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# Advisory Intelligent Speed Adaptation for government fleets

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## TITLE

Advisory Intelligent Speed Adaptation for government fleets

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## ABSTRACT

This project sought to determine the likely crash savings if state government fleets in Australia were fitted with advisory Intelligent Speed Adaptation (ISA). The cost effectiveness of such a fitment was assessed considering if the ISA device is kept within the government fleet (scenario 1) or if it is left in the government vehicle when it is sold (scenario 2). Data from the fleet vehicles involved in the recent NSW ISA was used. The reduction in crash risk was calculated by applying Kloeden's risk curves for travel speed to the "before" speed profile and the "ISA active" speed profile found in the trial. The reduction in risk was then estimated in terms of the difference in the total crash risk produced by these speed profiles. ISA was found to have the potential to reduce casualty crashes in government fleets by 20%. It was estimated that this would eliminate 171 casualty crashes involving state government vehicles per year and save $31.6 million in crash costs per year. Scenario 1 was more cost effective than scenario 2, although the wider benefit to the community produced by scenario 2 was not taken into account. Of the four ISA devices considered the navaid device that included ISA functionality was found to be the most cost effective.

## KEYWORDS

Intelligent Speed Adaptation (ISA), fleet, cost effectiveness, speed

# Summary

The central aims of this project were twofold: to model the likely crash savings if state government fleets were fitted with advisory Intelligent Speed Adaptation (ISA) and to assess the cost effectiveness of such a fitment. The assessment of cost effectiveness was conducted using two different scenarios:

- Scenario 1 -the advisory ISA device is kept within the government fleet by transferring a device from a vehicle that is about to be sold to a new government vehicle.
- Scenario 2 - the advisory ISA device is left in the government vehicle when it is sold.

The potential of monitoring advisory ISA was also investigated.

Benefit calculations assumed that ISA affects travel speed in a manner that was measured in fleet vehicles in a recent trial conducted by the New South Wales Centre for Road Safety in the Illawarra region of New South Wales. The reduction in crash risk was calculated by applying Kloeden's risk curves for travel speed to the distributions of speeds found in the trial. The risk curves were applied to the "before" speed profile and the "ISA active" speed profile. The reduction in risk was then estimated in terms of the difference in the total crash risk produced by these speed profiles.

The results show that advisory ISA has the potential to reduce casualty crashes in government fleets by 20%. It was estimated that this would eliminate 171 casualty crashes involving state government vehicles per year and save $31.6 million in crash costs per year.

Four devices currently available that provide advisory ISA functionality were identified and analysed for their cost effectiveness. Scenario 1 produced higher BCRs than scenario 2, although the ongoing safety benefit of leaving the ISA device in the vehicle when it was sold was not included in the BCR calculation of scenario 2.

The economic analysis revealed that the navaid device, which included ISA functionality (device C) had a payback period of around a year, and was cost effective regardless of the scenario or state being considered. The two dedicated ISA devices considered produced varied results. Device B was not cost effective for any scenario or state. Device A was cost effective for scenario 1, having payback periods of between 4 and 12 years, but was not cost effective for scenario 2. The multimedia centre that includes basic advisory ISA functionality (device D) was not found to be cost effective when residual value was not considered. To be cost effective under all circumstances that were considered in the analysis, device D would need to retain 70% of its original value when the government vehicle is sold.

# Contents

# 1 Introduction

Intelligent Speed Adaptation (ISA), also referred to as intelligent speed assist is a relatively new safety technology which has been demonstrated in many trials to have significant safety benefit; internationally (Adell et al., 2008; Biding and Lind, 2002; Carsten et al., 2008; Driscoll at al., 2007; Oei and Polak, 2002; Taylor, 2006; Várhelyi et al., 2004; Vlassenroot et al., 2007) and in Australia (New South Wales Centre for Road Safety, 2010; Regan et al., 2005). ISA is a blanket term referring to many different types of devices that share the aim of helping the driver adhere to the posted speed limit.

ISA devices can be divided into three categories: advisory, supportive and limiting. Advisory devices communicate to the driver that they are travelling above the speed limit by using audio and visual signals. The audio signal can be a simple beep or a statement delivered such as “you are driving above the speed limit”. The driver is not obliged to slow to the speed limit but some advisory devices encourage this by using more annoying audio signals the longer the speed limit is exceeded or the greater the amount the limit is exceeded by. Supportive devices prevent the vehicle breaking the speed limit by various methods such as ‘hardening’ the accelerator pedal, cutting fuel supply, electronically manipulating the throttle, applying the brakes or a combination of these methods. Supportive devices allow this control to be overridden. A limiting device works in the same way as a supportive device except that the driver cannot override it.

New safety technology can take a long time to become a common feature of vehicles. Consider, for example, electronic stability control (ESC) on passenger vehicles. ESC has been in production since the mid 1990’s yet it took until 2009 for half of the new passenger vehicles in Australia to be fitted with this safety technology as a standard feature (Truong et al., 2010).

Governments, and in particular state governments, are a significant purchaser of new vehicles in Australia. By requiring the installation of safety technology on these vehicles, governments can not only improve the safety of their fleet but also improve the safety of the general fleet as these vehicles are sold. Governments requiring certain features in their vehicles can also speed up the introduction of these features as standard features sold to the public. Government fleets may therefore have an important role to play in expanding the use of ISA in Australia.

The central aims of this project were twofold: to estimate the likely crash savings if state government fleets were fitted with advisory ISA and to assess the cost effectiveness of such a fitment. The assessment of cost effectiveness was conducted using two different scenarios:

- Scenario 1 - the advisory ISA device is kept within the government fleet by transferring a device from a vehicle that is about to be sold to a new government vehicle.
- Scenario 2 - the advisory ISA device is left in the government vehicle when it is sold.

The potential of monitoring advisory ISA was also investigated.

## 1.1 Background

### 1.1.1 Speed of government vehicles

Travel speed has been shown to be an important crash risk factor (Kloeden et al., 1997; Kloeden, Ponte, McLean 2001; Nilsson, 2004). It is the risk associated with travel speed that an intelligent speed advisory system reduces. Therefore, the extent to which ISA might reduce crashes depends upon the speeds of government vehicles, and how those speeds might change with ISA devices.

We could identify no specific studies on the speed of government vehicles, but the speeds of company or ‘fleet’ vehicles (as opposed to private vehicles) have been examined. It will be assumed for the present purpose that such studies can be generalised to government vehicles. Fleet and government vehicles may be subject to different driver behaviour than private vehicles for reasons that might include:

- they are not owned by the driver or that they are driven more kilometres than a private vehicle
- the identification of the vehicle by a government plate or other corporate information which may modify driving behaviour,
- much of the travel is work related, and hence speed selection may be affected by the needs of the workplace and workplace culture.

Harrison et al. (1998) covertly measured the speeds of 496 vehicles before stopping and surveying the driver. They found that one factor related to higher driving speeds was the use of a business or work vehicle.

Adams-Guppy and Guppy (1995) found 22% of 572 company car drivers self-reported exceeding the speed limit by 10 mph (16 km/h) ‘very often’ and a further 33% ‘quite often’. The main factor that predicted the likelihood of speeding was found to be time pressure and the desire to be on time for appointments. This study made no comparison between drivers of company vehicles and drivers of private vehicles.

Newnam, Watson and Murray (2002) surveyed 204 drivers from four organisations in Queensland to determine factors that influenced the safety of the drivers when driving in work and personal vehicles. One of the organisations was a local government. They found that drivers were less likely to speed in a work vehicle than their private vehicle. An explanation given by the authors as to why their results were at odds with other literature was that the majority of the sample fell within an older age group.

Directly relevant are the results from the New South Wales ISA trial. The data produced by the trial showed no differences between fleet and private vehicles with respect to ISA’s effect on speeding (New South Wales Centre for Road Safety, 2010).

The literature suggests that the travel speed of company cars is at least as high as the average vehicle. Some evidence exists that it may be higher than average, but the evidence is not consistent and not conclusive. The travel speeds of company cars are more likely to reflect the travels speeds of government vehicles than private vehicles, for the reasons stated above. However, differences may still exist. It may be that the public holds the government to a higher standard than private companies therefore government vehicle drivers feel a greater need to obey the speed limit.

### 1.1.2 Relative crash rate of government vehicles

No previous studies were identified that examined the crash rate of government vehicles relative to all vehicles. However, the crash rates of fleet vehicles have been examined.

Lynn and Lockwood (1998) used a postal questionnaire to investigate crash rates of drivers of company vehicles and compare them to the crash rates of drivers of private vehicles. Their sample included 4479 drivers from 212 different companies. They discovered that drivers who drove company vehicles as a necessary part of their job had 0.1 crashes per year when driving for work and 0.08 crashes per year when not driving for work (a 25% higher crash rate for work driving). Drivers of company cars had 50% more crashes than 'ordinary' drivers, allowing for exposure and demographic differences. Note that the number of crashes included crashes that occurred when the company car drivers were not driving for work. Further, drivers that said the car they drove most was a company car had 29% more crashes than drivers who did not say the car they drove most was a company car.

