CARS IN THE FUTURE

POLICY PAPER

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Abbreviations

ABS	Anti-lock Braking Systems
ACC	Adaptive Cruise Control
ADAS	Advanced Driver Assistance System
ATL	Automated Test Lane
BA	Brake Assist
CARS 21	Competitive Automotive Regulatory System for the 21st century
CCIS	Cooperative Crash Injury Study
DSC	Dynamic Stability Control *(a brand name of ESC)*
DETR	Department or Environment, Transport and the Regions
DRL	Daytime Running Lights
DfT	Department for Transport
EBA	Emergency Brake Assist
EC	European Commission
EDR	Event Data Recorder
EEVC	European Advanced Vehicle Safety Committee
ETP	Education, Training, and Publicity
EVSC	External Vehicle Speed Control
ESC	Electronic Stability Control
ESP	Electronic Stability Program *(a brand name of ESC)*
EuroNCAP	European New Car Assessment Program
GPS	Global Positioning System
HIC	Head Injury Criterion
HMI	Human Machine Interface
ISA	Intelligent Speed Adaptation
IVIS	In Vehicle Information System
LDWS	Lane Departure Warning Systems
MIRA	Motor Industry Research Association
MORR	Managing Occupational Road Risk
PNCAP	Primary [safety] New Car Assessment Program
PROSPER	Project for Research on Speed Adaptation Policies on European Roads
RoSPA	The Royal Society for the Prevention of Accidents
SBR	Seat Belt Reminder
SMMT	Society of Motor Manufacturers and Traders
TPMS	Tyre Pressure Monitoring Systems
TRL	Transport Research Laboratory
VSCS	Vehicle Stability Control Systems *(a brand name of ESC)*
WAD	Whiplash Associated Disorder

1 Introduction

This is a policy paper by The Royal Society for the Prevention of Accidents entitled Cars In The Future.

1.1 Summary: What does the future hold for the driver?

Vehicles are changing.

The motor industry has a long heritage of innovation, and this has shaped and influenced the way that vehicles are designed over the last 100 years. This commitment to resource innovation has never been more vital than today as there are areas of change that the automotive industry must address if private vehicle use is to be a sustainable method of transport in the future.

The two key areas upon which there is the urgent need to focus are to reduce significantly the environmental impact of transport, and to improve the safety which vehicles offer road users both inside and outside of the vehicle. These changes are fundamental to improving the quality of life of the world population, not just in the short term, but in the longer term also.

It is important to note that these changes will require commitments by those other than the automotive industry itself. There will be the requirement to change infrastructures, and the way that we as road users interact with the vehicle and the infrastructure. Reducing the environmental damage of vehicles and improving the safety of the roads is also the responsibility of anyone reading this policy document.

Environmentally, innovation will come from work to reduce damaging emissions in the short term, coupled with the sourcing and effective implementation of more modern, and less polluting fuels that will provide the basis for future vehicle power sources. Steps to improve the efficiency of vehicles and the transport network will also help to reduce the amount of energy that is wasted.

The general trend in the Westernised world has been a decrease in road casualties, although the impact that road deaths and injuries have on society is still too great. The car still has much to offer in order to reduce this impact. Further more, safety is an important area the developing world, and road traffic injury will be the third leading contributor to the global burden of disease in 2020[i].

Safety of vehicles is of particular importance in future to road safety in future. Technology is becoming available on vehicles that allow a much greater level of vehicle automation to take place, and the vehicle will start to use this information to see for itself. The steps towards automation of vehicles are intended to reduce the instances of driver error, which is a contributory factor in at least 9 out of every 10 road accidents.

These changes will also mean a much greater interaction between the driver, the road environment, the vehicle, and other vehicles using the transport system.

The vehicle itself will monitor the road around it, accurately making the many observations that are solely the responsibility of the driver at the moment.

Technological monitoring of the journey and hazards can be done more accurately and with less error, and a programmed vehicle may also be able to process and respond to the information in a better way than a human.

Technology will support a driver in different ways and at different times depending on the vehicle or circumstances, and there are many potential interventions to prevent an accident that can be implemented up until the point at which the accident occurs.

The driver of the future will play a very different role to the driver of today when using a car.

Of course, as the vehicle changes around the driver, there is also a need for drivers to ensure that they can control the vehicle safely. As technology changes, driver training is necessary to ensure that not only the basic driver skills are kept up to date, but also that the new skills which drivers will need to monitor and control varying levels of automation are developed.

1.2 Background: Where we are today.

Historically vehicle safety has focussed on crashworthiness and occupant protection, this has played an important role in reducing the yearly number of casualties on the roads. This field of passive, or secondary, safety has resulted in many developments designed to save lives in a crash - such as seatbelts, and airbags.

Consumer programs such as EuroNCAP have also encouraged vehicle manufacturers to develop vehicle structures to withstand crash tests at higher velocities than the legislation requires, and this has seen a rapid improvement in the performance of vehicle structures during crashes in the latter years of the 20th Century. These developments have contributed greatly to the drop in the casualty numbers in the UK.

There are areas of passive safety in which improvements can be made, such as safer vehicle fronts and vehicle-to-vehicle compatibility and work in these areas is still ongoing. However, progress in this field is expected to slow and any future work about passive safety is likely to be based around enhancing and developing existing technology rather than new design initiatives.

Along side these developments, there has been an increasing interest from consumers about their car’s safety. This demand has been instrumental in encouraging vehicle manufacturers to research and develop more and more advanced safety systems, which protect road users. Much of this research has been focussed on looking at the influence that the vehicle has leading up to the crash, and accident prevention is now high up on the agenda of vehicle manufacturers.

This consumer demand for technology on and aboard vehicles is set to continue into the future and much of this will fundamentally change the relationship between the driver and their car. Changes in vehicles will change the way we drive.

1.3 The Purpose of this Paper

This paper seeks to explore how driving will change in the future due to the advances in technology, and how it interacts with the driver. It will look at what predicted casualty savings we can expect from new technology, as well as how quickly it will spread into the market.

Several issues that the paper highlights need to be urgently addressed, as the effectiveness to which they are dealt with could change that way that we drive, and survive, on the roads significantly.

The policy paper is not intended to look at technical engineering issues, nor is it an in depth literature review of any of the technologies which it discusses. It will look at how technology will change the way cars and the roads are used as well as looking at and raising key issues which need addressing from literature and scientific studies, in order to facilitate a smooth introduction of vehicle safety systems.

It is intended to help the general public understand what exactly is happening with cars, and where the technology is going. Hopefully it will also raise consumer awareness of what many of these new technologies do, and how they can help.

It is also intended to help those working in road safety understand what all of the current issues around vehicle engineering are, and how in future, it will relate more to education, training and publicity work.

Finally, it is hoped that those working in the media will be able to use it as a point of reference, to balance or give a further perspective to articles.

The timescales that the paper looks at are longer than many other policy documents, as technology takes time to be developed and distributed throughout the national vehicle fleet. Indeed, there is no new vehicle engineering measure that could be launched tomorrow which will have a measurable impact on reaching the 2010 road safety targets.

Speeding the propagation of current technology through the vehicle fleet is where focus must lie if the influence of vehicle safety measures is to be increased on the short-term accident statistics.

1.4 How the Vehicle can Prevent Accidents and Injuries in the Future

A much used statistic in Road Safety in that driver error is a factor in 95% of road accidents, whether by failing to notice a hazard, not reacting in time, or simply adopting a dangerous behaviour. A vehicle can have an influence in many of these situations, whether by informing a driver, assisting a driver, or by ultimately removing the driver's ability to behave in an antisocial or dangerous manner by taking over some of the control.

In order to understand how vehicles can assist and influence the driver to prevent accidents, it is important to comprehend the events leading up to an accident. One way of doing this is by modelling the sequence of events that relate to the occurrence and outcomes in a crash.

It would have been equally as relevant to structure the paper under topics of road accident causation, rather than technologies, as the best way to maximise the effectiveness of new technology may be to look at the contributory factors that lead to an accident and then used evidence based decisions to choose the technology which could potentially mitigate the largest number.

Traditionally, the effects that the 'three Es' (education, engineering and enforcement) have on crashes have been broken up into three phases – Pre Crash, Crash and Post Crash. This is most commonly displayed in a Haddon Matrix. However, as vehicle engineering has become more sophisticated, a more sophisticated model is needed to address the influence of technology.

This is an area that several car manufacturers have looked into to see how and where vehicles can influence the risk of collision and injury. One such model of the chain of events is the Mercedes-Benz Integrated Safety Concept, which defines several phases:

Normal Driving
1. Warning Phase
2. Assistant Phase
3. Pre Crash Phase

Accident
4. Petty Collision
5. Minor Accident
6. Severe Accident

After the Accident
7. Post Crash/Rescue Phase

Each phase of the Integrated Safety Concept represents an escalation in the severity and consequences.

The injury prevention technology and passive safety has focussed on limiting the progression between phases 4, 5, and 6 of the integrated safety concept. However, as safety technology advances, the influence that a vehicle has before a crash occurs will increase, and the earlier a vehicle can intervene in a driver's decision-making process.

