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Safer vehicles

Their role in improving road safety, and some idea to improve vehicle safety in South Australia

It almost goes without saying that safer vehicles are critical component of reducing the road toll. Vehicle manufacturers now commonly promote the safety of their product in marketing material, and authorities actively promote safer vehicles through consumer rating programs and through regulation.

But the way in which new vehicle safety affects road safety is not immediately clear – vehicles on the road are a mixture of old and new, and the latest safety technologies are often in only the most expensive vehicles. Most drivers and their passengers benefit from new safety developments only when safety technologies become commonplace; even then, with a median vehicle age of about 9 years, most South Australians effectively wait for more than a decade before they begin to benefit from the latest technologies.

This characteristic of vehicle technologies – the inevitable lag between development and benefit – places vehicle technologies in a separate category from other road safety measures. A speed limit can be changed and a benefit is realised immediately, whereas improvements through vehicle technology, while often extremely important, must be considered as part of a much longer-term strategy to improve road safety.

The vehicles that are used by the community for business and private use are a component of the whole safety system, but the dynamics of how this component is changing, and whether it is possible to mould the future fleet are poorly understood. The characteristics of new vehicles – their size, primary safety and secondary safety features – are largely determined by a free market, in which safety must compete with other ideas of what constitutes value and satisfies the desires of customers. Yet, it is the new vehicle purchaser that determines the restocking of vehicles in the fleet. A new vehicle owner may drive a vehicle for a relatively short time (for as short as two years in some commercial and government fleets), but the legacy of that purchase will persist for almost two decades. New vehicles are the second-hand vehicles of tomorrow, and the safety features of some vehicles may only be tested out after 15 years (if at all), possibly in the hands of an inexperienced young driver – a driver who may have been barely a toddler when the vehicle was built.

In general, there are reasons to be optimistic about future generations of vehicles, and the increased levels of safety they will offer, but there are opportunities nevertheless to mould the vehicle fleet of tomorrow and to create a legacy of safer vehicles in our community.

This paper concentrates on passenger vehicle safety. This does not diminish the importance of the safety of other modes of transport, and many of the comments will apply equally to motorcycles and heavy vehicles. But the majority of road casualties are passenger vehicle occupants. Vehicles can mitigate injuries to a pedestrian or cyclist that the vehicle may hit through improved primary and secondary safety features, and so those types of crashes are also within the scope of this discussion.

A profile of passenger vehicles in South Australia

South Australia has a relatively old vehicle fleet. The average age of passenger vehicles is around 11 years of age, and the median age is about 9 years. This is slightly older than the vehicles in most other states in Australia and older than the Australian average.

Normally, the most common vehicle age is less than one year, as the fleet is constantly growing and because of the attrition of vehicles over time. The distribution of vehicle ages in South Australia has an interesting characteristic in that the most common vehicle is one that is 3-5 years of age. This characteristic is a result of the fact that many vehicles in the fleet – almost 30% – were imported from interstate as second-hand vehicles, when those vehicles were in the first five years of their service.

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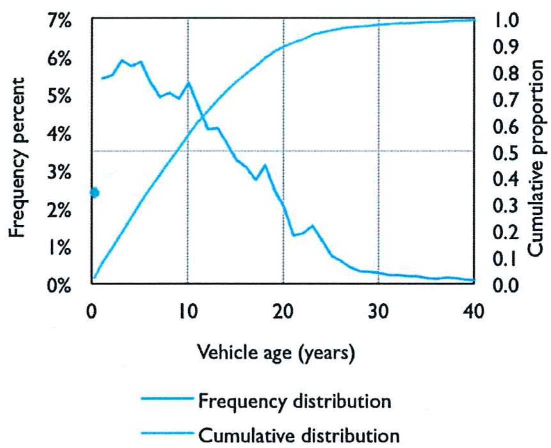
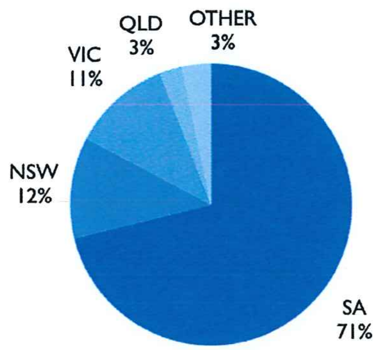


The age profile of South Australian passenger vehicles. Most vehicle are younger than 10 years, but the distribution has a long tail.



