivers, although the magnitude of the reduction is unclear. … the effectiveness of (graduated licensing) is supported by reductions in rates of all crash types, (almost entirely) consistent positive results across studies and within studies when adjusting for internal controls, clear temporal relationship between implementation of (graduated licensing) programs and observed reductions, and the plausibility that reducing exposure to high-risk situations would reduce crash rates."[25a]

The relative contributions of the individual conditions and restrictions underpinning graduated licensing remain largely unquantified. However indicative evidence from both New Zealand and Ontario support restrictions on alcohol use and night-time driving, with there being weaker support for passenger restrictions. More recently, an Australian review of specific components of GLS[25b] concluded that components showing clear associations with crash reductions were:

- increasing the minimum learner period (which subsequently increases on-road supervised driving experience)
- night-time driving restrictions for intermediate-licensed drivers
- passenger restrictions for intermediate-licensed drivers
- mandating a zero BAC limit for both learner and intermediate-licensed drivers
- mandating seat-belt use at all times for both learner and intermediate-licensed drivers.

## 3.5 Alcohol interlock programmes to reduce recidivist drink driving[26]

A breath alcohol ignition interlock device is an in-vehicle instrument that is connected to the vehicle's ignition. The driver must blow into the device and if the blood alcohol content (BAC) registers above a pre-determined level, the interlock prevents the car from being started. Given modern interlocks' high performance standards, the only way in which a drunk driver can successfully circumvent the device is to drive a non-interlock vehicle[27].

In Australasia, interlocks have been supported as an adjunct method for controlling drink-driving recidivism for well over a decade. Australia's National Road Safety Action Plan for 2001 and 2002[28] recommended the introduction of alcohol ignition interlocks as a sentencing option and/or administrative sanction, especially as a re-licensing requirement for repeat drink-drivers and this emphasis continued in later versions of the Plan[1]Prompted by the need for a consistent Australasian approach to the issue, Austroads has developed the following guidelines for interlock programs[29]:

- targets for assignment to an interlock program to include drink-drivers who meet the following criteria:
  - first offenders with BACs of at least 0.15g/100ml
  - recidivists whose later infringements involved a BAC of at least 0.08g/100ml, driving under the influence (DUI), refused test, etc.
- in organising the program, interlocks to be used as a complementary countermeasure along with traditional licence-disqualification penalties and other established programs
- main features of the program to include:
  - the court or the licensing authority to stipulate use of an interlock in addition to a minimum licence disqualification period, or the offending driver to volunteer for the program in return for a reduction in the period of licence disqualification

- three years' installation of an interlock is recommended, with two years as the minimum
- specific and sustained enforcement of the program is considered essential
- there is the need to include an interlock code on a driver's licence, licence checks need to be incorporated in random breath test operations and mandatory carriage of licence is encouraged. For drivers assigned to the program, driving another vehicle not fitted with an interlock should attract a severe penalty
- interlocks to be serviced and calibrated regularly, both to ensure effective functioning of the device and to monitor each driver's extent of compliance.

Alcohol interlock legislation in some form is currently in place in NSW, Victoria, South Australia and the ACT.

The weight of evidence from evaluations conducted in the USA and Canada have indicated that interlocks effectively reduce drink-driving recidivism over and above more traditional approaches, at least while the interlock was fitted to an offender's vehicle [30 31 32 33 34 35 36]. It has been estimated that the use of alcohol interlocks by all DUI offenders could save 1,750 to 3,500 lives per annum in the USA[37]. However it seems that these benefits largely or totally disappear once the driver comes off the program [31 33 38 39].

Although alcohol interlock legislation permitting the fitment of interlocks to repeat DUI offenders has been implemented in 43 States in the USA and in 5 Canadian jurisdictions[35], the numbers assigned to programs could be as low as 2% of eligible offenders[40]. As a general statement, interlock programs have not been accepted by the courts as a meaningful sentencing and rehabilitation option, at least in North America. It remains to be seen whether this problem will also be pertinent to Australia.