The aforementioned study by Newnam *et al*. (2002) found that company car drivers have a higher crash rate in work vehicles than in their personal vehicles. Note that this result was corrected for exposure.

An Austroads report into fleet safety (Austroads, 2008) examined registration and crash data from New South Wales from 2000 to 2004 to determine crash rates for fleet vehicles and private vehicles. The report found that the crash rate for fleet vehicles was between 37 and 50% higher than for non-fleet vehicles. Note that this is a vehicle based crash rate, which differs from Lynn and Lockwood's driver based crash rates.

### 1.1.3 The effects of advisory ISA

Publications that report the change in speed behaviour in trials using an advisory ISA system include New South Wales Centre for Road Safety (2010), Adell *et al*. (2008), Driscoll *et al*. (2007), Lahrmann *et al*. (2001), Päätalo *et al*. (2001), Taylor (2006), and Biding and Lind (2002). The results of these trials are summarised in Table 1.1.

Table 1.1
Advisory ISA trials

| 1st Author | Location | Study Year | Light Vehicles | Speed zones (km/h) | Mean speed change (km/h) | 85th% speed change (km/h) | Speeding Reduction |
|---|---|---|---|---|---|---|---|
| Adell | Debrecen, Hungary | 2003 | 20 | 50 | -0.7 | -1.8 | - |
| Adell | Mataro, Spain | 2003 | 20 | 30-120 | -1.9 to -2.8 | -0.4 to -5 | - |
| Lahrmann | Aalborg, Denmark | 2001 | 20 | undefined | -5 to -6* | - | - |
| Päätalo | Finland | 2001 | 24 | 40-80 | -2.8 | - | 39% |
| Taylor | Ottawa, Canada | 2006 | 20 | 40-100 | - | - | 13-22% |
| NSW CRS | Illawarra, Australia | 2010 | 104 | 40-110 | -1.1 to -2.8 | -1.6 to -4.2 | - |
| Biding | Borlänge, Sweden | 2001 | 400 | 30-110 | -0.6 to -3.4 | - | 10-77% |
| Driscoll | France | 2001 | 20 | undefined | -0.8 | - | - |

* This result may not be mean speed change – see discussion below

In all the trials, advisory ISA reduced the mean and 85$^{th}$ percentile speeds as well as reducing speeding. It should be noted that the results reported in Lahrmann *et al*. (2001) should be viewed with caution. It is not clear from the report if the reported reduction in mean speed is actually mean speed or if it is the reduction in the mean of speeds over the posted speed limit. Setting aside Larmann's results, the trials may be summarised by the result measured in the Borlänge trial where mean speeds were reduced by between 0.6 km/h and 3.4 km/h. It may also be noted that the results of the New South Wales trial are comparable to the results of international trials.

Figure 1.1 illustrates the changes in mean speed in 50 km/h zones in four separate regions. It can be seen that, despite the large differences in pre ISA mean speed, the effect of advisory ISA was similar in all the regions.

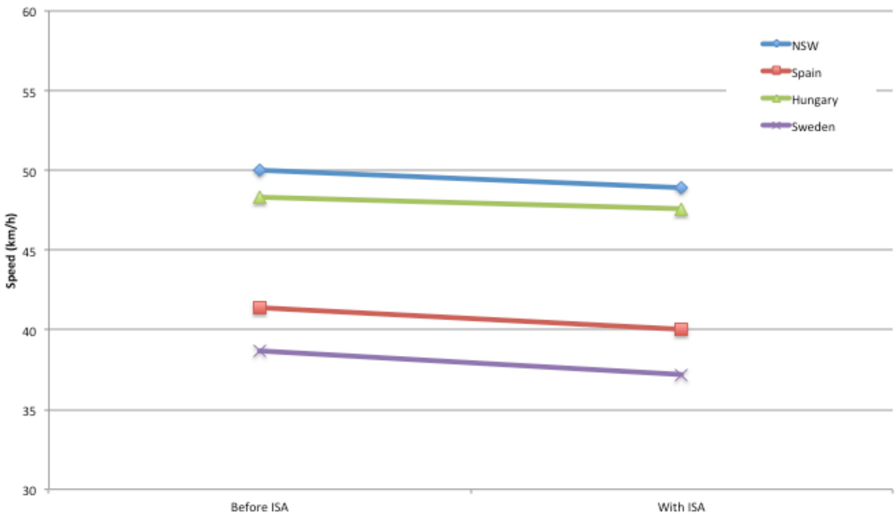


Figure 1.1
The effect of advisory ISA in 50km/h speed zones as reported in the literature
(1 represents the control period, 2 represents the effect period)

The mean speed reductions by speed zone are shown in Figure 1.2 for trials of advisory ISA which reported results for various speed zones. This illustrates that there is a tendency for advisory ISA to produce higher reductions in mean speed in higher speed zones.

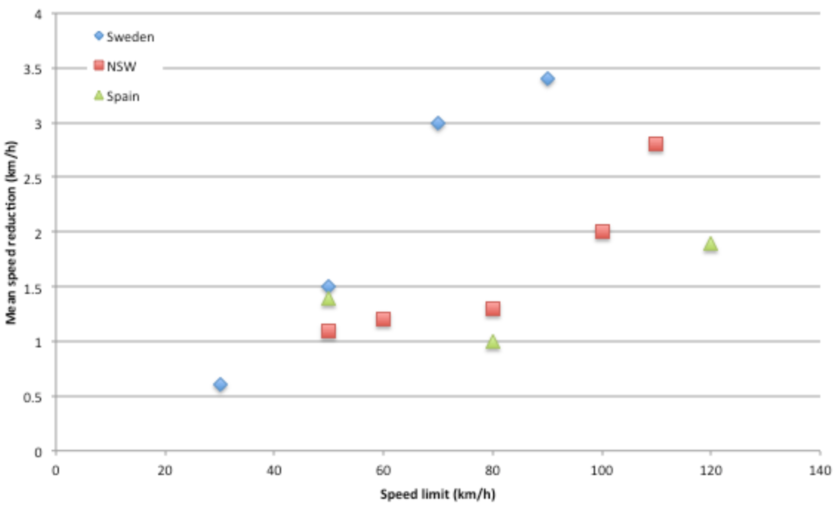


Figure 1.2
Mean speed reduction by speed zone for trials of advisory ISA as reported in the literature

### 1.1.4 Monitored advisory ISA

Several studies have investigated the effect of monitored advisory ISA. Some of these studies used some form of incentive in combination with the monitored advisory ISA to motivate the driver to conform to the speed limit.

Päätalo *et al*. (2001) investigated the effectiveness of several ISA devices including a 'recording' system over a set route. When using the recording system the drivers were aware that their speed behaviour was being recorded, although they were told that the information recorded would only be used by the driver and the experimenter. The speed limit was shown on a display, as was the percentage of the trip that had been driven above the speed limit. It is unclear if the driver was warned audibly if they were driving above the speed limit as no mention is made of such a warning. The recording system produced a reduction in mean speed of 2 km/h. In the same study an advisory ISA system produced a reduction of 2.8 km/h.

Agerholm et al. (2008) examined monitored advisory ISA in company vehicles in Denmark. When the speed limit was exceeded by more than 5 km/h they received a verbal warning that was repeated every six seconds. On the third warning they would receive penalty points, the number of which depended upon the degree of speeding. As some the vehicles were used by many drivers, a key ID to identify the individual drivers was used. An award was given to the driver with the fewest penalty points. The drivers could monitor their performance against others on a website. The researchers did not intend to compare advisory ISA to monitored advisory ISA but were able to do so because the key IDs were only used over 79% of the mileage. The percentage of mileage spent speeding with and without the key ID can be seen in Table 1.2. Note that the difference between the effect without the key ID and with the key ID is only significant at the 5% level for 50 and 70 km/h zones, although 80 km/h zones almost reach this significance level. For these speed zones it is apparent that the effect of advisory ISA in reducing speeding is enhanced with the use of the key ID to monitor the drivers performance. It is possible that there is some self selection bias in the results: drivers that did not use the key ID may have been those that were more likely to speed than those that used the key ID correctly.

Table 1.2
Percentage of mileage over the speed limit +5 km/h depending on the use of the key ID (Agerholm *et al*. 2008)

| | Speed limit (km/h) | | | | |
|---|---|---|---|---|---|
| | 50 | 70 | 80 | 110 | 130 |
| Baseline | 18.7 | 15.2 | 18.9 | 25.5 | 5.0 |
| Effect without key ID | 13.6 | 9.7 | 11.0 | 3.0 | 0.3 |
| Effect with key ID | 4.2 | 2.9 | 2.5 | 6.9 | 1.4 |
| p-value | 0.014 | 0.009 | 0.056 | 0.403 | 0.500 |

Another study in Denmark followed very similar principles to Agerholm *et al*. (2008) and was know as 'Pay as You Speed' or PAYS (Lahrmann et al., in press). While the ISA device and penalty points system was very similar to Agerholm *et al*. (2008) the penalty points reduced an insurance discount of 30% rather than counting against an award for the safest driver. No significant effect of the interaction between the information provided by the advisory ISA device and the incentive were found in terms of the distance spent above the posted speed limit, although both the information and incentive were found to have a significant effect on the distance spent above the speed limit. Lahrmann *et al*. stated that an explanation as to why the combination of information and incentive had no significant effect on the speed behaviour of the participants was that large problems with recruiting drivers meant it was likely that the drivers who did volunteer were drivers who were more likely to keep to the speed limit and were motivated to do so.