The state-of-origin of vehicles in the South Australian registered passenger vehicle fleet.

Another aspect of the South Australian (and Australian) fleet is the nature of vehicle buyers. The majority of vehicles in South Australia were not originally sold as new vehicles to private buyers. Around 40% were originally sold to private and government fleets, with another 15% originally sold to car rental companies, taxi operators and as company vehicles.

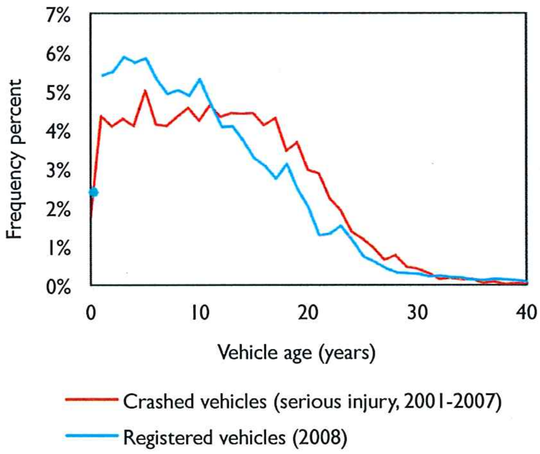
Vehicles that crash

The safety of vehicles becomes important only when a driver is confronted with the potential for a crash. Safety systems may be, in effect, dormant until a critical event, whereupon primary safety systems may help to avoid or reduce the severity of the crash, or in the case of a crash, secondary safety systems will determine how safely the vehicle's and occupants' kinetic energy is dissipated.

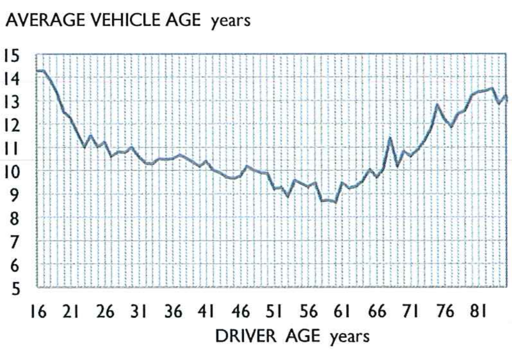
A characteristic of the age profile of crashed vehicles is that it is slightly older than the age profile of the general fleet. An immediate consequence of this is that, given the continuous improvement in vehicle safety systems, crashed vehicles have a lower average level of safety than the general registered fleet.

Young drivers and vehicle safety

The vehicles that crash are not equal with respect to some important driver characteristics. Younger and older drivers tend to crash vehicles that are older on average than those crashed by other drivers. Teen drivers that are involved in serious casualty crashes are driving vehicles that are, on average, 14 years old. This phenomenon also affects older drivers, but older drivers are at less risk of crashing than younger drivers. We don't currently know how much differences in crash outcomes with respect to driver age are due to differences in levels of vehicle safety.



The distribution of vehicle ages amongst crashed and registered vehicles is not quite the same. Crashed vehicles tend to be older than average and vehicles up to about 17 years old are equally represented in crashes.



The youngest drivers in South Australia tend to crash the oldest vehicles – the average age of a vehicle crashed by a 16 or 17 year old in South Australia is over 14 years, and many are older.

Some aspects about the patterns of vehicle use among younger drivers are not known. Some of these aspects would be useful to know when deciding whether it is possible to design positive interventions to improve the average safety of young drivers' vehicles. For example, it would be valuable to know if it is feasible to change patterns of young driver vehicle use by encouraging parents to allow teens to drive the safest car in the household, and whether such a strategy would materially affect the crashworthiness of vehicles in young driver crashes.

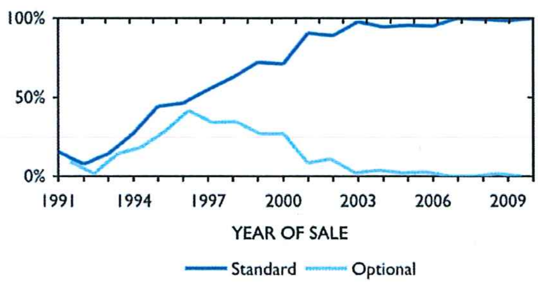
Even though such a strategy would be of unknown efficacy, efforts to promote safe vehicle choices to young drivers should be encouraged, and barriers to young drivers accessing safer vehicles minimised as far as practicably possible.