## 3.6 Strengthened sanctions to control unlicensed driving[41]

Vehicle sanction programs allow for the immobilisation, impoundment, confiscation or forfeiture of vehicles whose drivers continue to drive while suspended or disqualified or continue otherwise to re-offend. Of all the Australasian jurisdictions, New Zealand has the longest and most comprehensive involvement in vehicle sanction programs. Details are as follows:

- police may impound vehicles for varying periods for the following offences:
  - if the driver is disqualified from holding or obtaining a license, or if the license is suspended or revoked (28 days)
  - if the driver is unlicensed, or has an expired license and has already been forbidden to drive until a valid license has been obtained (28 days)
  - if the vehicle is suspected of being involved in a serious crash or 'hit and run' offence, for the purposes of preserving evidence (up to seven days)
  - if the impoundment is 'in the interest of public safety' (12-24 hours)
  - 'hooning' or deliberately reckless or nuisance driving
- vehicles may be confiscated if any of the following offences are committed by the offender, involving the vehicle:
  - offences punishable by imprisonment for 12 or more months and the vehicle has been used by the offender to assist in the offender's flight or attempted avoidance of detection or arrest
  - dangerous or reckless driving
  - careless or inconsiderate use of a vehicle resulting in injury or death

- aggravated careless use of a vehicle resulting in injury or death
- drink or drugged driving offences.

The above offences *may* result in vehicle confiscation. Under other circumstances, the Courts *must* confiscate the vehicle unless very specific exclusion criteria apply. These circumstances entail the owner of the vehicle having committed a serious traffic offence, and then within a 4-year period, committing a further serious traffic offence. The qualifying offences are:

- drink or drugged driving
- drink or drugged driving causing injury or death
- failing or refusing to supply a blood specimen
- driving while disqualified, suspended or the license is revoked, or contrary to the terms of a restricted license
- dangerous or reckless driving
- dangerous or reckless driving causing injury or death
- failure to perform the duties of a driver in an accident in which another person is injured or killed.

The available evaluations from America[21], summarized in Table 3, suggest that vehicle sanctions are associated with reduced drink driving recidivism and reduced driving while suspended, at least for the period of sentencing and sometimes beyond.

Table 3: Summary of American studies evaluating vehicle sanction programs

| Location | Program | Results |
|---|---|---|
| Ohio (published 1997) | The first driving-while-suspended offence can lead to 30 days immobilisation, the second to 60 days and the third offence to vehicle forfeiture. The second driving-while-intoxicated offence can lead to 90 days immobilisation, the third to 180 days and the fourth to loss of vehicle. | Offenders who received vehicle sanctions had lower drink driving recidivism rates both during the period of sanction and for at least two years afterwards, compared to offenders without sanctions. |
| Ohio (published 1998) | As above, except that vehicles were impounded rather than immobilised. | Offenders whose vehicles had been impounded had lower drink driving recidivism rates both during the period of sanction and for approximately one year afterwards, compared to offenders without sanctions. |
| Manitoba (published 1997) | Any person apprehended driving whilst prohibited from driving, can immediately have his or her vehicle impounded for 30 days (first offence) or 60 days (any repeat offence). | Vehicle impoundment plus administrative license suspension were associated with both general deterrence benefits (net decrease in drinking driver fatalities and in single vehicle night-time crashes) and specific deterrence benefits (reduced drink driving recidivism within 4 years in crashes amongst drink drivers in the 97 days following the offence and in reduced driving whilst suspended). |
| California (published 1999) | Vehicles driven by suspended/ revoked or unlicensed drivers impounded for 30 days. Vehicles driven by suspended/revoked or unlicensed drivers who have a prior conviction for this type of offence, forfeited. | Drivers whose vehicles had been impounded and forfeited had significantly reduced crashes and traffic convictions during the first year of subsequent driving. A later study however failed to demonstrate that impoundment/forfeiture had any general deterrence[5]. |
| Minnesota (published 1994) | Impoundment of license plates for drivers who are on their third drink driving charge, even if the vehicle belongs to someone else. | Offenders with impoundment sanctions had one-half the recidivism rate compared to offenders without sanctions during the subsequent two years. |

The legislation introduced in New Zealand in 1999 allowing for roadside impoundment as part of a new photo driver licensing system has been associated with the following results[42]:

- the roadside impoundment of more than 25,000 vehicles driven by disqualified or otherwise unlicensed drivers during the period May 1999 to May 2001
- a fall in the proportion of fatalities attributed to unlicensed drivers from 10% of all fatalities (1998) to 6.9% (2000) and an equivalent fall of one-third in all casualties attributed to unlicensed drivers
- a fall in the number of driving while disqualified offences by around one third.

Vehicle sanction programs represent a reasonably severe response to specified driver offences. Further, the programs hold a number of legislative, social and practical challenges. However, experiences from New Zealand and elsewhere suggest that vehicle impoundment or confiscation is effective in reducing the road safety risks posed by sub-groups of drivers who have proved otherwise difficult to influence.