Unfortunately none of these studies have been able to provide conclusive evidence that monitoring enhances the effect of ISA despite some indications that this may be the case. Further research will be required in this area. It could also be argued that most ISA trials include a level of monitoring: participants are generally informed that a researcher will be monitoring their speed behaviour.

### 1.1.5 Devices and costs

Several devices are currently available on the market that provide advisory ISA functionality, either as a core function or additional feature. These will be described in the following section in generic terms only. All suppliers were asked to provide information on the operation of their device or devices and estimate a price for the range of quantities state government fleets would purchase if they were fitting all their vehicles with the device.

#### Device A

Device A is a dedicated advisory ISA device. It is capable of receiving and transmitting information. This functionality may be used for live updates of speed limit maps, variable speed limit changes such as road works and variable zones as well as transmission of driving behaviour for monitoring purposes (such as speeding). Device A is wired into the vehicles electrical system and switches on automatically when the ignition is switched on. This device costs $500 plus a further $100 to install. Data and subscription costs of around $5 a month are likely, and monitoring a further $10 a month. While outside the scope of this report, it may be noted that a vibrating accelerator pedal to provide tactile feedback to the driver is now a $200 option of this device.

#### Device B

Device B is also a dedicated advisory ISA device. It is not currently commercially available but has been used in trials and could be produced commercially in the future. It can supplement the GPS signal with dead reckoning when the GPS signal is low. It can also, theoretically, supplement speed limit map data with information from portable transmitters placed at temporary speed limit locations such as work zones or car accidents. This device would cost $800 with installation costing a further $250. This device can be expanded to include an active accelerator pedal to produce a supportive or limiting ISA system. This device does not come with speed limit maps therefore no information on the cost of map updates is available. For the purpose of this report it is assumed that map updates are equal in cost to device C.

#### Device C

Device C is a navaid device that has the added functionality of advisory ISA. The retail versions have a relatively soft ISA functionality. For example, the audible warning that the speed limit and speed limit tolerance that the device allows have been exceeded is not repeated if speed is not reduced. For a large purchase the device can be customised to make the ISA functionality stronger and therefore similar in function to a dedicated ISA device. The base bulk order price for this device is $135 (including customisation) with map updates costing $50. Maps can be updated annually. The device does not require specialised installation.

#### Device D

Device D is a multimedia centre integrated into a vehicle during manufacture. One of the many functions of this multimedia centre is to display speed limit information. Unlike the other ISA devices only a visual warning is given that the speed limit is being exceeded; no audible warning is given. It is unknown how much this would reduce the effectiveness of ISA. This device costs $777 if added as an option, but is a standard feature on high specification models. The percentage of government vehicles that are of a high enough specification to include device D as a standard feature is likely to be negligible. As this technology has only just been released no information on the cost or mechanism to update the maps is available. The cost of updating the maps will therefore be assumed to be equal to device C.

# 2 Data and methods

## 2.1 Overview

In this report, crash savings will be calculated by multiplying the numbers (and costs) of crashes involving government vehicles by the reduction in crash risk brought about by the use of ISA. Both elements of the calculation (crashes and risk reduction) must be estimated first. Additionally, an estimate of the size of the states' government fleet was used in the benefit-cost calculation. The size of the fleet was also used to derive the probable numbers of crashes involving government vehicles for states where crash numbers were not known directly.

Ideally, the number of crashes involving government cars would be known directly. In reality some states can only provide incomplete data and others cannot provide any data. Similar comments can be made about the numbers of vehicles in the states' government fleet. The following sections describe which quantities were known directly and which quantities had to be derived. Where quantities had to be derived from other sources, the method of derivation is described. Where derivation was required it was performed with the understanding that it would produce a result that is a reasonable approximation of the unknown quantity. For crash data known directly five year averages were used wherever possible.

The crash data were disaggregated by speed zone and injury severity. Disaggregation by speed zone was required because the reduction in crash risk was applied by speed zone. Disaggregation by injury severity was required to calculate the value of the monetised crash reductions.

An objective in the study's design was to avoid the assumption that government vehicles are simply the same as other vehicles.

## 2.2 Estimating the size of the government fleet

The number of government vehicles is difficult to know precisely. Many state governments have a central fleet management service but this service is not necessarily used by all government departments in all states. Privatisation and semi-privatisation of government owned utilities has also added uncertainty to what is counted as a government vehicle.

Three separate ways to calculate total state government fleet numbers were utitlised.

- The first method takes the average vehicle sales to state governments over 2008-2010 (as determined by the FCAI) and multiplies this number by the average time that vehicles spent in the state government fleet (life span) over 2008-2010. Only state fleet management groups for New South Wales and Western Australia provided data on the average time a vehicle spends in the state government fleet. The average life span of these two states was applied to the other states for this method of determining government fleet numbers.
- The second method was to simply take the number of vehicles managed by the state fleet management service in the most recent reporting period. Only New South Wales, South Australia and Western Australia supplied this data.
- The third method was to access the number of vehicles that are registered as government vehicles. This data was available for South Australia from 2007 to 2011 (based on Feburary snapshots) and for New South Wales in 2007 (based on a December snapshot).

The preference was to use registration data to determine the size of the states' government fleet, as the registration data were also used to determine the corresponding crash statistics. If registration data was not available to determine the size of the states' government fleet, the number of vehicles managed by the state fleet management service was used. If neither of these were available, the size of the fleet was calculated using FCAI data (as detailed above).

## 2.3 Crashes of government vehicles

Crash data was collected from several states and registration information was used to identify those crashes involving a government vehicle. In some states, some government vehicles can be identified by a characteristic in the alpha-numeric registration plate. However, even in these states, some government vehicles are not government plated as they are used during hours in which the use of a government vehicle may appear inappropriate to the public; other vehicles are given to executives as part of their salary package. Using alpha-numeric identifiers to isolate crashes in which government vehicles are involved may not therefore be representative of all crashes involving government vehicles. While there may be no difference between the crash experience of government vehicles that have government registration plates and those that do not, the potential exists for the use of a government registration plate to produce differences in driver behaviour, and therefore crashes.

Data on crashes involving government owned vehicles were obtained from South Australia and New South Wales, with Queensland and Victoria providing limited data. As South Australia and New South Wales provided data on the size of the government fleets, it was possible to calculate crash rates for these states. These crash rates were applied to the number of government vehicles in the other states. Then, crash numbers were distributed amongst speed limits according to the unweighted average proportion of crashes occurring in different speed limit areas in New South Wales, Victoria and South Australia. (In New South Wales, Victoria and South Australia, the distributions of crashes by speed limit indicated by respective crash datasets were used.)

## 2.4 Benefit of advisory ISA on government vehicles

The benefit of ISA flows from reductions in travelling speed, which in turn reduces the risk of being involved in a crash. For this study the effect that advisory ISA has on travel speed is taken from a recent trial conducted by the New South Wales Centre for Road Safety in the Illawarra region of New South Wales. The results of this trial were chosen because it was undertaken in Australian conditions, used an advisory ISA device which is commercially available in Australia and included 41 fleet vehicles from private companies. Only the results from these 41 vehicles are used in this analysis. The New South Wales ISA trial data was recorded in a time-based format (e.g every 10 seconds). For more information on the New South Wales ISA trial see the report from the New South Wales Centre for Road Safety (2010).

In order to use the speed measurements from the New South Wales ISA trial to calculate a change in risk, the measurements were weighted by speed to produce distance-based measurements. Distance-based measurements are preferred over time-based measurements because the risk functions used in this study are interpretable as a risk per distance travelled rather than a risk per time spent travelling. Speeds were recorded in the New South Wales ISA trial to the nearest mile-per-hour (mph). The percentage of distance spent at each speed was calculated before the ISA device was active and during the time the ISA device was active. An example of the distribution of the speeds of the trial vehicles during the ISA inactive and ISA active periods is shown in Figure 2.1. It should also be noted that speeds below 75% of the speed limit were not included in the data. The lack of data at lower speeds is of little consequence: the potential error in the estimate of benefit is in the order of only 2% because of the exponential nature of speed - crash risk relationship.