Finally, it is worth noting that drivers who crash vehicles that are 14 years old, are only benefitting from crash safety technology circa 1996. If present patterns in the use of older vehicles are likely to remain entrenched, then acting now to help supply safe vehicles to young drivers in 2020 and beyond is the most important task.

Vehicle technology take-up and diffusion

The state of the present day fleet can give us some indication of the time taken for vehicle safety features to be taken up by new vehicle buyers, and for features to diffuse into the fleet. Examining how many vehicles of given age have a certain technology, and examining how this proportion changes across vehicle ages, gives an idea of how many new vehicles were being fitted with the technology over time.

Driver airbags installed as a supplementary restraint system were one of the first modern safety features to become widely known by the general public. When the prevalence of driver airbags is examined in the fleet, an estimation of the take-up rate over the last 20 years is possible.



The uptake of driver airbags in South Australia based on a sample of passenger vehicles registered in SA in 2010. The dark blue line indicates the take-up rate in vehicles where airbags were standard. The light blue line indicates the maximum additional installations through optional installation: the take-up rate in the 'optional' group is unknown (but is probably small).

It is apparent that driver airbags have been almost universally fitted in new vehicles since the beginning of 2000's, whereas they were much rarer in the early 1990's. Throughout the 1990's, driver airbags were commonly offered as option on a new vehicle, rather than as standard equipment.

While the uptake of driver airbags steadily increased through the 1990's, the age of the fleet means that the overall fitment rate is about 76% (plus those fitted as an option). Because cars involved in casualty crashes are older than in the general registered fleet, the fitment rate of driver airbags in crashed vehicles is 66% - in other words, a third of vehicles involved in serious casualty crashes still have no driver airbag.

A much more recent safety technology is electronic stability control (ESC). ESC differs from safety technologies such as airbags in that its purpose is to assist the driver to avoid a crash rather that to manage the energy of a crash. ESC is proving to be very effective because it is able to maximise a vehicle's traction to allow the driver to maintain steering control, in a way that is not possible in a vehicle without ESC.

ESC has become widely available only recently. Examination of the current fleet indicates that the current take-up rate in new vehicles in South Australia is about 50%. Overall, ESC may be found in about 14% of all vehicles.

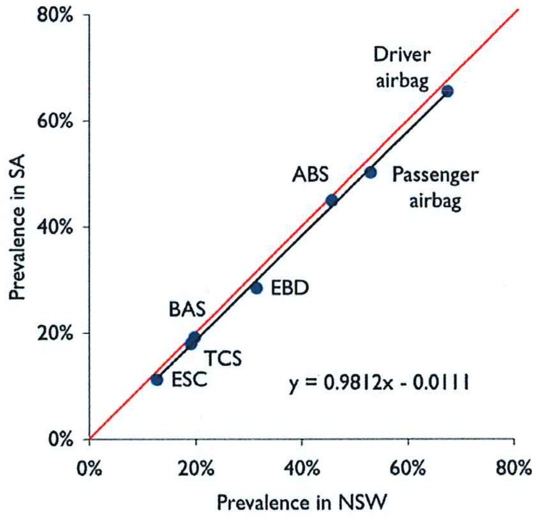
The uptake of electronic stability control in South Australia based on a sample of passenger vehicles registered in SA in 2010. The dark blue line indicates the take-up rate in vehicles where airbags were standard. The light blue line indicates the maximum additional installations through optional installation: the take-up rate in the 'optional' group is unknown (but is probably small).

Differences between vehicles in SA and elsewhere

The overall prevalence of a vehicle safety feature depends on both the take-up rate and the overall age profile of vehicles; as mentioned previously, South Australia has a vehicle fleet that is older than the Australian average.

Of the Australian states, New South Wales' fleet is the newest (apart from the Northern Territory). It is therefore interesting to compare vehicles in Sa and NSW, with regard to the potential improvement in the level of safety that might accrue if the South Australian fleet was

similar to the New South Wales fleet. An analysis of New South Wales vehicles, similar to the one applied to South Australian vehicles (described above), allows such a comparison to be made. The following figure compares the prevalence of various safety-related technologies. It is apparent that, despite the difference in vehicle ages, the difference in the prevalence of most technologies is not great.