## 3.7 Improved assessment of fitness to drive in the face of medical conditions and functional declines[43]

There is ample evidence to show that numerous medical conditions and their functional consequences are associated with heightened crash risk. Some of these conditions are listed in Table 4[44].

Table 4: A sample of medical conditions associated with higher crash risk

| General Condition | Details | Crash Risk |
|---|---|---|
| Visual Impairments / Illnesses | Low vision (20/200 to 20/50) | RR = 1.31*-2.38* |
| | Cataracts | RR = 2.2* |
| | Contrast Sensitivity | RR (one eye impaired) = 2.70*<br>RR (two eyes impaired) = 5.78* |
| Cerebrovascular disease | Resulting in chronic neurological impairment | RR = 2.18*-4.21* |
| Diseases of the Nervous System | Seizures | RR = 1.5-1.95 |
| | Sleep Apnoea | RR = 2.0-7.0. |
| Musculoskeletal Disabilities | Musculoskeletal Disabilities | RR = 3.07*-4.02* |
| Psychiatric Disease | Psychiatric or Emotional Conditions | RR = 1.74*-2.42* |
| Medication / Drugs | Anti-depressants | RR = 2.2-2.3 |
| | Anti-histamines | Possible increase in crash rates. |
| | Benzodiazepines | RR = up to 2.4 times |

NOTE: * = statistically significant.

Because many medical conditions are associated with ageing, there have been calls for mandatory assessment of older drivers to detect the presence of these conditions specifically and reduced fitness to drive generally. Increasingly however, age-based mandatory assessment is considered to be an unreliable means to identify older drivers at heightened crash risk because of functional decline. In dismissing mandatory assessment, an OECD Expert Group recommended that licensing strategies target only those discernibly at risk, effectively leaving 'safe' drivers outside the assessment process.

The proposed licensing model for managing older driver safety currently being developed in Australasia[1] complies with the stance taken by the OECD Expert Group. Its features include:

- the establishment of a network of community notification sources, whereby only drivers suspected to have a high crash risk are identified and referred to the licensing authority for formal assessment. It is proposed that notification sources include general practitioners, police, family and friends – as well as older drivers themselves
- the use of multi-tiered assessment, involving general practitioners, occupational therapists and other health specialists at more elaborate levels of assessment
- the use of assessment instruments of known validity for testing safe driving.

## 3.8 The promotion of vehicle crashworthiness ratings[45]

In research undertaken by the Monash University Accident Research Centre, vehicle crashworthiness has been defined as an estimate of a driver's risk of being killed or admitted to hospital once involved in a crash where at least at least one person is injured or one vehicle is towed away. A rating of 4.0 for example, means 4.0 drivers killed or admitted to hospital per 100 drivers in tow-away crashes. Figure 2 shows the relationship between vehicle crashworthiness and year of vehicle manufacture from 1964 to 2000, based on real crash data[46]. It also shows the dates of introduction of major safety-related Australian Design Rules for passenger vehicles.

