Vehicle Design & Research

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Devices to Assist Drivers to Comply with Speed Limits

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Introduction

There are several reasons why drivers would like to comply with posted speed limits. The most compelling reason is that the risk of a serious casualty crash is dramatically increased by travelling just a few km/h over the speed limit. In urban areas the risk doubles for each 5km/h over the speed limit.

Car manufacturers go to great effort to make us to feel safe and secure in their vehicles but the reality is that there are fundamental limits to the capacity of a vehicle to protect us in a severe crash. More than half of fatalities to seat-belt-wearing drivers in frontal crashes occur at an impact speed less than 55km/h (equivalent to falling from a fourth floor balcony).

The human brain is likely to suffer life-threatening injuries if the head hits a solid object at speeds higher than 20km/h. This includes pedestrians hit by vehicles and vehicle occupants contacting intruding objects like power poles.

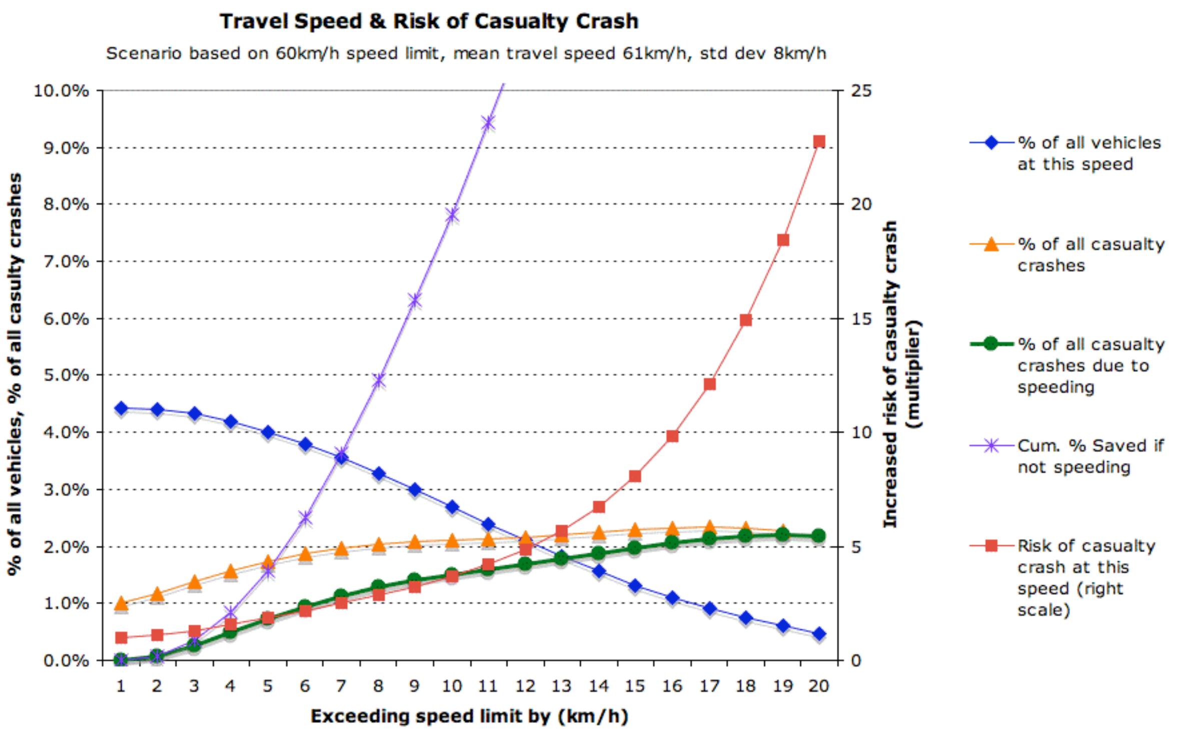
29km/h side impact with a pole likely to be fatal without head-protection

Many motorists travel at several km/h over the speed limit for much of the time. Reasons may include:

- A lack of appreciation of the violence of a collision at speeds that are perceived to be safe

- The ride and handling of the vehicle giving a somewhat false sense of security
- Road designs that appear to be designed for higher speeds than they actually are
- Pressure from other drivers
- Perceived lack of enforcement of minor speeding

The combination of a large number of motorists travelling at up to 10km/h over the speed limit, and the increased risk of a serious crash at these speeds, means that there are substantial road safety benefits arising from encouraging this group to comply with speed limits. The following graph illustrates that 10% of casualty crashes could be saved if vehicles travelling at up to 10km/h over the speed limit in urban areas had not been speeding.



It seems unlikely that enforcement/punishment alone will achieve these potential road trauma savings.

In recent years several technologies have been introduced to help drivers comply with speed limits. This report outlines Australian experience with speed limitation devices and describes recent technological developments.