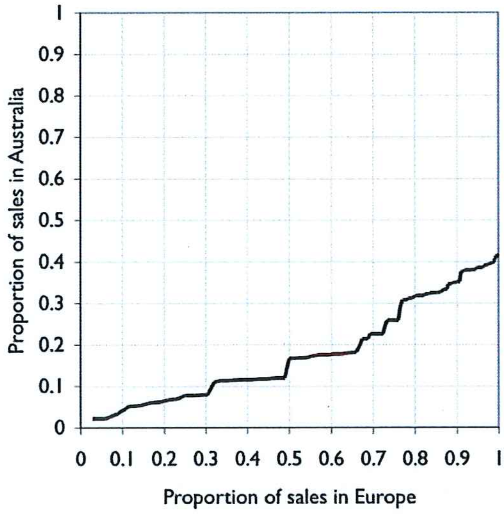


The prevalence of safety technologies in NSW and in SA. There are marginally fewer vehicles in SA with safety technologies, reflecting the difference in the average age of vehicles in each state.

There are, however, likely to be differences in levels of vehicle safety between vehicles in Australia in general, and those sold overseas. For example, Sweden is similar to Australia in that the average age of vehicles is about 10 years. ESC was deployed into new vehicles very quickly in Sweden such that the fitment rate had risen to 95% in new vehicles in 2008, from a rate of 15% in 2003 (not dissimilar to the rate of installation in South Australia at that time).

This kind of difference may emerge because of efforts made in a particular country to promote the technology (as was the case in Sweden) and because vehicle manufacturers selling into a market are ready to respond to increased demand.

Australia and Europe have markedly different fleets. The following figure shows the dissimilarity. Vehicle models were ranked according to their popularity in Europe and are represented by the black line; the line being the accumulated sales of models from the most to the least popular, from left-to-right. The vertical scale shows what proportion of vehicle sales in Australia these models comprise. So, for example, models comprising the top 30% of sales in Europe comprise about 10% of sales in Australia. 60% of vehicles sold in Australia are models with next-to-no representation in the European market.



The proportion of the new passenger vehicle fleet in Australia represented by the top selling proportion of the new car fleet in Europe.

A consequence of this disparity is that developments in vehicle safety in other highly motorised countries will not necessarily flow passively into the Australian market. There are numerous examples of periods where the uptake of technologies in Australian cars has lagged the uptake in overseas markets.

De-specification of vehicles and packaging of safety with luxury

South Australian motorists are being somewhat deprived of vehicle safety technology through the decision of vehicle manufacturers to withhold safety equipment on some imported vehicles. Safety features, which are standard in vehicles sold overseas, are sometimes not included in the same imported models on sale in Australia. The practice of not fitting safety features to vehicle sold in the Australian market is known as de-specification - or “de-speccing”.

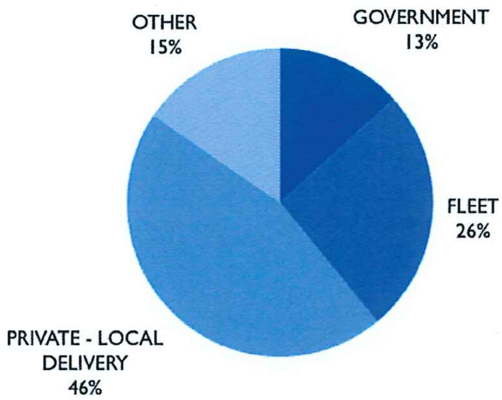
There have been several recent examples where specific models imported into New Zealand have carried higher safety specification than the same models imported in Australia, with Australian versions taking over year to be similarly specified. There are other instances where safety features have been bundled with luxury items, further inhibiting uptake.

The de-specification of safety, the slow introduction of features, the unnecessary optioning of safety equipment, and the bundling of safety into luxury packs are all practices that need to be discouraged to improve the safety of vehicles.

Government and corporate fleet purchasing policy as a way to improve overall levels of safety in the general fleet

The diffusion of safer vehicle technology can be

promoted by active policies to promote uptake by government and private-sector fleets. Around 40% of the registered fleet is, or once was, a vehicle purchased by a corporate or government fleet buyer. Such buyers therefore have important roles to play in shaping the fleet of the future.