This shows the wide range of ways that vehicles can prevent accidents before collisions occur, and provide drivers with information to reduce the number of accidents resulting from human error.

As the time that vehicle technology can help prevent a crash before a collision increases, it will find itself more and more working along side traditional road safety messages and a higher level of integration is important.

2 Active Safety

Active safety is the field of vehicle engineering where there will likely be the most changes and new technologies released in the future. This will change the way we drive as the interactions between the car and the environment and the car and the driver will increase.

Active safety is designed to reduce the occasions of human error, in order to understand this goal further; the various types of human error must be defined, rather than using the phrase loosely.

A study was conducted[ii] in 1990 that looked at human behaviour factors using a Driver Behaviour Questionnaire. This analysis sorted human errors into three distinct categories depending on the behavioural reason why the error was made

- **Lapses**. A lapse is an error that is more down to absent-mindedness than other reasons. For example, failing to turn off at the correct junction on a motorway.
- **Errors**. An error arises due to the failure of a driver to process all of the information available, or make best use of it. This is dependent on the cognitive ability of a driver.
- **Violations**. Violations are the result of a deliberate breaking of the regulatory system, which has been put in place to prevent accidents, in this case, traffic law.

It should be no surprise, especially to those from other areas of Health and Safety, that a violation error – i.e. the deliberate breaking of the code of behaviour which have been put in place to secure a safe environment – is most likely to lead to an accident.

Active safety fits into this context as a way of reducing the number of both errors, and violations, and making drivers actions on the road more predictable to other road users.

Road Safety can benefit from active safety, as

a) it is a way of alerting the driver to the environment around the vehicle and preventing **lapses**.
b) it can correct driver mistakes and prevent **errors** from occurring.
c) It is a way for engineering to influence safer driver decisions and behaviours to prevent **violations** of traffic law.

The current generation of active safety systems work by making crashes avoidable once an error has been made. They do not prevent driver error, but they do increase the chance that a driver can recover from their error with less serious consequences.

Future active safety systems will provide the driver with more information in order to prevent the error from occurring. They are intended to support a driver's mental thought process when encountering a hazard and help him or her decide on appropriate action sooner.

The ultimate aim of this type of active safety is automation and to ensure that the vehicle responds in the safest and most predictable manner, whether the driver is involved in the process or not.

These distinctions of when and to what extent the vehicle takes control or supports the driver is important when looking at the wider effects of active safety, such as how much the driver will rely on it, how the Human/Machine Interface works, and what the benefits to society of the systems will be.

Active safety systems need to be looked at and evaluated, to decide the best way to implement them. The decisions must be based on sound scientific evidence and reviewed when suitable real world data becomes available to ensure that the systems are having the effect that they were intended to.

Although the introduction of older active safety systems such as ABS has been slow, the take up of new technology in all fields as a society has quickened and looks set to continue this way into the future. It is likely that future active safety systems will integrate themselves into vehicles quicker in future.

2.1 Active Safety Systems in 2006

Active safety systems are now firmly established into the car market and in industry as a way of reducing the number of accidents

Behavioural adaptation is a concern about how any benefits brought by safety systems are offset by drivers taking more risk to make up for their increased safety. This is not a fault of the safety system, but with the knowledge about the engineering.

Of course it would be wrong to suggest that drivers will instantly adapt to new technology by compensating for the potential reduction in risk, or by immediately using the technology in a dangerous manner. It cannot be assumed that the human element will re-introduce risk, it will be the case that some drivers will learn how to optimally use the system safely.

Drivers can be encouraged to behave and use technology in a safer manner by better education, training, and publicity about what these systems do and why they are there – influencing a drivers attitudes and behaviours towards vehicle safety.

The system itself can also be designed to help the driver achieve the safety benefits of a system intuitively.

This highlights the ever-increasing interaction between vehicle technology and the driver and the fact that it needs to be considered more. Even the safest of vehicles is dependant upon how the driver uses the on board safety systems.

The current generation of Active Safety Systems – in the main – play a part when all of the factors that would lead to a crash have arisen and placed the driver in an already dangerous situation, rather than preventing the dangerous situation in the first place. They help a driver get out of a dangerous situation that factors (including the driver themselves) have created.

They work by improving the stability of a vehicle under different conditions, and mean that the forces needed to create a skid will be increased.

Although some systems such as Electronic Stability Control are becoming more common on new cars, and others such as ABS are now standard, there is a lack of public understanding about what the technology does and it’s availability. This needs to be addressed to get quicker benefits from proven safety systems.

A recent poll by Bosch showed that only 18% of the population knew about ABS and only 1% knew of ESP, and similar figures were found in a recent SMMT poll, which also revealed that only 42% of people could name an active safety system of a vehicle.

Addressing the lack of public awareness needs to be seen as a priority in order to help current active safety systems spread through the vehicle fleet, and make a contribution to reducing the number of casualties in the near future.

2.1.1 The Future of Active Safety

Active safety to prevent accidents is due to increase rapidly into the future, and it has potential to do this in many more ways than it currently does. This section will describe where and how a vehicle will assist a driver in future, by referring to the phases of the Mercedes-Benz Integrated Safety Concept, previously mentioned in section 1.4.

During normal driving, vehicles can make the driver's thought processes easier. Satellite navigation and well-designed Human Machine Interfaces will prevent drivers from becoming overly distracted and prevent an excessive overload of information on the driver. This will allow more driver time to be dedicated towards the primary task of driving the vehicle. These forms of technology will prevent a driver from getting into hazardous circumstances from which an accident could emerge.

Radar is capable of monitoring the road environment and dangers that may be present around a vehicle. This comprehensive picture of the road around the car can be fed back to the driver by many methods to inform his or her decisions. Radar systems are designed to complement driver observations rather than to replace them.

By providing information about the vehicles surroundings, the technology can provide a reduction in accidents during the pre crash phase. This is when all the circumstances for a collision have arisen, but there are still actions that the driver can take to avoid making an emergency manoeuvre or being involved in the crash.

The warning phase leading up to a crash is involved with providing drivers information about hazards in order to assist the driver's decisions. This not only concerns itself with augmenting the driver's observations – for example by alerting the driver to vehicles in the blind spot – but also improving the drivers awareness of the situation around the vehicle by means of radar and infrared.

The assistant phase is when the driver has failed to respond to a hazard effectively and it now becomes a risk of a collision. It is in this phase that the driver would usually respond to a hazard and systems to assist the driver in doing this are found on modern vehicles – examples of technology and equipment to help in this phase would be stability control systems, tyres, and Brake Assist.

In the further future, it is likely that the vehicle will use the information that it has gathered from the warning phase to intervene and prevent an accident. Adaptive Cruise Control and Lane Departure Warning Systems are early examples of systems that could be utilised for this purpose following further development.

The final influence that a vehicle can have on an accident before it occurs is the pre-crash phase, and this is a combination of active and passive safety. There are many ways that a vehicle can use the data gathered before the crash through sensors and active safety systems. The result will be that the passive safety systems respond in ways dependent on the circumstances of the crash and the occupant.

Early applications of automotive radar systems are currently working their way into the market, and there are two systems that can be found on some modern vehicles.

2.2 Specific Active Safety Devices

2.2.1 Antilock Braking Systems (ABS)

Antilock Braking Systems (ABS) is a form of electronic braking which was invented to help a driver control a vehicle under heavy braking by preventing the wheels from locking up.

Although the ABS will not decrease a vehicle's stopping distance compared to an identical vehicle without ABS, it ensures that the shortest distance in which a vehicle can be brought to rest is achieved. It is particularly effective in doing this on surfaces which are wet or icy upon which a vehicle is much more likely to skid.

Like every safety system, the effectiveness of ABS depends upon drivers knowing what the advantages of the system are, and being able to use them. One of the principal advantages of ABS is that drivers are able to steer whilst braking in order to avoid a collision. It is not always the case that drivers will take advantage of this ability.

This highlights the need for drivers to be fluent in how to interact with vehicle technology.

As ABS is the only active safety system that has had its effectiveness predicted before implementation, it gives a good chance to review how well this was achieved, which is looked at briefly in the 'Introducing New Active Safety Safely' section.

2.2.2 Electronic Stability Control (ESC)

Electronic Stability Control (ESC) is a further evolution of electronic braking technology such as ABS and also uses other systems such as traction control. It is intended as a way of correcting situations in which a driver has made an error by stabilising the vehicle quickly so as not to make any dangerous situations worse.

It will work in circumstances where steering is needed in order to turn the vehicle more effectively so as to provide a decreased risk of skid or loss of control.

One current hindrance to the spread of ESC onto a greater proportion of new vehicles is the shear number of names and trademarks associated with it. Consumers may not appreciate that a manufacturer offers a version of ESC on a vehicle from reading its literature, even though they may be aware of ESC and its benefits.

The following systems used by different manufacturers are equivalent to ESC,

Active Stability Control (ASC)
Dynamic Stability Control (DSC)
Dynamic Stability and Traction Control (DSTC)
Electronic Stability Program (ESP)
Electronic Stability Program Plus (ESP+)
Vehicle Dynamic Control (VDC)
Vehicle Stability Assist (VSA)
Vehicle Stability Control (VSC)

ESC has been the subject of a great number of published papers, each arriving at a different figure about what percentage of accidents it will prevent. It is important to judge each individual evaluation objectively. A paper predicting a high accident saving in countries with a different road environment may not be directly applicable in the UK.