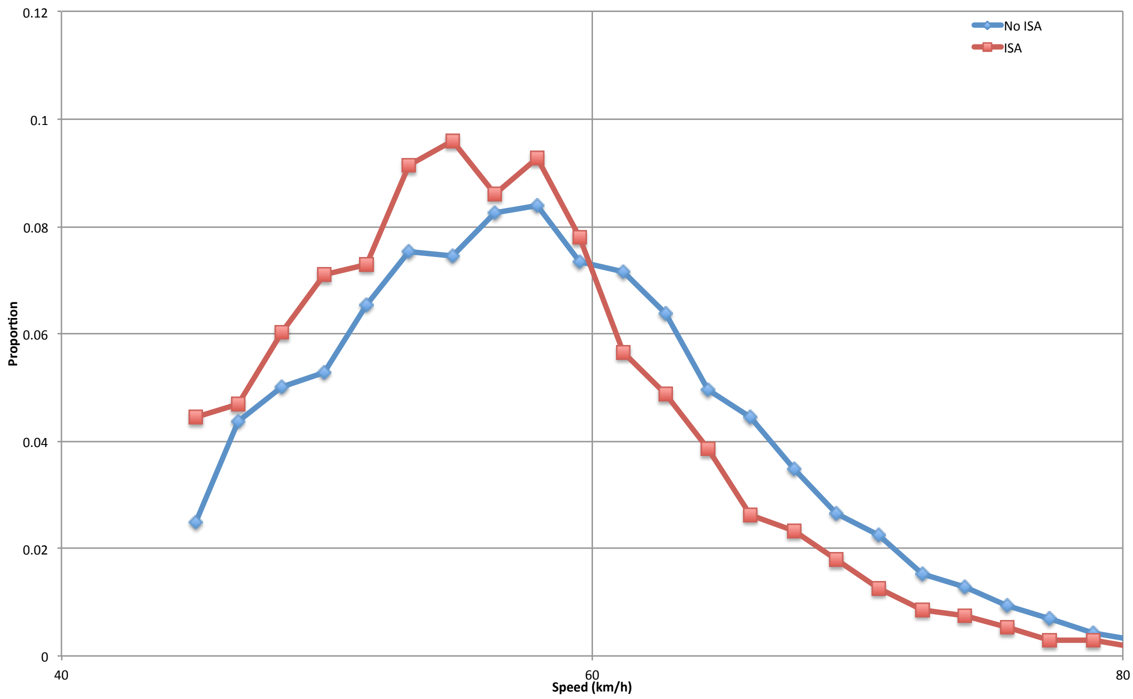

Figure 2.1
Distribution of speeds in 60 km/h zones with and without ISA (75% of speed limit and above)

The difference in crash risk between two speed distributions can be calculated by applying a crash risk function to each distribution. One of the widely recognised studies on the relationship between travel speed and crash risk was conducted in Australia by Kloeden, et al. (1997) and was further developed in Kloeden, Ponte and McLean (2001) and Kloeden, McLean and Glonek (2002). The relationships expounded in these analyses are widely accepted in the road safety community, and they have been applied to determining the benefits of ISA previously (Tate and Carsten, 2008; Doecke and Woolley, in press). Relevant in the present context is that they are based on Australian crashes. For this study, the risk curve was capped above 80km/h in 50, 60 and 70km/h zones and at 30km/h above the mean speed in 80, 100 and 110km/h zones to minimise the impact of small, potentially variable, amounts of high level speeding. The validity of risk curves above these values is also uncertain, but the end result in this study will be a conservative estimate of benefit. The risk curves for travel speed as used in this analysis can be seen in Figures 2.2 and 2.3.

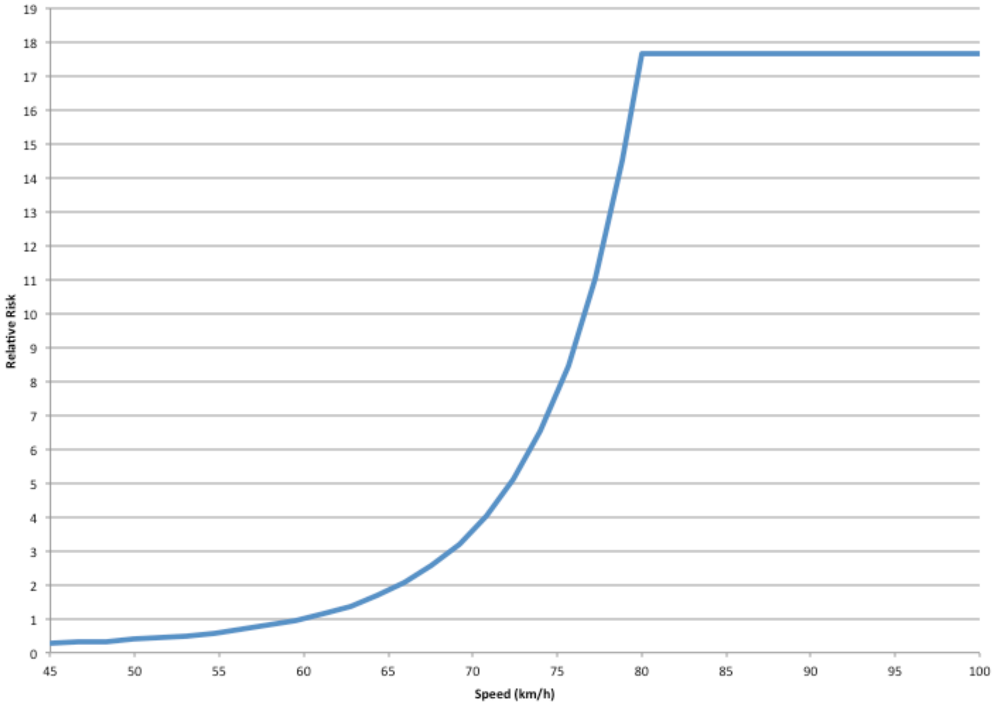


Figure 2.2
Risk curve for 50, 60 and 70 km/h zones

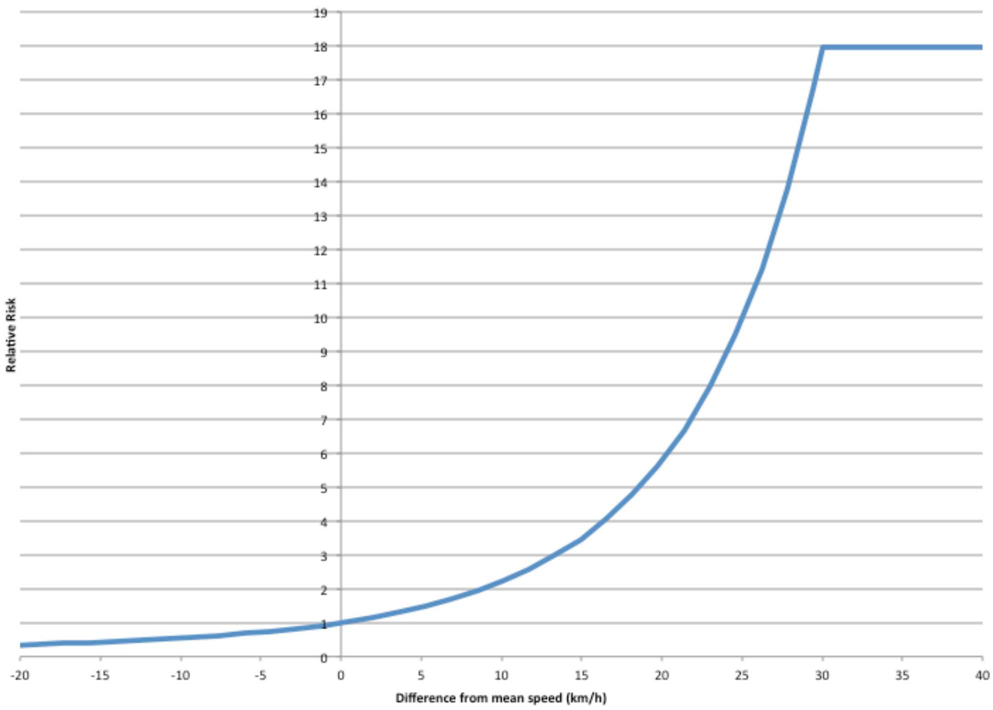


Figure 2.3
Risk curve for speed limits of 80km/h and above

The reduction in crash risk due to ISA is then calculated thus:

- The ISA and non-ISA speed distribution of the 41 fleet vehicles in the New South Wales trial was multiplied by the relevant risk curve. This was done for every speed zone speed distribution in the New South Wales trial. The result is a risk curve weighted by prevalence of each speed in the distribution.
- The total relative risk for each distribution is the weighted risk curve summed over all speeds in the distribution.
- The difference in the total relative risks for the ISA and non-ISA distributions is then used to estimate the reduction in relative risk brought about by the use of ISA.
- These crash risk reductions were then multiplied by the number of casualty crashes involving a government vehicle in each speed zone and state to produce the casualty crash reductions by speed zone and state.