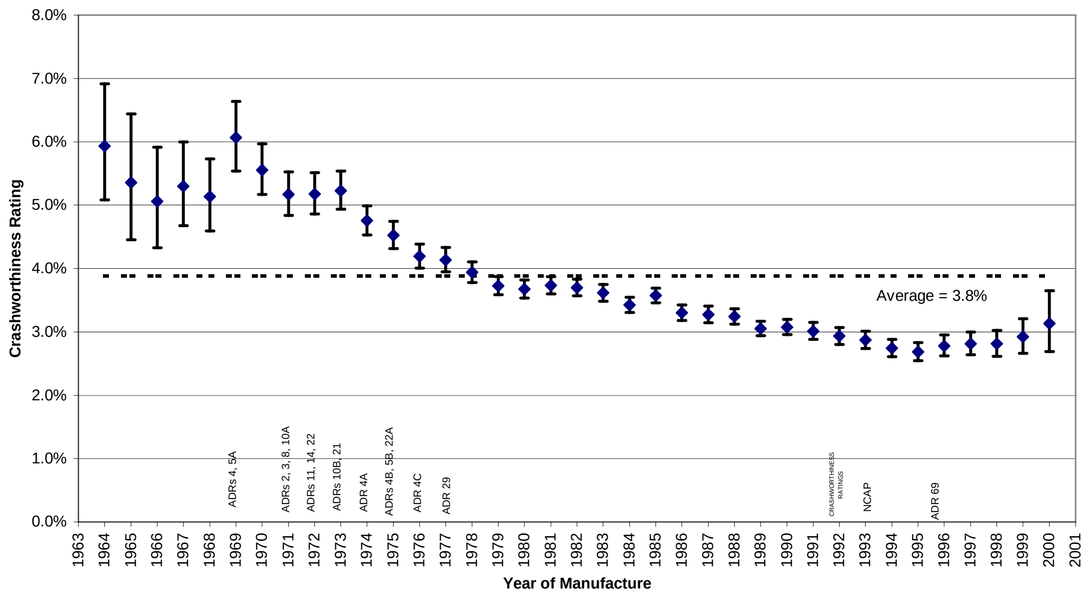


Figure 2: Crashworthiness by year of vehicle manufacture (with 95% confidence limits)

Figure 2 shows that current vehicles as a group, are twice as safe (as measured by crashworthiness) than vehicles manufactured some thirty years earlier[46].

However, when individual vehicle models are considered, there is substantial variation in crashworthiness ratings:

- the safest model had less than one-half the risk of death or serious injury in a tow-away crash, compared to vehicles with average crashworthiness
- the least safe model had more than double the risk of death or serious injury in a tow-away crash, compared to vehicles with average crashworthiness
- the least safe model had more than five times the risk of death or serious injury in a tow-away crash, compared to the safest model.

Rather than using real crash data, the Australian New Car Assessment Program (ANCAP) tests the crashworthiness of most major current car models by conducting barrier crash tests under laboratory-controlled conditions. Current ANCAP testing requires each vehicle model to be subjected to at least two crashes[47]:

- an off-set frontal impact test, whereby the car is driven at 64 km/h into a barrier with a crushable aluminium face. The crash forces are concentrated on the driver's side of the vehicle and the use of a deformable barrier simulates the effect of crashing into another vehicle
- a side impact crash, whereby the driver's side of the stationary vehicle is struck by a trolley travelling at 50 km/h.

Where vehicles have side airbags or equivalent, their manufacturers can elect to have a third test performed to gain extra safety credit. The vehicle is crashed side-on at 29 km/h into the equivalent of a round power pole, at a position in line with the head of the dummy – with any extra safety credit being for low risk of head injury.

Stronger promotion of vehicle crashworthiness – be it based on real crashes or on ANCAP test results – as a key factor in purchasing a vehicle, represents a meaningful road safety countermeasure that has been far from fully exploited.

## 3.7 The development of safer fleet vehicle purchase policies[48]

In Australia, business travel accounts for around one-third of all driving, and over one-half, if commuting is included[49]. While the full extent of crashes involving work-related vehicles has yet to be quantified, the best available estimate for Australia is that occupants of light vehicles on work-related travel account for 6 to 7 per cent of all road fatalities[50]. These figures exclude other persons killed as a result of these crashes and exclude the resultant range of non-fatal injuries.

Since 1986, the majority of new cars in Australia have been sold as fleet vehicles, with Ford and Holden each selling almost three-quarters of their new cars to fleets[50]. If fleet purchasers could be directed towards the safest available vehicles, road safety benefits would occur at two levels:

- reduced crashes during work-related travel
- reduced crashes during all travel, as the benefits of safer fleet purchases would spread throughout the entire light vehicle fleet.

The evidence suggests that safety has not been a paramount concern to fleet purchasers, who have been largely guided by operational needs and budget. Although even standard vehicles are increasingly including more extensive safety features, it remains that buying a safer vehicle often entails additional initial cost. Too often, fleet purchasers decide upon the cheaper alternative.

The promotion of safer vehicles is currently occurring on a number of different fronts. However it is likely that success in establishing safety as the leading priority in vehicle purchase policies represents the single most important step in this context.

# 4. POLITICAL, SOCIAL AND OTHER FACTORS

Each of the tools presented in this paper have their own political, social and other challenges. These have been described in the individual Handbook papers in Volumes 1 to 3.

# 5. CONCLUSIONS

Many of the tools necessary to support a Safe System are already known and to greater or lesser extents, are already in place. However the relative plateau in the national road tolls for Australia and New Zealand suggests that these tools in their current form are likely to have only a limited further impact upon the road toll.

Advances in road safety are invariably accompanied by additional costs – be it in terms of reduced mobility, greater social regulation, extra enforcement efforts or increased expenditure for assorted programs. The extent to which the current array of tools necessary to support a Safe System will be improved and expanded will invariably depend heavily upon political and social commitment.

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