A situational context under which the studies are carried out also needs to be examined when looking at the potential benefits of active safety, and the wide range of results for accident savings shows this.

There are a large number of ways of studying an active safety system (e.g. simulators, real world trials, statistical analysis post introduction of the system), environments that an experiment can take place in (e.g. rural or urban, different countries road networks) and for measuring the outcomes (e.g. speeds, different types of accident, driver behaviour, casualty reductions). Finally, in some studies, the prior social and situational context in which driving takes place in is not an examined variable.

There is one conclusion that all the papers reach however, no matter what debate may take over the exact percentage of accidents that ESC will prevent, it will be relatively significant, and out of all the technologies discussed in this paper, has the potential to make a measurable impact on the 2010 targets. It is important that the spread of ESC onto all vehicles should be encouraged.

The European Commission has proposed, as part of the CARS 21 program, that ESC is made mandatory[iii]. RoSPA would support this proposal, but will add that further evaluation on driver behaviour is required in order to produce ETP measures at the same time. This is to ensure that the best potential casualty savings from ESC are achieved.

Safer vehicle design to prevent skids needs to be encouraged along side of the introduction of ESC, as a large difference exists between the most and least stable[iv] of vehicles. ESC is a quick solution to increase a vehicle's stability but it is not all that can be done. Setting standards that define an upper benchmark for a vehicle's stability, and then rating individual vehicles against it, as part of a consumer information program, may be the best way to achieve progress in this area of primary safety.

One unique scheme working towards propagating the fitment of ESC is the Bosch ESP-rience (ESP is the trademark name for Bosch's variant of ESC). This focuses on improving consumer awareness by improving the knowledge of the sales staff, which can then be directly passed on. Although no published evaluation has taken place, other than the monitoring of the fitment rate of ESC onto new cars.

This type of event should be evaluated in order to show if it can be viewed as good practice in helping the spread of a specific type of active safety that has been proven to have a large impact. In future, similar programs should be run showing what the technology does and giving a section of the population who can influence the public's opinions and use (car sales people) a better grasp of the technology. An evaluation of the schemes impact will help road safety professionals understand more about how to help in this field.

2.2.3 Brake Assist

Brake Assist (BA) is a technology that ensures that the maximum pressure is applied by the brakes to stop a vehicle in an emergency situation. Some manufacturers also refer to the same system as Emergency Brake Assist (EBA).

When a driver makes an emergency stop the brake pedal has to be pressed, the more pressure applied to the brake pedal, the greater the pressure through the braking system, which is amplified and provided to the brake. In some cases a driver might fail to respond to a hazard up ahead as well as possible and fail to depress the brake pedal fully, meaning that the full pressure of the braking system is not being applied to the wheels.

Brake Assist detects how quickly the pedal is depressed to judge whether the driver wanted to perform an emergency-braking manoeuvre. If it concludes that the situation is an emergency and the pedal isn't depressed fully then it will increase the hydraulic pressure in the braking system to make up the gap.

It has been proposed by the EC that Brake Assist is fitted to all new vehicles as part of the new Regulations that require manufacturers to provide better front-end protection for pedestrians. This is part of a compromised deal, and the fitment of Brake Assist would mean less stringent safety standards. RoSPA are supportive of the introduction of Brake Assist on new vehicles, but stresses that active safety is not a substitute measure for an improvement in passive safety standards. The two are different methods of achieving injury reductions.

2.2.4 Adaptive Cruise Control

Adaptive cruise control (ACC) is a system designed to increase the comfort of a driver and is the first step towards Advanced Driver Assistance Systems (ADAS) reaching the vehicle fleet. It is comprised of radar technology that works in conjunction with the cruise control of vehicles. Whilst regular cruise control systems allow a driver to choose a speed which the vehicle maintains, adaptive cruise control monitors the distance to the vehicle in front, and will slow down the vehicle if necessary. The most modern versions of the system starting to appear on the upper end of the car market will stop the vehicle.

As cruise control is generally used on national speed limit non built-up A-roads, and motorways, this is where the current generation of ACC will be used. Like cruise control, it is a driver comfort system, although comfort and safety are interrelated and it will have an effect on safety depending on how it is used.

It will be mainly used when the road is congested and the driver has to apply the brakes to respond to the pulse like nature of the traffic flow. The current system will have an influence in safety and congestion, as well as driver comfort. The extent that it does depends upon the driver's knowledge, attitude and behaviour. Ultimately, the driver still remains in control.

Adaptive cruise control also bears a precautionary message about driver comfort systems and active safety. It has been introduced without widespread trials that evaluate how it will be used in the real world context. Drivers could easily misuse a

system, whether by accidental misunderstanding and assuming that the system is more effective than it is, or on purpose by relying on the system beyond its operational capacity. These issues must be looked into before a system is implemented, the potential use and misuse of a system will have an impact on safety – whether it is termed a comfort system or a safety system. There is no evidential link that shows that the category of a system would affect the way in which it is used.

One interesting study of Adaptive Cruise Control[v] looked at the consumers awareness of the system and what they though of it before and after use.

The first interesting result was that 39% of the respondents had found out about the system in a sales brochure, 20% had heard about it from a sales person and 10% from a magazine article. This shows where consumers are likely to get information about vehicle technology, and similar studies in the UK may suggest how best to disseminate information about vehicle safety systems.

The study also concluded that consumers who chose to have ACC fitted were more likely to use the system to aid them during driving, showing a link between prior knowledge of the technology and a willingness to use it.

The development of ACC has lead to Stop and Go technology, which will automate the starting as well as the stopping (longitudinal control) of a vehicle depending on the vehicle in front.

2.2.5 Lane Keeping and Adaptive Steering

Lane Keeping and Adaptive Steering systems are the initial versions of ADAS designed to keep a vehicle in the correct lane position on the road.

Initial versions of this system monitor the lane markings by the side of the car, and if the car starts to deviate from the travelling lane, alerts the driver. The next generation of systems will be more proactive by applying torque to the steering wheel to encourage drivers to correct the drift. Eventually the system automation will itself prevent the vehicle from drifting out of lane.

In future, the systems can also be linked to blind spot information systems to prevent vehicles from moving into the path of another when a driver has not made the correct observations.

2.2.6 In Vehicle Driver Monitoring

One element of active safety that may potentially bring accident reductions is when the vehicle monitors the driver's state and performance for dangerous behaviour and practices.

Monitoring technology in a vehicle has many complex applications – such as monitoring a driver's workload before deciding whether to give the driver useful but not crucial information – the most immediate to be realised will be in-vehicle systems, which detect the onset of driver fatigue.

Fatigue can be a highly dangerous impairment, and will result in the driver withdrawing and reducing the level of attention that they can dedicate towards maintaining appropriate levels of safety.

A recent study by the Sleep Research Centre at Loughborough University indicates that driver fatigue causes up to 20% of accidents on monotonous roads. This suggests that there are several thousand casualties each year in accidents caused by drivers falling asleep at the wheel.

A study of road accidents between 1987 -1992 found that sleep related accidents comprised 16% of all road accidents, and 23% of accidents on motorways. Research by the TRL found slightly lower proportions of sleep related accidents: 9%-10% of accidents on all roads, and 15% of accidents on motorways involved driver sleepiness. In this study, 29% of drivers reported having felt close to falling asleep at the wheel at least once in the previous twelve months.

The majority of the systems will monitor driver's actions to detect to onset of fatigue, as there are many externally displayed signs which can be detected. It can be reasonable assessed whether someone has become less alert during an activity by judging where his or her attention lies.

In a vehicle, this reduction in alertness manifests itself by an individual item attracting a driver's gaze and attention for a long period of time, the length of and period rate of a driver's blink, and also the driver's head position.

A human would be able to make an assessment of a driver's concentration intuitively, or through experience, by looking at all of these factors. The challenge therefore lies to design a system that can also perform this task accurately.

The most researched method of doing this has been through a camera, which can provide an image of the driver. Software then works out what the camera is seeing (much like the interaction between the brain and the eye) and determines whether any of the indicators of fatigue are occurring.

The system would then work out what information to feedback to the driver, if it detects fatigue or drowsiness then a method of communicating this is required. Of course there is then the issue of how the machine would best output this information to alert the driver.

Finally, drivers would need to know what to do with the information that the system has given them. It would be of no benefit for the driver to know that they risk an accident due to fatigue if they do not know a suitable countermeasure for them to

take, and many common practices that drivers will tend to do to keep themselves awake and alert are generally ineffective.

The only proven measures to reduce sleepiness in the short term are to drink at least 150 mg of caffeine and taking a short sleep of around 15 minutes.

However, this is only a temporary solution and the safest option is for drivers to avoid driving when sleepy, and it may also be worth the driver planning an overnight stop – again, technology could inform the driver of suitable places locally. The best way to combat sleepiness is to sleep.