Classification of Speed Limitation Devices

Speed limitation devices assist the driver in not exceeding a specified or selected speed, which is generally the posted speed limit for the section of road being driven along. There are several classifications of speed limitation devices:

- Top-speed limiting - prevents the vehicle for exceeding a set speed. Most modern vehicle engine management systems have a top speed setting but it is usually well in excess of maximum national speed limits and could not be regarded as a safety device.

- Speed alarm set by the driver - alerts the driver if a selected speed is exceeded. Some production vehicles have this feature (eg Holden Commodore).
- Speed limiter set by driver - prevents the vehicles from exceeding the selected speed, except for temporary over-ride situations (eg "kickdown" of throttle pedal). A few production vehicle models have this feature (eg Renault Megane). These are also known as "Adjustable Speed Limitation Function" (ASLF).
- Intelligent speed alarm - system "knows" the speed limit of the current section of road and direction of travel and alerts the driver if that speed is exceeded. Feedback may be an audible alarm, a visual signal, haptic feedabck such as a vibrating throttle pedal or a combination of these. Two commercial products are available with these features in Australia: SpeedAlert works with PDAs and Smart Phones and is portable (between vehicles) and Speed Shield is a unit that is built into the vehicle and interfaces with the vehicle electronics.
- Intelligent speed limiter - the system "knows" the speed limit of the current section of road and direction of travel and prevents the vehicle from being accelerated beyond this speed. These systems normally have provision for temporary over-ride. The Australian Speed Shield product has this function available.

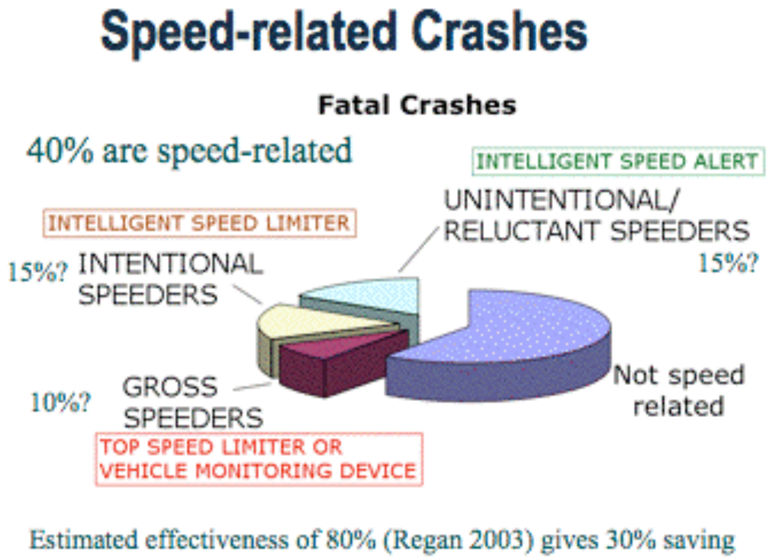
Systems that require the driver to manually set the speed have several limitations:

- they assume that the driver knows the speed limit or can decide on a "safe" speed - in both situations the driver can be in serious error.
- the task of setting the speed is tedious and may be distracting.
- in practice these voluntary systems are unlikely to be used on a regular basis

The latter two systems are known as "Intelligent Speed Adaptation" or "Intelligent Speed Assistance" (ISA). The first is known as Passive ISA and the second is known as Active ISA. The speed limit information is available on three levels: static (location based), variable (time and location based) or dynamic (able to be changed in real time through communication with the road infrastructure - eg roadworks). There are increased road safety benefits for each level.

In recent years the feasibility and performance of ISA system have been substantially improved by developments in the Global Positioning Satellite systems (GPS) and the digital mapping of speed limits. Some systems, like Speed Shield augment the GPS positioning with dead-reckoning systems that work in tunnels.

The following graph, prepared several years ago, shows the estimated benefits of the various types of speed limitation devices.



Experience with speed limitation devices

In 1996 Michael Paine researched the topic of speed control devices for the New South Wales Roads and Traffic Authority: http://tinyurl.com/2vutwc (link to PDF). He has been involved in policy and technical development of ISA since that time, which preceded the widespread commercial use of GPS.

Mr Paine has driven vehicles with each type of speed limiter. He has been using a SpeedAlert passive ISA system on Sydney roads since August 2006. In 2007 he co-authored a paper on this topic for the Proceedings of the 20th International Conference on the Enhanced Safety of Vehicles: http://tinyurl.com/bw757e (link to NHTSA web page PDF).