The Bureau of Infrastructure, Transport and Regional Economics (BITRE) calculated the cost of crashes in Australia (BITRE, 2009). BITRE estimates the average cost per crash by determining the overall costs of crashes and dividing by the number of crashes. It should be noted that BITRE's estimates of crash numbers far exceed those reported to police, and hence BITRE's crash costs should be multiplied by an under-reporting factor when applied to crash savings based on police reported crashes (as is the case in this report). For more discussion on this topic see Doecke, Woolley and Anderson (2010). The cost of a crash as reported by BITRE was converted to 2010 dollars using the consumer price index reported by the ABS (ABS, 2011). The overall cost per police reported crash calculated from BITREs report were determined to be $66,230 for a minor injury crash (non-hospitalised), $438,333 for a serious injury crash (hospitalised) and $2,988,011 for a fatal crash.

To calculate the monetised value of the casualty crash reductions:

- Casualty crashes involving a government vehicle were disaggregated according to severity according to BITRE definition (non-hospitalised injury, hospitalised injury and fatal).
- The total cost of crashes involving government vehicles was then calculated. Dividing this figure by the total number of relevant casualty crashes gave the average cost of a casualty crash involving a government vehicle.

Crash data identifying government vehicles, categorised by severity, were only available from South Australia, Victoria and Queensland.

For other states, the average crash cost had to be determined from examining the average cost of all casualty crashes

- For South Australia, Victoria and Queensland, the cost of a casualty crash involving a government vehicle was expressed as a ratio of the average cost of a casualty crash involving any vehicle.
- These ratios were applied to the average casualty crash costs in other states: for New South Wales the Victorian ratio was used and in Western Australia and Tasmania the average of the South Australia and Queensland ratio was used. This was felt to be most representative way to extrapolate crash costs.

The crash reductions estimated by the change in risk were then multiplied by the average cost of a crash. This produced an estimate of the monetised value of crash reductions accruing from the use of advisory ISA in the states' government vehicle fleet.

## 2.5 Economic analysis

Two scenarios were considered for the economic analysis. Both scenarios considered installing advisory ISA in all government vehicles. The difference between the two scenarios relates to what happens to the ISA device when the vehicle is sold. In scenario 1 the device is removed from the government vehicle when that vehicle is sold and placed in a new government vehicle. In scenario 2 the device is left in the government vehicle when it is sold. In the latter scenario, the benefit is transferred to a new owner, but this benefit is neglected in the present analysis.

Payback period was used as the central economic indicator as it is independent of a time period, which is uncertain in the case of new electronic technology. Payback period represents the period required to achieve a benefit costs ratios (BCR) of one. If the time period over which the ISA device would be used before it is replaced or malfunctions is known in the future this can be compared to the payback period to determine cost-effectiveness. A BCR was also calculated. The time period used to calculate the BCR, 20 years, assumed that the technology would remain in the vehicle until it is scrapped. At first this may seem overly optimistic, but consider that consumers would expect many other electronic components in modern vehicles, such as electronic throttles, to function for the duration of the vehicles life.

Discount rates that are applied to economic analyses are designed to reflect the return on investment that could be gained elsewhere. This has the effect of devaluing future benefits (and costs as well if the net benefit at that point in time is negative). Discount rates that are applied to transportation economics can vary from as low as 3% up to 10% (Tate and Carsten, 2008: COWI, 2006: Litman, 2009: Cairney et al. in press). Considering this, discount rates of 4%, 6% and 8% were used in the economic analysis to examine the sensitivity of the economic indicators to the discount rate.

Several assumptions were made in the economic analysis. It was assumed that the cost of the device is constant over the period being considered. This is likely to be the case with device C as navaids have plateaued in cost, but is less certain for the other devices. It is also assumed that the current crash rate of government vehicles will continue if ISA is not installed on vehicles. It is also assumed that the number of government vehicles (and hence sales) remains static.

In scenario 1 the device is removed from the government vehicle when it is sold and installed in the replacement vehicle. Due to the assumption of static government fleet numbers the number of devices that need to be transferred per year is equal to the annual government vehicle sales numbers. It is assumed that the cost of transferring the device from one vehicle to the next is equal to twice the installation cost. As device D cannot be easily removed from the vehicle and installed in a new vehicle it was not considered in this scenario.

In scenario 2 the device remains in the government vehicle when it is sold. The number of new devices that are purchased each year is therefore equal to the government vehicle sales numbers. Only the benefit to the government vehicles is considered in the calculations. Clearly, scenario 2 would produce benefits for the general fleet as vehicles equipped with advisory ISA are sold to the public. Such benefits were not included in the economic analysis directly but should be noted when comparing scenario 1 and 2.

As described in Section 1.1.5, device D has many multimedia functions besides advisory ISA. It is therefore possible that it may have a residual value that adds to the resale value of the vehicle. Given that this device has only just been released it is difficult to predict how much this residual value might be. Rather than make a difficult prediction, the residual value required to produce a BCR of one for the device was calculated.

### 2.5.1 Monitored advisory ISA

Monitoring of a government vehicles speeding behaviour by managers within a government department may enhance the effectiveness of advisory ISA. Monitoring may be accompanied by either internal reward of speed limit compliance or punishment of speeding. At this point in time the literature does not provide conclusive answers on this topic (see Section 1.1.4).

As stated in Section 1.1.5, device A is capable of transmitting data and can therefore be used for monitoring purposes, at a cost of $10 per vehicle per month. As the benefits of monitoring are uncertain it was decided to determine the percentage increase of the effect of advisory ISA required to cover the cost of the monitoring service.

# 3 Results

## 3.1 Size of government fleet

Government purchasing of vehicles represents a significant proportion of total vehicle sales in Australia. Data from the Federal Chamber of Automotive Industries (FCAI) shows that, in 2010, 6.3% of all vehicle sold were sold to governments. Of the three tiers of government, state governments were the largest purchaser (4.4%) followed by local governments (1.4%) and the federal government (0.4%). Over the past six years the percentage of vehicle sales to state government has been decreasing (Figure 3.1), although this downward trend has slowed in recent years. Figure 3.2 shows that this trend is consistent across all states. Note that in both Figure 3.1 and 3.2 the national state percentage includes the territories.

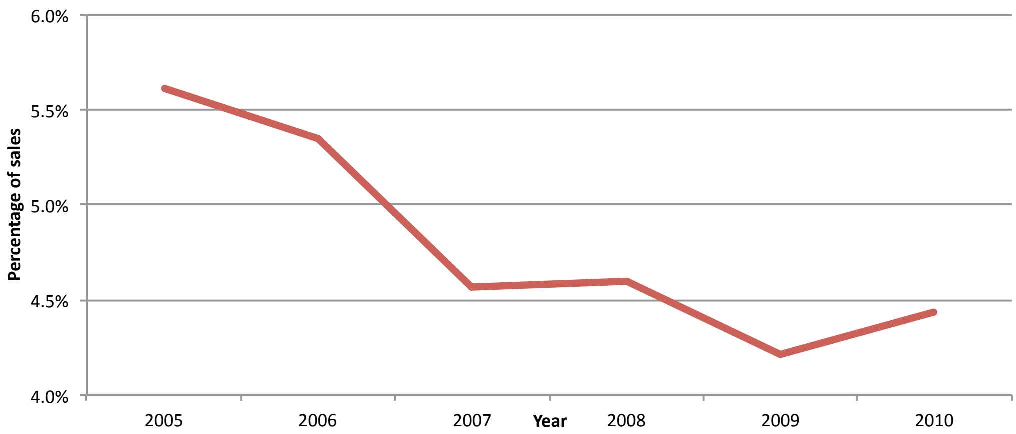


Figure 3.1
Pecentage of sales to state governments (2005-2010)

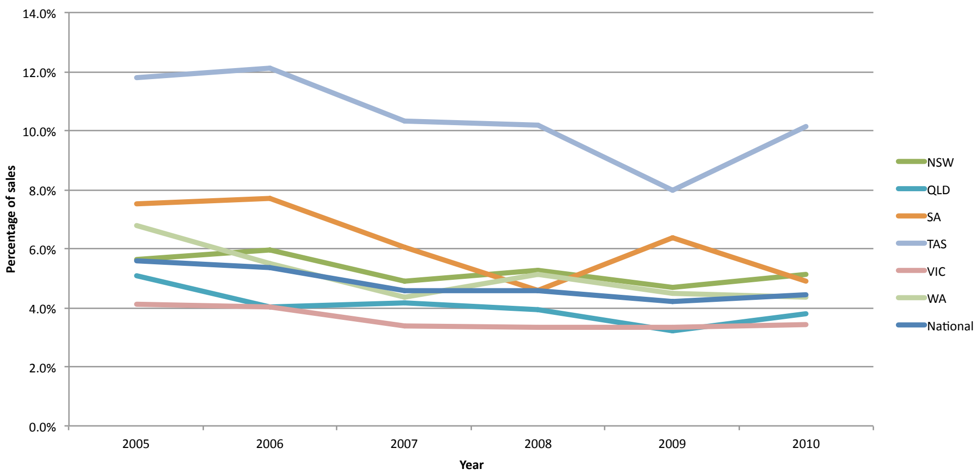


Figure 3.2
Percentage of sales to state governments (including national average), 2005-2010

The size of state government fleets are shown in Table 3.1; calculated from sales, managed by the state fleet management service, or registered as government vehicles. In South Australia the three methods produce similar results, but in New South Wales there is a large difference between the three methods. In Western Australia the difference between the calculated and managed fleet size is relatively small. An explanation for the discrepancy between the calculated fleet size and the managed fleet size is that not all vehicles classed as government vehicles in the FCAI sales data are managed by the state government's fleet management agency. The large difference between the size of the government fleet in New South Wales determined from registration data compared to the other methods may be partially a result of the difference in time period, approximately 2.5 years.