There is also potential for vehicles to take a proactive, rather than reactive, role to preventing driver fatigue. The best technical solutions will warn drivers that they have planned a long journey which will take a significant length of time, and help them plan it to encompass breaks and overnight stays – helping to prevent fatigue from becoming a risk which the vehicle needs to detect the onset of.

Technology could also be used to monitor the hours that a driver has undertaken and maintain a record.

2.2.7 Alcohol Ignition Interlock

Drink driving continues to be a casualty problem in this country, although societal attitudes towards drink driving have changed significantly over the last 30 years, and the number of drink drive accidents has fallen. It still accounts for a large proportion of the fatalities and serious injuries from road accidents in this country. In the UK in 2004, it was estimated that there were 590 fatalities in accidents where a driver or rider had consumed an illegal amount of alcohol.

Worryingly, the number of fatalities from accidents involving illegal alcohol levels has been increasing since 1999.

Alcohol Ignition Interlocks (‘Alcolocks’) are a way of reducing the number of repeat offences of drivers who are convicted of drink driving, and may too have a role in preventing drink driving before an initial offence is committed.

An alcolock works by requiring a driver to pass a breath test before ignition, thus stopping a driver who is over the limit from starting the vehicle. Modern systems can prevent people from getting round the test by requiring further breath tests after ignition, and also by requiring users to hum, or breathe in after providing the test.

Alcolocks can either be implemented as a primary or secondary safety strategy. A primary accident prevention strategy would be the use of alcolocks in vehicles where there is no history of drink driving, and a secondary strategy is the provision of alcolocks as part of an offender’s rehabilitation.

The technology is already available for a primary strategy and one vehicle manufacturer has started to introduce the “alcokey” into some models as an additional extra, it is expected that the technology will be available in the UK soon.

There are clear benefits to a primary prevention strategy, especially if the vehicle is used for transporting high risk, hazardous, cargo – or indeed if the vehicle was a school bus or other public transport vehicle, and a primary strategy based on this is

currently being trialed in Sweden. The technology may also help fleet operators control the level of risk posed by drink driving by fitting alcokeys to their fleet.

A secondary strategy is to offer alcolock use for drivers who have been convicted of drink driving – especially repeat offenders – as it will reduce the risk of them driving under the influence of alcohol with the alcolock in the car. A wide range of studies has shown that there is a large reduction in the likelihood of a convicted drink driver being convicted of the same offence again whilst an alcolock is installed, compared to convicted drink drivers without an alcolock.

A secondary strategy is starting to be introduced in the UK. Clauses 14 and 15 of the new Road Safety Bill will introduce the ability for courts to offer drink drive offenders the chance to partake in an “alcohol ignition interlock program”. This will comprise of a combination of education measures, along with the alcolock to give a combined approach to the problem.

The introduction of the alcolock will hopefully help participants to separate the acts of drinking, and driving, and increase the effectiveness of the educational messages – like all good road safety interventions, it is several measures working in unison towards the same outcome.

A strong case could be put forward for mandatory interlock use for some offenders based on the evidence that many who lose their license for driving under the influence continue to drive without it. It must be remembered though, that a users attitude towards the alcolock may also influence its effectiveness and also the chances of recidivism if the device is removed.

Criterion must be set for interlock removal, and the criterion must be proven indicators of a reduced repeat offence rate. As well as assessment by a psychologist, an alcolock can give a warning of future intent to drink drive, based on the number of, and frequency of, attempts to start a vehicle which have been prevented by an alcolock

There has not yet been a sufficiently large enough study to demonstrate the exact number of casualties that an interlock program may save. However, the risks of driving under the influence are well known and understood, as is the magnitude and increasing number of fatalities caused by it. If alcolocks can provide a way of reducing this risk and preventing drink driving, then it is fair to accept that their use will reduce the number of road casualties.

The relationship between alcolock use and potential casualty reduction needs to be determined, and from this a roadmap for an effective and evidence based, combined primary and secondary safety strategy could be produced.

It is also hoped that in future, devices may be developed to prevent drug driving.

2.3 Intelligent Speed Adaptation

One of the potentially most important changes in future vehicle technology will be the introduction of Intelligent Speed Adaptation (ISA) on to road cars.

Intelligent Speed Adaptation is a term that must be defined. The following definition was proposed by The Project for Research On Speed Adaptation Policies on European Roads (PROSPER)[vi]

"ISA: An Intelligent Speed Adaptation (ISA) system is one that aids the driver or rider in maintaining road speeds compliant with relevant local statutory or desirable speed limits"

The first clear point to make is that every country that has performed widespread trials of ISA has also deemed that it will be feasible to introduce this technology throughout the national vehicle fleet. The methods of introduction are discussed later.

A vehicle equipped with ISA technology will be aware of the speed limit of the road that it is travelling on. The most likely way of doing this that is being researched is to have the vehicle's co-ordinates transmitted to it from a satellite network, such as the GPS, or the future Galileo satellites. The vehicle can then relate these co-ordinates to an onboard map to determine which road it is travelling on.

There are 3 different ways that the ISA interacts with the driver, which are being researched. A closed ISA system will force the vehicle to keep to the speed limit by restricting the fuel supply. An open ISA system informs the driver of the speed limit in vehicle, and alerts the driver that the speed limit has been exceeded via an audio or visual system. The half-open variant of ISA attempts to alert the driver to excess speed by giving a physical feedback, for example, by increasing the force that the driver needs to exert on the accelerator pedal. This means that compliance with the limit should be made much easier.

The results of ISA trials in the UK and around Europe are examined by the PROSPER, which is supported by the European Commission, Directorate General for Energy and Transport, and is co-ordinated by the Swedish National Roads Authority. PROSPER contains partners from 10 European countries which allows a wide range of projects to be conducted, each looking at a different aspect of ISA.

There are 3 main questions which the PROSPER seeks to answer[vii] –

1) How efficient are the use of road speed management methods based on information technology (ISA) in comparison with traditional physical means?

2) How will road users across Europe react to such developments?

3) What are suitable strategies for implementation and what obstacles have to be overcome?

The results will help to inform the policy of all stakeholders, by providing information on a variety of topics. The results of the project will look at the feasibility of implementing ISA, as well as legal, environmental, and technical issues. The cost efficiency of ISA will be compared to that of other traditional traffic calming

techniques and the attitude and behaviour of its users will be evaluated, as well as the attitude of society as a whole towards ISA.

There are several ISA projects being conducted across Europe, the results of which will contribute to PROSPER. The most pertinent study to this document is the evaluation currently taking place in Leeds, as this studies the use of ISA in the UK, with the associated national trends in driver attitude, behaviour and roads engineering. There are other ISA studies being conducted through out Europe, which are also discussed in less detail.

2.3.1 External Vehicle Speed Control (EVSC)

The forerunner to the current study at the University of Leeds was carried out with the help of the then Department of Environment, Transport and the Regions (DETR) and the Motor Industry Research Association (MIRA).[viii]

The project looked at three different types of EVSC, each one allows the driver different levels of control over the system, and so the three would have different levels of effectiveness.

- Advisory EVSC is the most permissive form of EVSC; it constantly displays the speed limit of the road to the driver and doesn't seek to limit the driver's speed choice in any way, other than by keeping the driver better informed about the road.

- Voluntary EVSC was trialled, and this type of system allows the driver to toggle the speed limiter on and off, and so whilst the vehicle is restricted to the speed limit, he or she has the choice to turn it off.

- The last version of EVSC is the mandatory version that restricts the driver to the speed limit at all time.

The speed to which the vehicle was limited was divided into three categories.

- With fixed EVSC, the vehicle is restricted only to the speed limit of the road. This means that the driver could still select speeds that may not be appropriate for the conditions.

- Variable EVSC, informs the driver of additional hazard locations where a lower speed is appropriate where the vehicle is also informed of the locations of hazards (e.g. pedestrian crossings or schools) and suggests a more appropriate speed for the situation.

- Finally, dynamic EVSC will help the driver keep to an appropriate speed, as additional speed restrictions were based on the current circumstances (e.g. bad weather, congestion).

Two different types of user trials were performed in order to look at driver behaviour and how the systems would affect speed choice.

A simulator study was conducted in order to get the driver's responses to the system in a controlled environment. The study found that the system reduced maximum speeds, but had no effect on mean speeds, possibly suggesting some level of driver

compensation during slower parts of the course. The system had the biggest effect at the approach to changes in the speed limit where drivers were more likely to reduce their speeds in response to a lower speed limit ahead. From the simulated trials there were some more dangerous driving habits, and drivers tended to move into, or pull across when turning, smaller gaps than they would without the system. Drivers using the system would be more likely to follow the vehicle in front closer.

The second section of the trial was conducted on the road; once again, speeds and the driver's behaviour when using the system were studied. The results were more promising than the simulator trials, as no negative compensatory driver behaviour was noted. The problem of closer following also disappeared, due to the fact that unrestricted vehicles in front would break the speed limit and pull away.