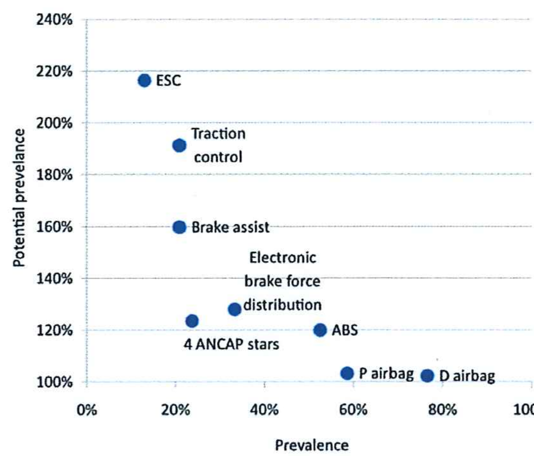
The type of buyer of vehicles currently registered in South Australia. The type of buyer referred to is the buyer when the car was brand new. The majority of vehicles would now be privately owned.

It is important to note that the contributions of the different types of fleet are not equal. Vehicles that were originally South Australian government vehicles constitute about 7% of the total passenger vehicle fleet in South Australia, while vehicles that were originally South Australian private sector fleet vehicles have contributed 3.5 times the number of vehicles.

By examining the safety features of vehicles bought by fleets in the past, and making an assessment about whether it is feasible that certain features would have been available to purchasers at the time, it is possible to estimate how different the present day fleet might have looked if government and fleet buyers had aggressively required such features soon after the feature was available.

The figure at the top of the next column shows the current prevalence of range of vehicle safety attributes on the horizontal scale. The vertical scale shows a potential prevalence over the actual prevalence – the potential being the effect of government and corporate fleets in Australia would have had, if they had mandated the feature in their purchasing policies in the past.

It is clear that the effect is most pronounced early in cycle of technology take-up: ESC would now be in about 30% of vehicles rather than in 14%, but the effect on frontal airbags would be now minimal given the high rates of installation that have existed for 10 years.



The potential factor by which the prevalence of certain technologies would be higher, if all South Australian fleet buyers (government and private sector) had been early adopters of new vehicle technology. The effect on prevalence is greatest for newer technologies that have not yet saturated the newer vehicle fleet.

The effects described above do not include any additional 'halo' effects that such purchasing polices would have. For certain vehicle models, a consistent policy of purchasing optional equipment would increase the likelihood of that technology becoming standard across that model's sales.

If government and corporate fleet buyers could be encouraged to adopt such a stance, there would be benefits for the future fleet. Additional coercive policies might also be envisaged: corporate and government fleets might also adopt a policy of dealing only with manufacturers who comply with benchmarks and timetables that related to the proportion of *all* sales (fleet and private) complying with certain minimum safety standards.

Encouraging vehicle turnover to improve vehicle safety

It is sometimes mentioned that policies to encourage turnover should be considered to lift the average standard of vehicles. Such policies include 'cash-for-clunkers' programs and vehicle inspection schemes.

The evidence for the effectiveness of such programs is thin. Studies on the effect of inspection schemes find no effect on scrappage rates, and in some cases may have contributed to the extension of vehicles' service through better maintenance.

However, the evidence on the benefits of inspection schemes is not strong for either side of the argument. The existing research would imply that there may be an immediate effect of refreshing the vehicle fleet with the introduction of compulsory vehicle inspections. This would be due to older un-roadworthy vehicles being scrapped initially, as their owners realise they would not pass the inspection. Following this, the average fleet

age may actually begin to increase, as older vehicles are kept in better condition in order to pass inspection, and this may prolong vehicles' service life.

Compulsory vehicle inspections may depress the second hand car market in those jurisdictions where the requirement exists, relative to jurisdictions where no requirement exists. This is sometimes cited anecdotally as a reason for lower wholesale prices of second hand motor vehicles in the eastern states compared with South Australia, the lower prices providing an incentive for large scale importation of second hand vehicles into South Australia from New South Wales and Victoria. (Further, vehicle transport costs have been relatively cheap for such operations because of the export of manufactured vehicles from South Australia into New South Wales and Victoria – this provides fleets of trucks with space for vehicles to enter South Australia on the return trips).