Table 3.1
Size of state government fleets in Australia by state, 2010

| State | Sales | Life Span | Calculated fleet | Managed fleet | Registration data |
|---|---|---|---|---|---|
| NSW | 15,300 | 2.59 | 39,635 | 25,219 | 58,587* |
| QLD | 7,580 | 2.49 | 18,876 | - | - |
| SA | 3,364 | 2.49 | 8,376 | 8,501 | 9,017^ |
| TAS | 1,760 | 2.49 | 4,384 | - | - |
| VIC | 8,932 | 2.49 | 22,241 | - | - |
| WA | 5,198 | 2.39 | 12,422 | 11,331 | - |
| Total | 43,960 | - | 110,480 | - | - |

* Figure based on snapshot taken in December 2007

^ Figure based on average of snapshots taken February 2007 to 2011

## 3.2 Crashes of government vehicles

The crash rate was expressed per-vehicle-per-year. The results are shown in Table 3.2. The ratio of the government vehicle crash rate to all vehicles crash rate is also given. A ratio of less than one indicates that the government vehicle crash rate is lower than the all vehicles crash rate.

Contrary to the literature on company vehicle crash rates, government vehicles have a lower crash rate than all vehicles in South Australia and New South Wales. This is also the case when injury crash rates are considered. When serious crashes or fatal crashes are considered the crash rate of government vehicles is higher, however, the low number of serious and fatal crashes of government vehicles (60 and 11 respectively) used to calculate the rates means caution should be exercised when interpreting these results.

Table 3.2
Crash rate per vehicle per year for government and all vehicles (SA, 2006 to 2010; NSW, 2007)

| | SA | | | NSW | | |
|---|---|---|---|---|---|---|
| Crash type | Gov. | All | Ratio | Gov. | All. | Ratio |
| All severity | 0.02631 | 0.03018 | 0.87 | 0.01618 | 0.01879 | 0.86 |
| Injury | 0.00732 | 0.00874 | 0.84 | 0.00707 | 0.00784 | 0.90 |
| Serious | 0.00133 | 0.00125 | 1.06 | - | - | - |
| Fatal | - | - | - | 0.00019 | 0.00014 | 1.36 |

The percentage of casualty crash involved vehicles from 2005 to 2009 in each speed zone by state for government vehicles and all vehicles are shown in Table 3.3. In New South Wales, government vehicles follow a very similar casualty crash pattern to all vehicles. In South Australia, and to a lesser extent Victoria, a greater proportion of casualty crashes involving government vehicles occur in 100 and 110 km/h zones than average; concomitantly, a smaller proportion occur in 60 km/h zones. The averages shown in Table 3.3 are straight averages of the values shown for the three states; i.e. they are not weighted by crash numbers. It was this average that was used to calculate the derived results for other states. Casualty crashes involving a government vehicle per year are shown in Table 3.4, both directly provided and derived.

Table 3.3
Comparison of the percentage of casualty crash involved vehicles at a given speed limit, 2005 to 2009

| | SA | | VIC | | NSW | | Average | |
|---|---|---|---|---|---|---|---|---|
| Speed Limit | Gov. | All | Gov. | All | Gov. | All | Gov. | All |
| <50 | 2.9 | 2.0 | 1.4 | 2.0 | 1.9 | 1.3 | 2.1 | 1.8 |
| 50 | 22.1 | 21.2 | 22.4 | 17.5 | 32.9 | 30.2 | 25.8 | 23.0 |
| 60 | 42.1 | 52.7 | 33.3 | 38.5 | 36.3 | 37.3 | 37.2 | 42.8 |
| 70 | 2.6 | 3.6 | 9.4 | 9.9 | 9.4 | 10.6 | 7.1 | 8.0 |
| 80 | 6.2 | 8.7 | 9.6 | 13.9 | 7.5 | 7.9 | 7.8 | 10.2 |
| 90 | 1.8 | 1.1 | 0.6 | 0.7 | 1.2 | 1.6 | 1.2 | 1.1 |
| 100 | 10.6 | 6.0 | 19.5 | 14.0 | 8.4 | 8.3 | 12.8 | 9.4 |
| 110 | 11.2 | 4.7 | 1.2 | 0.7 | 2.2 | 2.5 | 4.9 | 2.6 |
| Unknown | 0.6 | 0.1 | 2.4 | 2.7 | 0.2 | 0.3 | 1.1 | 1.0 |
| Total | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Table 3.4
Casualty crashes per year involving a government vehicle, 2005 to 2009

| | State | | | | | | |
|---|---|---|---|---|---|---|---|
| Speed Limit | NSW# | QLD* | SA# | TAS* | VIC# | WA* | Total |
| <50 | 8.0 | 2.8 | 2.0 | 0.7 | 1.4 | 1.7 | 16.5 |
| 50 | 142.2 | 35.0 | 15.0 | 8.1 | 21.8 | 21.0 | 243.2 |
| 60 | 156.6 | 50.6 | 28.6 | 11.7 | 32.4 | 30.4 | 310.3 |
| 70 | 40.6 | 9.7 | 1.8 | 2.3 | 9.2 | 5.8 | 69.4 |
| 80 | 32.6 | 10.5 | 4.2 | 2.4 | 9.4 | 6.3 | 65.5 |
| 90 | 5.2 | 1.6 | 1.2 | 0.4 | 0.6 | 1.0 | 10.0 |
| 100 | 36.4 | 17.4 | 7.2 | 4.0 | 19.0 | 10.5 | 94.5 |
| 110 | 9.4 | 6.6 | 7.6 | 1.5 | 1.2 | 4.0 | 30.3 |
| Unknown | 0.8 | 1.4 | 0.4 | 0.3 | 2.4 | 0.9 | 6.3 |
| Total | 431.8 | 135.8 | 68.0 | 31.5 | 97.4 | 81.5 | 846.0 |

* Derived; # Direct

## 3.3 Benefit of advisory ISA on government vehicles

The percentage reductions in crash risk for fleet vehicles in the New South Wales ISA trial, were calculated as described in Section 2.4. The results are shown in Table 3.5.

Table 3.5
Percentage reduction in fleet vehicle crash risk
produced by advisory ISA in the NSW ISA trial, by speed zone

| Speed Limit | Crash risk reduction |
|---|---|
| 50 | 18.8% |
| 60 | 22.8% |
| 70 | 27.2% |
| 80 | 15.3% |
| 90 | 21.2% |
| 100 | 18.2% |
| 110 | 19.6% |

To determine overall casualty crash reductions, the casualty crashes shown in Table 3.4 are multiplied by the percentage reductions shown in Table 3.5. Summing the total of the crash reductions and dividing by the total crashes (Table 3.4) produces a percentage reduction in crashes due to the installation of ISA. These results are shown in Table 3.6. Note that the percentage reductions are the same for Queensland, Tasmania and Western Australia because the crash numbers are derived, as discussed previously.

Table 3.6
Government vehicle casualty crashes saved per year with ISA by state and speed zone

| | State | | | | | | |
|---|---|---|---|---|---|---|---|
| Speed Limit | NSW | QLD | SA | TAS | VIC | WA | Total |
| 50 | 26.8 | 6.6 | 2.8 | 1.5 | 4.1 | 4.0 | 45.8 |
| 60 | 35.6 | 11.5 | 6.5 | 2.7 | 7.4 | 6.9 | 70.6 |
| 70 | 11.1 | 2.6 | 0.5 | 0.6 | 2.5 | 1.6 | 18.9 |
| 80 | 5.0 | 1.6 | 0.6 | 0.4 | 1.4 | 1.0 | 10.0 |
| 90 | 1.1 | 0.3 | 0.3 | 0.1 | 0.1 | 0.2 | 2.1 |
| 100 | 6.6 | 3.2 | 1.3 | 0.7 | 3.5 | 1.9 | 17.2 |
| 110 | 1.8 | 1.3 | 1.5 | 0.3 | 0.2 | 0.8 | 5.9 |
| Total | 88.0 | 27.2 | 13.5 | 6.3 | 19.2 | 16.3 | 170.7 |
| Percentage reduction | 20.4% | 20.0% | 19.9% | 20.0% | 19.8% | 20.0% | 20.2% |

The average cost of a casualty crash involving all vehicles and government vehicles is shown in Table 3.7. The average cost of a casualty crash involving a government vehicle is consistently lower than the average cost of a casualty crash in a particular state, though the amount below varies (3, 7 or 21% below). Note that in New South Wales, Tasmania and Western Australia the average cost of a government vehicle crash was based on an assumed ratio of government vehicle casualty crash cost to all vehicle casualty crash costs.