Drivers preferred the voluntary system because they felt vulnerable when moving slower than other traffic and being overtaken approximately twice as many times when constantly limited to the speed. (If a high percentage of drivers were using ISA, it is reasonable to suggest that this feeling of vulnerability and frustration would decrease). The report, therefore, concluded that it would be unwise to make the system mandatory until a significant number of vehicles on the road were equipped with it.

A disadvantage with the voluntary system was that drivers tended to disengage it in areas where speeding was the norm, so it was only half as effective as the mandatory one. The table below[ix] indicates that the cost benefit ratio is not as high when voluntary systems are used, because it is not in constant use.

System	Speed Limit Type	Best Estimate of Injury Accident reduction	Best Estimate of Fatal and Serious Accident reduction	Best Estimate of Fatal Accident reduction	Benefit to Cost Ratio (low GDP)	Benefit to Cost Ratio (high GDP)
Advisory	Fixed	10%	14%	18%	5.0	6.9
	Variable	10%	14%	19%	5.3	7.2
	Dynamic	13%	18%	24%	7.0	9.6
Voluntary	Fixed	10%	15%	19%	3.7	5.0
	Variable	11%	16%	20%	4.0	5.4
	Dynamic	18%	26%	32%	6.1	8.3
Mandatory	Fixed	20%	29%	37%	7.4	10.0
	Variable	22%	31%	39%	8.0	10.9
	Dynamic	36%	48%	59%	12.2	16.7

In all cases the benefits of ISA outweigh the costs.

Future variants of ISA may have an adaptive mode to further help drivers with their speed choice. Whilst the speed limit sets the maximum risk that can be tolerated by society on a road, in certain conditions the risk of driving at the speed limit speed limit may be disproportionately high. This is the difference between inappropriate speed (driving too fast within the limit) and excess speed (driving over the limit).

Currently it is up to the driver to define how much they wish to control and reduce this risk below the speed limit. Adaptive ISA will help drivers control this risk, further to training and experience. Variable ISA will help drivers receive information about location risks (black spots, road works) whilst dynamic ISA will add to this by helping

the driver controlling risks that are dependent on time rather than location, such as poor weather conditions.

2.3.2 ISA In The UK

The second trial is being conducted with MIRA using DfT funding. Four trials have been conducted in which ISA has been fitted to twenty cars with a mix of male, female, young and old drivers in the Leeds area and the East Midlands.

The results of the trial are due to be released in 2006, however preliminary results back up other studies of ISA and show that it would have a positive impact in the UK.

The initial study was conducted with 20 volunteers, which were split evenly between genders. Half of the drivers are younger and half were older, and the 20 had a range of opinions about ISA.

The results looked at the number of errors and violations that drivers committed before using the system[x], during the early and later stages of the system's use and driving a normal car after using ISA. The study found that both decreased; as did the number of conflicts on observation drives. After using the system, the number of errors and violations remained lower than initially, and although the number of conflicts increased for both men and women, they did not return to the number of pre ISA use conflicts.

Drivers reported that their perception of how useful the system is increased during its use, and also increased after the drivers had finished using the system and were driving a non-ISA equipped vehicle. The trend of driver satisfaction also followed the same pattern of improving attitudes.

A review of how a locally implemented system would reduce casualty numbers[xi] found that a scheme in which all vehicles registered within a 5 km radius were fitted with ISA would be 63% as effective in that area as a nationally implemented ISA. A scheme of 10km radius would be 73% as effective and 15km radius would be 84% as effective. These results are especially relevant in estimating the effectiveness of the system if it were to be introduced into a region, such as London or the West Midlands, although the results may vary depending on the nature of the location.

2.3.3 ISA In Denmark

There have been two ISA projects conducted in Denmark; INFATI looked at 24 vehicles over 2 six weeks period, and interestingly also a project called Safe Young Drivers, which offers ISA equipment in return for discounted insurance premiums.

Even with the relatively recent Young Drivers Act in the UK, meaning that enforcement of the law and the risk of being caught may more commonly result in a ban, young driver deaths have risen over the last couple of years. It is well documented that young drivers are at a higher accident risk than more experienced drivers, and part of this problem is the inexperience of young drivers and a lack of adherence to the speed limit.

In order to study if ISA can improve the safety of young drivers by influencing their speed choice, The Safe Young Drivers project has taken a sample of 300 young drivers (aged between 18 and 24) in the Danish county of North Jutland. The project

will last over 2 years and is due to finish in 2008. The large sample size, lengthy duration of the project, and mix of urban and rural roads will provide interesting results that can influence policy on young drivers.

The results of this trial may give feedback about introducing of ISA into a graduated licence scheme.

Another similar, useful, study may be looking at the use of ISA as part of the rehabilitation process for drivers who are banned for speeding. A similar approach is being taken with the introduction of Alcolocks into the vehicles of those convicted of drink driving. There may be many crossover conclusions that can be made from the current Alcolock studies.

2.3.4 ISA in Sweden

A wide scale trial was conducted in Sweden using the ISA technology in four different cities between 1999 and 2002[xii]. It identified the primary application of ISA to be in towns and urban areas where speed humps are currently used to slow down traffic speeds.

Borlänge
In Borlänge, 400 vehicles were fitted with a system which monitored the driver's position using GPS and then matched it to a map of the speed limits. If a speed limit was exceeded, a tone sounded in the vehicle, which repeated if the offence continued. This type of system that constantly gives the driver information of their speed is referred to as an 'informative display system'.

Lidköping
In Lidköping 150 vehicles were fitted with the informative system, and 130 of those were also fitted with active accelerator (described below). A speed sensor monitored the vehicle's speed and again map matching was used to determine if the vehicle was exceeding the speed limit. The trial compared the differences in attitudes of drivers using the two systems in the same environment.

Lund
In Lund, 290 vehicles were fitted with active accelerator pedals that interfaced with the driver by exerting a counterforce to the pressure applied by the driver when depressing the pedal, but only when the vehicle exceeded the speed limit. If the driver exceeded the limit, s/he needed to exert three to five times the force usually required to depress the pedal. The idea being that when a driver feels a mildly uncomfortable sensation through their leg, the instinct will be to lift the foot off the pedal, which will slow the vehicle back below the speed limit. It also removes the need for an audible tone to alert the driver. The drivers were constantly reminded of their speed by a display in the car and GPS monitored the vehicles' speed and position.

Umeå
4,000 cars (representing approximately 10% of the vehicle kilometres travelled in the municipality) participated in the Umeå trial, which allowed the effects of ISA on overall traffic flow to be assessed. The main difference with the other trials was that the speed limit was not constantly displayed inside the vehicle. Transmitters mounted on lampposts let the vehicle know the speed limit and if the driver exceeded it, an audio and visual signal was activated inside the vehicle. This system is an example

of a warning ISA system. This trial also compared the effects of the warning system with the informative system.

Results

ISA had a clear effect on the average speed of the vehicles during the time of the trial although it was small, due to the average speed being dependent of the traffic flow and road design as well as the speed to which a vehicle is limited. The report also concluded that the average speed at which a vehicle travelled would have little effect on safety as it is not a vehicle's average speed that causes problems but the 5-10% of vehicles which drive the fastest.

The number of speed violations fell sharply with the use of ISA and drivers returning to non-regulated vehicles were found to be less likely to exceed the speed limit. The percentage of drivers exceeding the speed limit increased again after a short period of time.

The widespread trials in Umea found there was a slight noticeable drop in the average speeds and the number of vehicles travelling above the 85th percentile taken from traffic speeds in the area before ISA, showing that even the introduction of 10% of the vehicles having the system leads to a drop in speed.

The findings of the active accelerator pedal in Lund were that there was an initial decrease of speeds – possibly due to the driver not being used to the resistance force – followed by an increase in speeds as the driver became more familiar with the counterforce applied by the brake. This increase between the short term and long term use of the system was only between 5 and 50% of the initial decrease, meaning that long term use did lead to a reduction in mean vehicle speeds on different types of roads. The largest reductions in speeds were found on the faster 70mph and 50mph roads.

The effects on driving at intersections during the Lund trials were studied by recording an average speed profile of vehicles approaching them. For crossroads and roundabouts the maximum speed during approach was reduced by 5% but there was no reduction of minimum speed. For T-junctions a different trend was found with a 5% reduction to the minimum speed and a slight reduction in maximum speed.

The turning speed was also studied for the Lund and Borlänge trials. It was found that ISA had no bearing on the speed at which these manoeuvres were performed.

Previous small-scale trials had found that distances between vehicles increased with the use of ISA and this was one of the areas investigated in the Umea trials. It was found that there was no overall difference to the time gap between the vehicle with ISA and the vehicle it was following. To further test the hypothesis a trial was conducted in Lund where both standard and ISA equipped vehicles followed a route 33km long, it was again not possible to detect a difference between the two sets of vehicles.

A driver's awareness of pedestrians was also studied. Selecting six intersections in Umea where pedestrians were judged to be at a high risk of being involved in an accident, the number of conflicts between pedestrians and cars was monitored. It was found that the number of serious conflicts fell by 54%, if ISA was fitted to a higher percentage of vehicles.

The overall accident statistics were examined as part of the Umea trial although this does not necessarily mean that casualty numbers would fall by this amount. The fall in casualties was minimal over the year, however, when judged against a national increase of 7% the trial was concluded to have improved road safety.