Key points from that paper are:

a) Speeding is a contributing factor in 10-20% of all crashes and 30-40% of fatal crashes (Australia, New Zealand, Europe and North America).

b) Many road fatalities occur at surprisingly low impact speeds. In the USA in the mid-1990s half of the deaths to seat-belt wearing drivers involved in frontal crashes occurred at a delta-V of 50km/h or less.

c) Crash risk rises dramatically at travel speeds above the speed limit. A study in Adelaide found that the risk of a casualty crash doubled for each 5km/h above the 60km/h urban speed limit.

d) This is consistent with earlier studies that found a 3% reduction in mean traffic speeds produces a 12% reduction in fatal accidents. A 2005 European Transport Safety Council (ESTC) report states that 15% of injury accidents would be saved if mean traffic speeds reduced by 5km/h.

e) Studies of the effects of major speed limit changes (increasing or decreasing the speed limits for a region or major section of road) have had similar results.

f) The same Adelaide study estimated that casualty crashes would reduce by 20% if all vehicles obeyed the speed limits.

g) Properly designed ISA systems can be highly effective in encouraging motorists to obey speed limits and should be encouraged by governments.

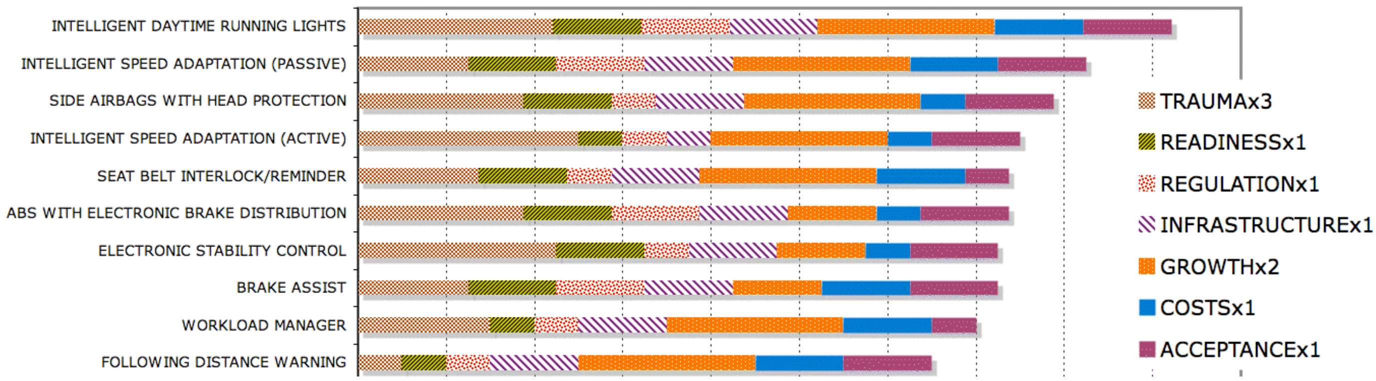
h) During a 6 month evaluation the SpeedAlert passive ISA product was found to be highly accurate and reliable under most road conditions. Start-up time and performance in areas of poor GPS reception were issues that needed to be monitored but were acceptable.

i) A variety of speed settings were evaluated in on-road trials. An audible alarm set at 2km/h over the speed limit is optimal for preventing excessive alarms, while enabling the driver to travel at the speed limit. Setting it to 3km/h or more above the speed limit (as prescribed in ECE Regulation 89) allows continuous driving in excess of the speed limit and so diminishes the road safety benefits.

j) There are myths and misunderstandings about the need for reserve power and excessive speed when overtaking. In nearly all circumstances a decision to use excessive speed to overtake greatly increases the risk of a serious crash and it would have been much safer to brake rather than accelerate. Not only is the time to return to the lane much less with braking but also, if a head-on impact should occur, the speed will be much lower. It has been pointed out that the main effect of a speed limiter is that "the driver of a high-performance vehicle would no longer perform certain manoeuvres which he now regards as safe". However, it is recognised that initial public acceptance of ISA will be improved if there are over-ride capabilities.

It is important to note that *ISA in Australia has gone beyond the trial/prototype stage and pilot programs of commercial products are underway*.

Since preparing the ESV paper Mr Paine has carried out benefit/cost analyses of numerous in-vehicle technologies. Passive and active ISA stand out as technologies that deserve more attention as they are unlikely to grow due to market forces alone.



Extract from analysis of in-vehicle technologies

He has developed conservative estimates of the potential savings in serious road crashes *in Australia* through the widespread implementation of various speed limitation devices:

Table. Estimates of crash savings in Australia

Device	% of all serious crashes potentially influenced by use of device (relevant crashes)	% of relevant crashes that are saved by device (effectiveness)	% of all serious crashes saved by device
Top-speed limiting	1% (exceeding 120kmh)	100%	1%
Speed alarm/limiter set by the driver	20%	5% (low due to the task of setting the device)	1%
Passive ISA	20%	25%	5%
Active ISA	20%	50%	10%

In 2006 ETSC wrote: "There is no single vehicle technology remaining to be implemented - neither on the market nor in development - that offers the same safety potential as ISA."

Note that the ETSC statement was written after the potential savings from ESC became evident.