Table 3.7
Average cost of a casualty crash involving a government vehicle or all vehicles
(2005 to 2009 – SA, NSW; 2004 to 2008 - QLD)

| | Governent | All | Ratio |
|---|---|---|---|
| NSW | 167,039 | 172,205 | 0.97* |
| QLD | 207,043 | 261,835 | 0.79 |
| SA | 144,001 | 154,034 | 0.93 |
| TAS | 168,993 | 196,503 | 0.86# |
| VIC | 254,250 | 260,794 | 0.97 |
| WA | 205,849 | 239,359 | 0.86# |

* From the ratio for Victoria
# The average of SA and QLD

Table 3.8 displays the annual monetary savings that were estimated to result from the installation of advisory ISA in government vehicles by state. The figures used to arrive at monetary savings are also shown.

Table 3.8
Casualty crash and monetary savings per year
as a result of installing advisory ISA in government vehicles

| | State | | | | | | |
|---|---|---|---|---|---|---|---|
| | NSW | QLD | SA | TAS | VIC | WA | Total |
| Casualty crash reduction | 88.0 | 27.2 | 13.5 | 6.3 | 19.2 | 16.3 | 170.7 |
| Average cost per crash ($) | 167,039 | 207,043 | 144,001 | 168,993 | 254,250 | 205,849 | - |
| Monetary savings ($) | 14,701,625 | 5,635,478 | 1,946,866 | 1,068,315 | 4,892,410 | 3,363,390 | 31,608,085 |

## 3.4 Economic analysis

### 3.4.1 Scenario 1: ISA device removed when vehicle sold

The payback periods calculated for scenario 1 are shown in Table 3.9. In some cases the BCR would never reach one. In such cases the payback period was not applicable (NA). Payback periods for device A varied from 4.2 years to 12 years. For device B the payback period was mostly not applicable. Device C would pay for itself in less than a year.

Table 3.9
Payback period (years) for installing advisory ISA in government vehicles – scenario 1

| | Device A | | | Device B | | | Device C | | |
|---|---|---|---|---|---|---|---|---|---|
| Discount | 4% | 6% | 8% | 4% | 6% | 8% | 4% | 6% | 8% |
| NSW | 4.9 | 5.1 | 5.5 | 23.2 | 38.4 | NA | 0.7 | 0.7 | 0.7 |
| QLD | 4.2 | 4.4 | 4.7 | 53.6 | NA | NA | 0.5 | 0.5 | 0.5 |
| SA | 8.9 | 10.0 | 11.6 | NA | NA | NA | 0.8 | 0.8 | 0.8 |
| TAS | 6.7 | 7.3 | 8.1 | NA | NA | NA | 0.7 | 0.7 | 0.7 |
| VIC | 9.1 | 10.3 | 12.0 | NA | NA | NA | 0.8 | 0.8 | 0.8 |
| WA | 4.6 | 4.9 | 5.2 | NA | NA | NA | 0.5 | 0.5 | 0.6 |

Table 3.10 shows the BCRs for scenario 1 by device, discount rate and state. While there is variation between states this does not cause the BCR to be above one in some states and below one in others, for a given device. This is also the case for the discount rate. For device A the BCR varies from 1.09 to 1.6, for device B it varies between 0.61 and 0.97 and for device C between 3.49 and 4.88.

Table 3.10
BCRs for installing advisory ISA in government vehicles – scenario 1

| | Device A | | | Device B | | | Device C | | |
|---|---|---|---|---|---|---|---|---|---|
| Discount | 4% | 6% | 8% | 4% | 6% | 8% | 4% | 6% | 8% |
| NSW | 1.60 | 1.53 | 1.45 | 0.97 | 0.92 | 0.87 | 4.22 | 4.10 | 3.98 |
| QLD | 1.62 | 1.55 | 1.48 | 0.91 | 0.87 | 0.83 | 5.02 | 4.88 | 4.74 |
| SA | 1.21 | 1.16 | 1.10 | 0.69 | 0.66 | 0.63 | 3.63 | 3.53 | 3.43 |
| TAS | 1.32 | 1.27 | 1.21 | 0.74 | 0.71 | 0.68 | 4.10 | 3.98 | 3.87 |
| VIC | 1.19 | 1.14 | 1.09 | 0.67 | 0.64 | 0.61 | 3.70 | 3.60 | 3.49 |
| WA | 1.52 | 1.45 | 1.39 | 0.83 | 0.80 | 0.77 | 5.00 | 4.85 | 4.71 |

### 3.4.2 Scenario 2: ISA device remains in vehicle when sold

The payback periods calculated for scenario 2 are shown in Table 3.11. In most cases the BCR would never reach one (NA). Payback periods for devices A, B and D were not applicable with one exception, in New South Wales with the low discount rate. Device C was found to have payback periods of 1.2 years and less.

Table 3.11
Payback period (years) for installing advisory ISA in government vehicles – scenario 2

| | Device A | | | Device B | | | Device C | | | Device D | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Discount | 4% | 6% | 8% | 4% | 6% | 8% | 4% | 6% | 8% | 4% | 6% | 8% |
| NSW | 30.7 | NA | NA | NA | NA | NA | 0.8 | 0.8 | 0.8 | NA | NA | NA |
| QLD | NA | NA | NA | NA | NA | NA | 0.7 | 0.7 | 0.7 | NA | NA | NA |
| SA | NA | NA | NA | NA | NA | NA | 1.1 | 1.2 | 1.2 | NA | NA | NA |
| TAS | NA | NA | NA | NA | NA | NA | 0.9 | 1.0 | 1.0 | NA | NA | NA |
| VIC | NA | NA | NA | NA | NA | NA | 1.1 | 1.1 | 1.2 | NA | NA | NA |
| WA | NA | NA | NA | NA | NA | NA | 0.7 | 0.7 | 0.7 | NA | NA | NA |

Table 3.12 shows the BCRs for scenario 2 by device, discount rate and state. As in scenario 1, variation between states does not cause the BCR to be above one in some states and below one in others, for a given device. This is once again the case for the discount rate as well. For device A the BCR varies from 0.61 to 0.96, for device B it varies between 0.38 and 0.63, for device C between 1.92 and 2.65 and for device D between 0.5 and 0.81.

Table 3.12
BCRs for installing advisory ISA in government vehicles – scenario 2

| | Device A | | | Device B | | | Device C | | | Device D | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Discount | 4% | 6% | 8% | 4% | 6% | 8% | 4% | 6% | 8% | 4% | 6% | 8% |
| NSW | 0.96 | 0.93 | 0.90 | 0.63 | 0.60 | 0.58 | 2.70 | 2.65 | 2.60 | 0.81 | 0.78 | 0.76 |
| QLD | 0.87 | 0.85 | 0.82 | 0.54 | 0.53 | 0.52 | 2.69 | 2.65 | 2.61 | 0.71 | 0.69 | 0.68 |
| SA | 0.66 | 0.64 | 0.63 | 0.42 | 0.40 | 0.39 | 2.01 | 1.98 | 1.95 | 0.54 | 0.53 | 0.52 |
| TAS | 0.71 | 0.69 | 0.67 | 0.44 | 0.43 | 0.42 | 2.20 | 2.17 | 2.13 | 0.58 | 0.57 | 0.55 |
| VIC | 0.64 | 0.62 | 0.61 | 0.40 | 0.39 | 0.38 | 1.98 | 1.95 | 1.92 | 0.52 | 0.51 | 0.50 |
| WA | 0.78 | 0.77 | 0.75 | 0.49 | 0.48 | 0.46 | 2.51 | 2.48 | 2.44 | 0.64 | 0.63 | 0.61 |

Device D has many multimedia functions besides advisory ISA that may have a residual value that adds to the resale value of the vehicle. The residual values of Device D required to produce a BCR of one (break even) are shown in Table 3.13. The residual values required range from \$196 to \$539, or 25 to 70% of the device's original cost.

Table 3.13
The residual value required to break even for device D by state and discount rate ($)

| | Device D | | |
|---|---|---|---|
| Discount | 4% | 6% | 8% |
| NSW | 196 | 243 | 294 |
| QLD | 280 | 314 | 352 |
| SA | 447 | 485 | 525 |
| TAS | 407 | 443 | 482 |
| VIC | 462 | 499 | 539 |
| WA | 344 | 376 | 411 |

### 3.4.3 Monitored advisory ISA

Device A is capable of transmitting data and can therefore be used for monitoring purposes, at a cost of $10 per vehicle per month. As the benefits of monitoring are uncertain it was decided to determine the percentage increase of the effect of advisory ISA required to cover the cost of the monitoring service (Table 3.14). The percentage increase in the effect of ISA required to cover the costs of monitoring range from 48% to 115%.