A large user survey was conducted to asses driver's attitudes towards ISA, one area of this which needs drawing out of the report is that drivers felt that the ISA systems changed their workload and took their attention away from other important aspects of driving.

The survey found that there was no great change in a driver's perceived stress. However, drivers did feel more frustrated in general with a greater proportion stating that the active gas pedal increased frustration. A reason for this was that a greater proportion of drivers felt as if they were in the way of others – which in turn lead to the feeling that such a system would have to be implemented on all cars, otherwise the traffic flow would become disjointed.

Drivers also felt that they were being controlled and that their freedom had been reduced. A clear majority of drivers answered that they did not feel that ISA was distracting them from other matters although in Lund a slightly reduced number of drivers said that it was not the case.

A further bonus found with the use of active accelerator pedals was the reduction of environmentally harmful emissions such as HC, CO and NO_x groups. The relationship between speed and emissions is an important one.

A huge benefit of speed constraint is that it will reduce the environmental impact of motoring, and this aspect has yet to be explored in as much detail. Further analysis and discussion of the fuel savings for drivers and reduction in emissions may also increase the acceptability of ISA.

2.3.5 Introducing ISA and Possible Driver Acceptance

There have been several proposed deployment methods for ISA, it is important that as soon as the ISA trials in the UK have finished, the results are widely disseminated and implementation scenarios studied.

The Project for Research on Speed Adaptation Policies on European Roads published a report entitled Recommendations for Technical Implementation of ISA Functionalities[xiii], which identifies a large series of conclusions based on current research from across Europe, and also makes a series of recommendations about how to progress ISA rapidly.

RoSPA supports these recommendations and highlights the need for rapid progress to be made by all stakeholders, in order to ensure that this vital, life-saving, technology is helped to become commonplace.

It is urgent that drivers can make use of this technology as soon as possible, as ISA has a lot of potential to reduce the number, and severity of accidents. This requires a communication and introduction strategy. Once again ETP has a major part to play.

In addition, if ISA introduction is conducted at a European level, then it will be essential to address the different cultures and attitudes to speed across Europe through education measures, in an attempt to harmonise them.

An ideal point when the first ISA systems can be phased in would be when road user charging is introduced. The two technologies both rely on a satellite network to track a vehicles location and the road that it is on. Data about the speed of the road could be transferred to the car at the same time as data about the roads charging scheme. This point is highly important as it may bring about the benefits from ISA at an earlier date to it being introduced separately.

There are two general scenarios for implementation, either authority led or market led.

Market driven

In a market driven scenario, the emphasis would lie on car manufacturers to provide ISA as an option on new vehicles, and then on fleet managers and private car buyers to purchase the vehicles.

In a market driven scenario, there would be no incentives for buyers to equip ISA, other than the clear safety gains.

It is a fair assumption to consider the possibility that the initial introduction of ISA equipped vehicles would be slow – as, naturally, a commercial organisation would not expend the money to develop an item of technology without the proof that there would be consumers who would purchase it. This has meant that historically, many beneficial safety technologies have taken a long period of time to be equipped to all vehicles.

This type of scenario would also likely result in a greater initial take up of ISA systems which are designed to alert the driver or rider to the speed limit of the road rather than confine the driver to it.

In this scenario, an appropriate level of safety would be based solely on a societal judgement, rather than being led by a technical assessment of safety benefits. Clearly, continued education and publicity about the dangers of speeding would help bring social judgement on the risk of speed in line with the technical judgement, and would provide a more realistic focus for car buyers on the issue.

To further speed up this process of fitting, consumer organisations such as EuroNCAP could develop protocols and offer points to reward manufacturers who fit ISA.

In order to increase consumer demand, it is important that the advantages of ISA as a way if reducing the risk of driving to employees is put forward to businesses, and fleet managers should be encouraged to purchase vehicles fitted with ISA. There is a lot that can be done in the MORR context for ISA.

The dangers with leaving the introduction of ISA down to purely market forces is the longer period of time that it would take for ISA to be fitted to all vehicles on the road, and the likelihood that the majority of vehicles would be fitted with an advisory system. Lives will be lost the longer it takes to equip all vehicles with ISA.

Authority driven

Under an authority driven scenario, there is a more proactive role played by bodies that can enable a quicker ISA take up rate. This role will generally be through either financial encouragement or legal punishment.

Government bodies would take the lead on ISA and can equip their vehicle fleets with it in order to lead by example. This fitment would also extend to public service vehicles that authorities are responsible for licensing, such as buses and taxis, and there is no reason why a licensing authority in the UK could not specify ISA as a licensing requirement.

A method of increasing ISA awareness during this stage and promoting it to both private and fleet buyers in an authority driven scenario is via lower insurance premiums. Speed already plays an influence on insurance premiums in two ways.

Firstly the ability for a vehicle to speed, and the severity of the likely damage, is taken into account when determining a vehicle's group rating. Insurance companies use a relationship between the top speed of a vehicle and both the risk of that vehicle being involved in an accident, and the level of damages paid.

If the top speed is limited to 70 (or indeed to the speed limit of the road), then it follows that ISA equipped vehicles may be a special case in qualifying for a lower group rating.

Secondly, the propensity for a driver to speed will also affect insurance costs as many insurance companies increase premiums for drivers who have speeding convictions.

Although the technology is relatively new and there may be a limited amount of data available on it for the insurance industry to analyse to determine its real world effects, the increased risks of speed is an old one problem and is already appreciated by insurance companies.

In order to help speed up the introduction of ISA, an evaluation would need to take place based around how ISA mitigates the serious and ever present risk of speed, and how this would affect the frequency and cost of potential claims.

The value of this process could be added to by reviewing current evidence about speed and ISA. This evaluation would need to be complete by the time the first commercially available ISA systems appear in order to be the most beneficial towards society as a whole.

Within an authority driven scenario, ISA can be used to help prevent crashes and injuries amongst high-risk groups of road users.

The risk that young drivers encounter on the roads due to inexperience is well documented, and inexperience with using speed can be dangerous.

It may also be a viable option for learner drivers to take their driving test in an ISA equipped car, and to then receive a licence to only drive an ISA equipped car following the test – much like how there is currently a separate licence for automatic transmission vehicles only. This may well occur with many different technologies as the level of automation available on vehicles increases and the skills required to use a vehicle also change.

Much like how alcolock programmes can now legally be made part of the rehabilitation process for convicted drink drivers, a mandatory ISA could be fitted in the vehicles of drivers who are convicted and banned from driving due to speed. The process is that the system will help the driver make a distinction between the acts of driving and the need for using excessive speeds.

One of the key points within an authority driven ISA implementation strategy would be that a date is set, after which users of an advisory ISA system switch over to a mandatory system.

Initial estimates suggest that the date when mandatory ISA is fitted and used in the whole of the European vehicle fleet would be around 2035, although this may clearly slip to a later date without strong political backing for ISA.

2.4 In Vehicle Information Systems

Modern vehicles can have many systems that give the driver information, whilst the concept of giving the driver information is clearly not new - as even early automobiles would have dials and gauges to inform the driver - what has changed recently to is the increase in the number of drivers using communication and navigation devices.

Early information systems gave necessary information about the state of the vehicle – speedometers and rev counter are systems designed to give the driver information. Some systems are designed as an entertainment function - in car radios, CD's and more lately MP3 players are examples of this.

Communication systems have also become available, and since the invention of mobile phones, drivers have had the ability to (illegally in the case of hand help phones) conduct phone conversations.

Driver assistance systems also communicate information to the driver, as do satellite navigation units and a wide range of in vehicle devices designed to help drivers with tasks.

This has lead to the question, what level of information can drivers receive whilst driving before it becomes a safety risk, and how can this risk be managed or reduced?

The UK ban on mobile phone laws is an example of how this has been done; research showed that mobile phone use whilst driving caused a significant distraction, and evidence became available that this risk was causing deaths and injuries on the road. The use of mobile phones presented an unnecessary risk, and a legal change to ban hand held mobile phones whilst driving was introduced.

Whilst it is certainly not suggested that all devices with the potential to distract should be banned (for example a well designed satellite navigation system may cause less excess workload than the driver trying to find and follow road signs), their inherent risk should be highlighted. This is especially the case with nomadic (portable) devices that can be fitted into the vehicle, as this can create the potential for the driver to receive many bits of information at the same time.

The current rise and use of in-vehicle information systems demonstrates a potential road safety risk that must be controlled by

- educational messages about their potential distraction,
- training to help drivers understand when and how to use systems safely and correctly
- better designed systems to reduce distraction
- consumer information designed to inform the purchaser about the comparative risk of systems
- appropriate enforcement measures where their use has created careless or dangerous driving or has been a factor in an accident.

In short, a well-designed system will give the driver the necessary information when he or she needs it, without attracting the driver's attention unintentionally. The type of tasks that a device triggers must also be considered, as different tasks will demand different levels of cognitive attention.

2.5 Vehicle Conspicuity

Vehicle conspicuity is an important issue; the theory goes that the sooner other road users see you, the more time they have to respond. It is not a replacement for safe driving however – a dangerously driven silver car will be just as dangerous as if the car is black. Advantages of conspicuity are lost if drivers do not make safe predictable choices.