Market distortions created by mandatory vehicle inspections (or lack thereof) provide a convenient explanation for the older average age of vehicles in South Australia. However, such reasoning is speculative; even if inspection regimes interstate contribute in some way toward older average vehicle ages in South Australia, its contribution may only be partial, as the average vehicle age may also be related to patterns of motor vehicle ownership in each state with some indication of higher levels of multiple vehicle households in South Australia than, for example, in New South Wales.

A more complete explanation of the differences in the distribution of vehicle ages (whether in terms of registered vehicles or crashed vehicles) in each state of Australia would likely need to account for the numbers of vehicles per household, economic conditions, availability and use of alternative transport modes, as well as the presence of periodic compulsory vehicle inspections.

The next generation of emerging technologies

New vehicle safety technology is in the midst of a revolution. For the past 25 years, major advances have been made in the area of vehicle crashworthiness with high levels of secondary safety expected in new vehicles. But much more recently, technologies have been developed that tackle primary safety by focusing on crash causations and mechanisms. New primary safety technologies are still emerging and the vehicle of the future will have ever-tighter integration of primary and secondary safety features. But while primary safety features appear to offer much, their potential to reduce crashes remains, for many, uncertain.

These technologies include:

- Intelligent speed adaptation systems
- Active forward collision detection and intervention systems
- Lane departure warnings
- Side blind spot/ lane change warnings
- Seatbelt interlock/intrusive reminder
- Active pedestrian detection systems
- Night vision enhancement systems
- Fatigue warning systems
- Alcohol interlocks
- Automatic crash notification systems
- Vehicle to vehicle and vehicle to infrastructure communication systems

Even though the effectiveness of some of these technologies is uncertain, some estimate can be made by identifying the numbers of crashes that would have been affected if the vehicle(s) involved were fitted with technologies such as those listed above.

Based on patterns of crashes in New South Wales crash data, it is probable that the technology with the largest potential for reducing the number of serious and fatal crashes in coming years is forward collision detection and avoidance (setting aside likely gains from further uptake of systems such as ESC). Forward collision technologies currently include emergency brake assist, 'city-safe' low speed obstacle detection with automatic braking, and adaptive cruise control with automatic braking (operating sometimes only above, for example, 60 km/h). In the next five years, it is expected that the technologies will continue to develop such that there will be complete convergence in the operable range of systems, and a complete integration of the sensing and intervention technologies. It is from such future systems that the largest road safety gains are likely to be made.

Another important technology is intelligent speed adaptation (ISA). ISA devices include technologies that advise drivers of current speed limits, assist them to stick to that limit, or even force the vehicle to drive at a speed no faster than the speed limit. These systems have a particular feature in that they may be retrofitted to many vehicles, although it is unlikely that many drivers will voluntarily purchase such systems unless they are integrated into navigation aides.

Studies predict large crash reductions from ISA systems, and current activities include a recently completed trial in NSW. Several states have instituted processes for the generation of speed limit maps – it is important that ISA systems, which rely on a global positioning system, are able to work in conjunction with an accurate speed limit database. However, the costs of setting up and maintaining such a database are not insignificant. At this time, South Australia is yet to implement a government-run ISA speed limit database.

Other systems with potential to reduce crashes are fatigue management systems and alcohol interlock systems. Alcohol interlocks are designed to prevent the operation of a vehicle while intoxicated, while fatigue management systems detect driver impairment through

one of several means: for example, systems that monitor steering wheel and vehicle movements, or eye movements. An effective fatigue system (one that reliably detects and prevents fatigued driving) is likely to be very beneficial, but, as with many new technologies, there is great uncertainty regarding the effectiveness of current systems.

Dedicated short-range communication (DSRC) describes a system involving wireless communication between vehicles and between vehicles and infrastructure. Installed equipment records the location of a vehicle and other vehicle attributes such as speed, brake use, and steering wheel movement. DSRC systems can provide information that allows real-time analysis of traffic flow. It also allows for instantaneous communication between vehicles that are in the vicinity of each other, thus enabling cooperative communications between vehicles and between vehicles and surrounding infrastructure.