Table 3.14
Percentage increase in the effect of advisory ISA required to cover the cost of monitoring

| | Device A | | |
|---|---|---|---|
| Discount | 4% | 6% | 8% |
| NSW | 48% | 51% | 55% |
| QLD | 52% | 55% | 58% |
| SA | 103% | 107% | 111% |
| TAS | 87% | 90% | 94% |
| VIC | 107% | 111% | 115% |
| WA | 65% | 68% | 71% |

# 4 Assumptions and limitations

Data on government vehicles is not easily obtained, especially crash data. Ideally the analysis in this report would have utilised detailed crash and general data on government vehicles from every state. As such data was not readily available from every state, the data that was obtained was generalised to states in which the applicable data was not obtained. The accuracy of the results is therefore dependant on the accuracy of such generalisations. However, such generalisations were made on the understanding that a reasonable approximation of actual result would be achieved.

The effectiveness of advisory ISA in based on the speed behaviour of 41 private fleet vehicles in the New South Wales trial. The analysis in this report assumes that the effect of advisory ISA on the drivers of these fleet vehicles in Illawarra, New South Wales, is representative of the effect that advisory ISA would have on the drivers of government vehicles across Australia. It should be noted that this represents and improvement over previous work that, by necessity, relied on the results of international trials, but nevertheless brings with it its own limitations.

The analysis assumed that every device was equal in effectiveness to device A, the device used in the New South Wales trial. This assumption is likely to be more accurate for some devices than others. Device B is a dedicated ISA device, like device A, and should therefore have similar effectiveness. Device C is a navaid device with advisory ISA functionality. With appropriate customisation (such as repetition of audible warnings if speeding continues) this device is likely to be similar in effectiveness to device A. In its current format, device D is unlikely to be as effective as device A as it includes no audible warning that the speed limit is being exceeded. At the time of writing the authors were advised that customisation of this device to include an auditory warning is not currently an option. It is hoped that, were device D to be required in government vehicles, the manufacturer could be persuaded to include an auditory warning, but this is uncertain. For this reason the economic analysis of device D should be treated with caution.

Devices A, B and C can be switched off by the driver when the vehicle is being driven. This is not currently an option on device D. Ideally, an advisory ISA device should not be able to be switched off. Jamson (2005) found that, if given an option, those that are most in need of ISA are the least likely to use it. Deactivation of advisory ISA is included in the results of the New South Wales ISA trial and therefore did not need to be accounted for specifically in this study. The New South Wales Centre for Road Safety was not able to directly measure the prevalence of ISA device deactivation in the New South Wales ISA trial, but rather it relied upon an online questionnaire administered after the effect stage. This survey showed that 10% of the exclusive drivers of vehicles (including exclusive drivers of private vehicles) reported that they turned off the ISA device regularly (New South Wales Centre for Road Safety, 2010). If an advisory ISA device can be made in such a way that it cannot be switched off when the vehicle is in motion the effect of ISA, and therefore the BCRs shown in Section 3.4, would be expected to increase. To allow for map inaccuracies, an ISA device should only allow temporary 'override'.

The prices reported in Section 1.1.5 and used in the economic analysis (Section 3.4) were provided by the manufacturers of the devices for the purposes of research. While every endeavour was made to ensure they were an accurate representation, they were not official quotes and therefore the price may vary somewhat if a government negotiates an actual order. It is possible that the prices of devices may reduce in time, especially the price of dedicated ISA devices. If this were to occur the payback periods would reduce and the BCRs would increase.

In scenario 2 the ISA device remains in the vehicle when it is sold. This scenario would, over time, result in about four to five per cent of vehicles in Australia being equipped with advisory ISA. If advisory ISA can reduce casualty crashes by 20%, scenario 2 would eventually produce a casualty crash reduction of around one per cent. This may seem insignificant; however, consider that BITRE calculated the national cost of casualty crashes in Australia for 2006 to be $13.48 billion (BITRE, 2009). Without indexing, a one per cent reduction in casualty crashes would equal savings of $135 million. Such savings were not included in the economic analysis as it was considered outside the scope of this report; however, such benefits should not be ignored when comparing scenario 1 and 2.

The cost of a crash used was BITRE's hybrid human capital costs. Another crash costing method may have been to examine the direct cost of a crash in a government vehicle to that vehicle's department, such as; repair of vehicle, loss of labour, insurance premiums, compensation etc. It is likely that this would have produced lower costs as such costing is not as broad as BITRE's hybrid human capital approach. Another costing method is known as 'willingness to pay'. This method produces higher crash costs than any other current method. BITRE states that if it had used this method to cost fatal crashes, the total cost of crashes would have risen by 52% (BITRE, 2009). The method used for costing crashes should therefore be considered the 'middle of the road' option.

The analysis assumed that speed limit maps are complete, as they were for the New South Wales ISA trial in Illawarra. Currently speed limit maps used by the devices cover major cities, some rural centres, and major interconnecting highways. The coverage of the commercial speed limit maps is ever increasing. The exact coverage may vary from device to device, depending on the map provider the device uses. Most states are progressing towards producing completed speed limit maps of their states, with Victoria and Western Australia having completed theirs already. Unless government vehicles spend a significant proportion of their journeys on minor rural roads the assumption of map completeness is reasonably close to the current and future situation, albeit an overestimation. It should also be noted possible differences in map coverage between the devices was considered outside the scope of this report and was not taken into account in the analysis.

An underlying assumption resulting from the use of a 20 year period in the BCR calculations is that the ISA device can last this long. This does not affect scenario 2, as the device is only kept within the government fleet for less than 3 years, on average. The time an electronic device lasts can vary greatly and determining how long the ISA devices would last is outside the scope of this report. If, in the future, the life of an ISA device is known the payback period can be used to determine if it is cost effective.

The analysis revealed that device C is cost effective and that device B is not, regardless of the scenario being considered. Device A was cost effective in scenario 1 but was not in scenario 2. Device D, which could only be considered for scenario 2, was not cost effective. Device C produced the highest BCRs, followed by device A, device D and device B.

Factors other than the calculated payback period and BCR may be important when comparing the devices:

- Device A can automatically update its speed limit maps producing greater map accuracy.
- It is likely that the speed limit maps of Device A are more comprehensive than device C and D.
- Device B does not currently include a speed limit map.
- Device A has the capability to transmit data and can therefore be used for monitoring purposes. It can also be expanded to include a vibrating accelerator pedal.
- Device B can be expanded to function as a supportive or even limiting ISA.

- Device C is not wired into the vehicle. This results in no installation costs, a major contributor to its high BCRs, but also makes it less secure. This also makes it more likely to be switched off, the importance of which is discussed above.
- Device D may have a residual value that adds to the resale value of the vehicle. This residual value must be at least $539 for it to be cost effective in all situations considered. This is equivalent to 70% of its original value.

As mentioned above, device A is capable of transmitting data and can therefore be used for monitoring purposes. The percentage increase in the effect of ISA required to cover the costs of monitoring range from 48% to 115%. It appears unlikely that such a large enhancement of the effect of advisory ISA would be achieved by monitoring. More research is required in this area to conclusively determine the effect of monitored ISA and therefore determine if it is cost effective. However, a side benefit of the monitoring of the device would be to examine speed distributions of these vehicles on an ongoing basis, making the data suitable for other road safety performance measurements.

Government fleets that were not included in the analysis were the territory governments' fleets, the federal government fleet and local governments' fleets. Two factors suggest that neither the benefits nor costs of ISA calculated for the states can be confidently generalised to the territories. Firstly, their government fleets are relatively small when compared to the states. Secondly, it is likely that the territories have unique crash rates and patterns. Federal vehicles are located in all states and territories, with a high proportion located in the Australian Capital Territory (ACT). The spread of federal government vehicles across Australia suggests fitting ISA in federal government vehicles may produce results within the ranges found for the state government vehicles, although the high proportion of vehicles in the ACT reduces confidence this generalisation. Local government fleets are likely to be individually very small and have different uses relative to state government fleets. For these reasons caution should be used in generalising these results to local government vehicles.

# 5 Conclusions

Advisory ISA has the potential to reduce casualty crashes in government fleets by 20%. It was estimated that this would eliminate 171 casualty crashes involving state government vehicles per year and save $31.6 million in crash costs per year.

Four devices currently available that provide advisory ISA functionality were identified and analysed for their cost effectiveness. This economic analysis revealed that the navaid device that included ISA functionality (device C) had a payback period of around a year, and was cost effective regardless of the scenario being considered. The two dedicated ISA devices considered produced varied results. Device B was not cost effective for either scenario. Device A produced payback periods between four and 12 years and was cost effective for the scenario where the ISA device was removed when the government vehicle was sold (scenario 1), but was not cost effective for the scenario in which the ISA device remains in the government vehicle when it is sold (scenario 2). The multimedia centre that includes basic advisory ISA functionality (device D) was not found to be cost effective when residual value was not considered. To be cost effective under all circumstances that were considered in the analysis, device D would need to retain 70% of its original value when the government vehicle is sold.

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