Conspicuity in the future will be achieved by more methods than just visibility of vehicles and car-to-car communications and other methods of detecting the road users location will be employed in future.

2.5.1 Daytime Running Lights (DRL)

Daytime Running Lights (DRL) are a way of improving vehicle conspicuity in the daytime; they draw further attention to the vehicle from other drivers making observations.

A technical implementation of daytime running lights would be a bulb close to each headlight that are automatically illuminated by the ignition system. The bulbs are energy efficient and are of a lower intensity than full headlights, as they do not need to illuminate the road, their purpose is to be noticed by other road users. This reduces the environmental impact of having the lights permanently on.

Recent studies have shown that DRL would be highly effective in reducing the number of casualties on the roads. TNO conducted a meta-analysis based on 25 past studies of DRL, it was hoped that the wide range of methodologies analysed in the past studies, as well as the consistency of the results from them, would lead to a highly accurate figure. It concluded that the overall net reduction of accidents would be 5.9%.

The hypothesis that this reduction in accidents as a result of the use of DRL may be a novelty effect was also studied in the TNO report. It concluded that, although there were indications that this might be the case, the evidence is inconclusive.

There is major concern that the adoption of daytime running lights by all road users will diminish any advantages that are currently received by motorcyclists that use daytime running lights. This concern also extends to other road users whose conspicuity may suffer alongside a car using DRL, such as cyclists and pedestrians.

Current research by TNO[xiv] on the issue sums up the concerns stated by previous analysis into three categories, based on the hypothetical conclusions on how DRL will increase conspicuity.

1. The adverse effects of DRL due to higher conspicuity. This describes the concerns by motorcyclists that the adoption of DRL by all vehicles would lead to a reduction of a motorcycle's conspicuity. This is because as all road users become more conspicuous, motorcyclists – who are already less conspicuous than cars due to colour and shape – will become less conspicuous relative to that increase.

2. The adverse effect of DRL due to a consistent search feature. This is related more to the psychology by which drivers make observations rather than the conspicuity. When making observations, people tend to search for specific features rather than survey the entire scene, be it shape, colour or luminosity. By creating a specific feature on all vehicles that drivers can look for – such as DRL – it decreases the reliance on searching for other features, and thus the chance that a road user without DRL is spotted.

3. The adverse effects of DRL due to a feature for identification. This is again related to the psychology behind DRL, a driver making observations may notice a vehicle without DRL, but not identify it as a hazard due to it's lack of DRL.

The TNO report conducted experimentation to see if any of the three hypothesised effects manifested themselves in an experimental scenario. The tests were conducted on a variety of subjects who were asked to survey scenes of varying complexity in order to mimic a real life traffic scenario.

The conclusions of the experiment were that the conspicuity of other road users did not suffer, in terms of the time taken until their detection. The report concluded that although it is impossible to test every combination of possibilities and complexities on the road, if there was an overwhelming adverse effect upon the conspicuity of other road users then it would have shown up within the data under review.

This is a positive result, and should go someway to alleviate the concerns of motorcyclists. It shows that the increase in risk that DRL poses to motorcyclists is small and was un-measurable.

Although the risk posed will never proved to be zero, as there is always risk, by working with motorcyclist groups and representatives, a solution needs to be found whereby all road users would benefit from this technology, and are comfortable with the solution.

A viable solution to any concerns of the potential reduction in the effect of motorcycle DRL's could potentially be addressed by fitting cars with low intensity daytime running lights and for motorcyclists to use dipped headlights.

Certainly, the debate on DRL needs to be re-opened, and research specific to this country needs to guide it - as a potential 5.9% reduction in all accidents is a significant figure that should not be ignored.

2.5.2 Headlights

Vehicle lighting systems are set to improve into the future - the better the illumination, the more chance a driver has of spotting hazards and planning to avoid them.

Adaptive lighting system swill make the lit area more relevant to the environment that the vehicle is in as well as improving the quality of the illumination. When waiting at junctions, for example, the lights will illuminate the area to the side of the vehicle so that the driver can see if any pedestrians are waiting to cross, or when going around a corner the lights will angle themselves to illuminate the direction that the vehicle is heading, not the direction it is facing.

It is important that both discomfort and disability glare is taken into account, so as not to put other drivers at risk. There is such a thing as ‘too powerful’ where vehicle lighting is concerned.

Protocols such as PNCAP will help to standardise the areas lit by vehicle headlights and this information could be fed back to road engineering to standardise the location of road signs.

2.6 Tyres

With active safety systems that improve a vehicles stability becoming more common, the integrity of the contact between the vehicle and the road becomes more essential.

It is important that drivers frequently check their tyres for damage, the correct pressure, and tread wear. There are also design improvements that can be made to tyres to increase their safety in different circumstances.

2.6.1 Winter Tyres

Tyres can be designed specifically for use in the low temperatures that are commonly found in the winter. According to figures supplied by Continental, at 7° Celsius the rubber in the tyres starts to solidify and become harder, this decrease in flexibility means that the tyre becomes less able to grip the road surface.

The compound of winter tyres is designed to remain elastic in the cold weather, and provide better grip with the road surface. The result is of course, shorter stopping distances at low temperatures when compared to standard tyres in the same conditions.

Generally the concept behind winter tyres is good; however, there need to be more research performed which looks at the details. What is the effect on stopping distances over a range of temperatures? Do standard tyres give a better performance at higher temperatures? If so, what is the best advice to give to a driver when the temperature is fluctuating around 7°C over a period of time?

The ideal date and length of time when winter tyres should be fitted will vary dramatically across the UK due to the geographical and meteorological differences.

Further more, standards need to be set to ensure that all tyres branded as winter tyres give the same level of performance in the temperatures they are designed to be more effective in, and temperatures they are not.

2.6.2 Runflat Tyres

In conventional tyres, the pressurised air contained within the tyre supports the weight of the car. However, recently tyres have been developed which are able to support the weight of the car by themselves, for a short period of time. These are known as runflat tyres.

Runflat tyres can support the weight in several different ways; however, the most common approach taken by tyre manufacturers is to increase the thickness and strength of the tyres sidewall.

Whilst runflat tyres can support the vehicle and possibly prevent the severe consequences from a suddenly deflated tyre, they can suffer internal damage when deflated and should not be used at speeds or distances greater than the manufacturer recommends. The runflat capacity allows a driver to pick a safer and more secure place to deal with the deflated tyre although ideally, the tyre should be used in this uninflated state for as short a time and distance as possible.

Runflat tyres should not be retrofitted onto a vehicle that was not designed to use them. It is also important that runflat systems are also accompanied with a Tyre Pressure Monitoring System that will alert the driver if the tyre has deflated, and allow him or her to take appropriate and immediate action.

Tests to guarantee a minimum operational safety level need to be set, to assure that the tyre has adequate runflat capability. Markings on the tyre sidewall can indicate that the tyre has runflat capabilities and has passed these tests.

2.6.3 Tyre Pressure Monitoring Systems

Tyre Pressure Monitoring Systems are designed to give the driver feedback about the pressure in the tyres without the driver having to check the tyres himself.

There are several different types of system available, all of which work to a varying degree of accuracy. It is important that a driver is aware of the accuracy of a tyre pressure monitoring system before getting in the vehicle and using it. It is also still just as essential for drivers to check their tyres frequently as many systems cannot detect a slow equal deflation in all of the tyres.

2.7 Introducing New Active Safety Safely

The generation of active safety systems – such as ESC and BA – which are currently starting to become firmly established into the car market, are the last generation that society can afford to be so laissez-faire in introducing. The next generation of systems, which can start to take a degree of control away from the driver may have implications that have not yet been fully understood.

Just because a safety measure should theoretically reduce the number of accidents if used in an idealistic manner, the argument doesn't necessarily follow that this is what effect it will have on real world accident statistics.

Similarly, many of the systems that are currently marketed as driver comfort features and will evolve into advanced driver assistance systems, will also have an effect on driver's behaviour and have the potential to be misused. Technology cannot be pigeonholed in this manner as the effects that it has on comfort and safety are interrelated.

It seems a fair hypothesis that drivers will expect more from the system than it can provide, in some circumstances, which will increase the accident risk of vehicles. It is also a concern that systems which take a degree of control away from the driver will make the driver more reliant on the system and complacent. We can see from the accelerator pedal and use of speed that drivers, whether by accident or purpose, can misuse the tools given to them. Drivers who have both good and poor spatial awareness need to be supported by the technology, and it should help them make the correct decisions.

Another danger of increased risk of crash is known as 'driver underloading'. If a driver has less to do – one of the effects of automation – then they will be less able to respond when they are required to. Current automated systems still cannot detect when and where the errors of other drivers will occur, and it is left up to the driver to respond to these situations when they arise. If a driver is underloaded and less involved with the task of driving then they will be less alert to sudden changes in the road environment and less able to respond to them.

The consequences of slowly replacing the systems that a driver has control over with ones that a driver has to monitor needs to be looked at in depth before this type of system becomes common on vehicles. A recent study at Brunel University[xv] has highlighted the dangers of driver underloading, especially in novice drivers.