These technologies will improve safety by enabling vehicles to "be aware" of road conditions and the presence of other vehicles in the traffic stream. Some examples include the ability to warn drivers of adverse road or weather conditions ahead, or warn drivers that another vehicle is approaching a blind corner and care should be taken etc. While the potential for a reduction in crashes is great, the amount of infrastructure required (external to the vehicle) to enable these technologies to operate effectively is extensive.

DSRC technology has been trialled overseas, and there is a belief that it will eventually be an important road safety system. There have yet to be trials in Australia, however the Motor Accident Commission has recently sponsored a trial in Adelaide. This will commence in December 2010 and the trial will include 'event' days demonstrating the technology in February 2011.

Taking a lead in promoting safer vehicles

There are several ways to encourage safer vehicles to become more common.

- Encouragement directed at fleet managers. A large proportion of new vehicle sales are to fleets. The people making decisions are thus highly influential in deciding the speed of take-up of a safety technology. Persuading quite a small number of people to take the lead on this would have disproportionate benefits.
- Encouragement directed at private buyers of new vehicles.
- Encouragement directed at private buyers of second hand vehicles. The re-sale value is one of the things that influences buyers of new vehicles. Thus if buyers of second hand vehicles demand safety features, there would be a knock-on effect in the new car market. However, second hand buyers are restricted to choose from the existing stock of vehicles, and so demand from buyers of second hand vehicle is likely to be much less effective in improving average safety levels in the fleet. Note though that encouragement aimed at younger drivers may help to elevate the average safety amongst this group of drivers.

As mentioned earlier, a large proportion, up to 40%, of the stock of vehicles in the registered fleet is determined by the purchases of government and corporate fleets. Purchasing polices that include requirements for effective safety technologies are likely to be cost-beneficial for the fleet purchaser as well as improve the efficiency of technology uptake in the entire fleet, as ex-fleet vehicles continue their service life in the second-hand vehicle market. Such policies are also more likely to lead to lower marginal costs for manufacturers and purchasers alike, further encouraging take-up by all buyers.

The major guide to selecting safer vehicles is ANCAP, the Australasian New Car Assessment Program. Certain aspects of safety of a car model are summarised by a star rating. Where fleets adopt policies to buy 'safe' cars, it is reasonable to assume that the ANCAP rating will figure largely in such a policy. ANCAP therefore also has an important role to play in encouraging uptake of technologies at the purchasing stage. Of course, ANCAP are likely to also have a direct influence on manufacturing decisions through the inclusion of technologies in assessment protocols.

A potential limitation of ANCAP is that positive results are rightly lauded, but there is no accounting for sales volume. Rewards and coercive policies targeting sales-weighted safety levels may encourage more widespread use of safer vehicle technologies.

A "safe fleet" scheme might allow businesses to accredit their fleets, and to be recognised for contributing positively to vehicle safety in South Australia, much as businesses are able to be recognised for emission reductions through the "Greenfleet" scheme.

Greenfleet gives a company corporate accreditation for measuring and offsetting their CO_2 emissions. In the process, it raises the profile of "green motoring". There may be an opportunity to use this approach in fleet vehicle safety. Organisations such as ANCAP could accredit fleets that have a 5 star fleet, and this accreditation would give companies and organisations the opportunity to be publically recognised for having the highest possible average level of safety their fleet. Furthermore, an obligation of accredited organisations and companies might be to "spread the word" to other companies or fleets they deal with.

Governments also have more mainstream coercive options available to them. For new vehicles, the Australian Design Rules impose certain standards, and are updated from time to time as technology advances. The current policy is one that moves regulation into the international arena, and hence future regulation is likely to be tightly linked to international processes such as the World Forum for Harmonization of Vehicle Regulations (WP.29) of the United Nations Economic Commission for Europe.

Governments could use the system of taxes and levies to progress their objectives: fees could be lower for vehicles incorporating certain new technologies, or for vehicles less injurious to people outside them, or registration of vehicles without certain technologies might be refused. Recently the Victorian State Government has made some moves in this direction.

With 4 or 5 stars for occupant passive safety having become common, it might be asked whether further improvement is at all likely. There is some positive (albeit limited) evidence from French accident data – even among cars with at least 4 stars, further safety features lead to substantial (10 to 40 per cent) reductions in injury crashes. Consequently, improvement vehicle safety is worth encouraging even amongst car makes and models that already perform reasonably well by current standards.

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