Systems that remove a driver's input from steering the vehicle, or controlling it's braking, will have a psychological effect and driver's may believe that they are not travelling at high speed. Attention must also be paid to the increase in automation resulting in the removal of indicators that a person is engaged in driving.

Priorities for vehicle safety need to be set, and this debate needs to include the road safety community as a whole, to find out how the introduction of technology can add value to road safety work. The introduction of active safety needs to be integrated with road safety initiatives.

An interesting case study can be made of ABS, as it is the only new active safety system that is now fitted on the majority of the vehicle fleet, and which had assessments of it's effectiveness prior to it's widespread introduction. It is possible that there is much to learn.

There has been a great deal of debate over the extent to which ABS has reduced accidents, and the actual effect that it has had compared to the predicted effect.

However, the engineering benefits of ABS are clear, it has almost certainly improved a vehicles ability to brake capably and achieve shorter breaking distances in the real world compared to the same vehicle without ABS. This can be proved on the test track.

Early ABS also highlights a case where drivers may have benefited from understanding the feedback that the drivers receive upon its use. It is likely that some users will feel the brake pedal vibrating or pulsing when ABS is activated.

This can be an unfamiliar and maybe uncomfortable experience for a driver, and many drivers may react to this experience by taking their foot off the brake pedal, but it is proof that the ABS is working. The correct course of action is to keep your foot hard on the brakes.

If theoretical estimates of accident reduction do not translate into actual accident reduction then there must be another effect that was not taken into account in the methodology of the predictions.

The effect could be chiefly explained in two ways; firstly that the driver changed their behaviour in a negative manner, or secondly if the driver didn't feel that the feedback received from the system was indicative of a safe action and therefore stopped using it. There may be measures that can be implemented to reduce these two effects and these must be an essential part of a strategy of implementing active safety features.

It is also highly important in vehicle safety policy to prioritise systems depending on their proven potential to reduce the number of accidents and injury.

It is important to remember that the benefits of each safety system cannot simply be added. Generally there are many factors which will cause an accident, and the prevention of one may mitigate the accident, for example, it is not hard imagine an injury in an accident which may have been prevented if either a seat belt reminder system, ISA, or ESC had been fitted to a vehicle.

However, some systems will have a greater sphere of influence and can make a contribution in a larger number of accidents and injuries, these are the systems which must be identified and supported by policy.

When introducing a mandatory technology, standards should be set which measure the performance of that technology, rather than the specification that a particular 'type' of technology is used.

We see this approach illustrated in the field of passive safety, where safety criterion for the protection of the occupant is set and it is left to the vehicle engineers how to achieve that level of protection. In this way innovation is allowed, but there also is a measurable outcome.

This is an especially pertinent point when considering Brake Assist - which may be made mandatory by the most recently proposed EC Pedestrian Protection Regulation - and ESC - in which a similar suggestion was made by the high level EC CARS21 report. Rather than specifying these technologies without a definition of what the technologies are, braking and stability performance standards could be set. If equally

good solutions to improve a vehicles braking and stability can be found without using Brake Assist and ESC then there is no logical reason why not to allow it.

It is important when setting minimum performance standards that they are relevant to the real world.

During the introduction of new technologies, research must be conducted into the length of the introduction process, and what the effects will be of having vehicles on the road both with and without the technology. New technology does take time to filter through the whole vehicle fleet and this process may introduce an accident risk during the crossover period. Ways of reducing this risk need to be looked at, including whether financial incentives could be used to encourage take up of new technology. This could either be done through the Government offering lower levels of taxation, based on the benefit of the technology to society, or insurance companies offering lower premiums based on the risk reduction seen from the technologies use.

Maintenance issues need to be looked at too. The MOT Test, which ensures the roadworthy conditions of the vehicle, could be used to check that the systems are maintained to standards. Recent and forthcoming improvements to the MOT test – such as Automated Test Lanes (ATL) – have sped up the process of conducting an MOT and will be much more commonplace by the time advanced driver assistance systems are introduced.

Evaluation of the technologies needs to take a prominent role in the introduction of active safety systems, much like it does in road safety initiatives to the point where many consider it as the ‘fourth E’ (alongside Education, Engineering and Enforcement), and it is essential that this is also how vehicle safety progresses into the future.

3 Human Machine Interface

One of the most important areas that research to concentrate on in the future is Human Machine Interface (HMI). Human Machine Interface is an important part of getting the best out of informative systems.

As vehicle technology becomes more advanced, it will interact with the driver in more ways. The ways that it interacts with the driver needs to be looked at in depth. User errors need to be studied to see how frequently they occur, and the consequences of misunderstanding or over relying on the system.

It is important that this does not add to the driver's workload and cause distraction in the vehicle, systems need to feed back information to the driver in a concise yet understandable manner. Systems that the driver interacts with need to be simple to use and always encourage the driver to maintain the primary task, which is to drive the car in a safe manner.

A good HMI system will prevent driver overloading, this is where a driver encounters a situation where there are too many things to respond to. This overloading can either be biomechanical or cognitive, and has been demonstrated to be a risk historically by mobile phones.

When using a mobile phone, it creates a significant cognitive distraction that is more than a driver can deal with. This increased attention to a conversation results in decreased attention to the road, and a similar effect will occur with all in vehicle systems which have not been designed to support the driver.

The use of nomadic devices that are not part of the vehicles overall controls may add to this as the feedback they give cannot be coordinated with the vehicle, especially if the HMI is poorly designed. The risks associated with in vehicle devices need to be assessed and managed.

One way of acclimatising drivers to the information that an HMI system gives them is by training, and training needs to be seen as a future tool to help drivers get the best out of active safety.

As different manufacturers develop more ADAS systems, different tactile, visual, and auditory communication methods with the drivers will be conceived. Standards urgently need to be set for active safety system HMI feedback so that drivers can confidently predict what their vehicle is telling them and how to respond appropriately in an emergency situation.

The driver should be able to make good decisions based on prior use of practically identical active safety systems in a different vehicle. Letting each car and information system manufacturer develop their own protocols is akin to changing the pedal layout between car models and expecting the driver to intuitively know what to do.

If a driver misinterprets what the vehicle is telling them, avoidable accidents will occur. This is why standards are needed.

The standards could be either qualitative, based on expert assessment and opinion, such as The European Statement of Principals on HMI (ESoP), or quantitative, such

as the regime being developed as part of the Human Machine Interface and the Safety of Traffic in Europe (HASTE) project.

The European Statement of Principals on HMI is a good tool for manufacturers to use to ensure that the design of an IVIS is not overly distracting, and that the information that it gives a driver is predictable and manageable. It contains a number of design goals that give a good framework to make a judgment on the safety of a system and its HMI.

The ESoP on HMI also contains design goals for the accompanying manual. It is important that the manual is clear and concise, and gives the driver necessary information. The manual essentially acts as the training course on the IVIS use, in lieu of seeking further driver training with the system.

The ESoP does not contain pass/fail criterion however, and it depends on the judgement of an expert in HMI. This creates an element of subjectivity in any certification process.

Empirical data is a much better tool to assess a systems safety because it can then be compared against a benchmark level of safety. This is where RoSPA believes the assessment of HMI must head in the future.

Empirical tests that assess the effect that the amount and predictability of information has on driving safety could also form the basis of a consumer information program.

4 The Future of Passive Safety

In the field of passive safety there are still large injury prevention gains to be made, and RoSPA believes that it should not be discounted as a tool to further reduce road casualties. The improvements in passive safety over the last 10 years has been shown to reduce casualty numbers and it would be error to assume that there is little more that can be done in this field, or that the evolution of passive safety has reached a plateau.

Despite advances in active safety, a good plan to prevent accident and injury prevention plan does not stop at the first level of countermeasures on the assumption that they will work. It is important that all occupants in the vehicle are offered a high degree of protection in addition to any prevention technology.

Much of the technology and theory for improving the safety of car occupants in a crash is understood, although the further development and refining of both will improve tests and protocols. Evaluation of databases like CCIS will identify new injury trends and highlight issues that crash safety will need to address in future.

There is also great potential for passive safety measures to be combined with active safety measures that gather information about the vehicle's surroundings.

In terms of crashworthiness, vehicles are designed to perform well in series of specific front, side, and pedestrian crash tests. A good performance in these tests will result in a safer car in the real world, although every crash is different, and the passive safety systems on a vehicle would not be optimised for most of the circumstances in which a crash occurs.

Studies have shown that there is a relatively long period between a collision becoming unavoidable, and actually occurring. This time period could be used gather information to prime the vehicles restraint systems, and for an on board computer to decide how to best protect an occupant. In a way, the vehicle will 'react' to the collision.

Examples of this area of 'pre impact' protection may be a vehicle deciding which airbags to fire and how rapidly to fire them, or even adjusting it's suspension and height to achieve a better geometric compatibility with a vehicle that it is striking.

4.1 Pedestrian Protection

Pedestrian protection is an urgent issue that manufacturers need to address. The majority of vehicles on the road today could be improved upon vastly and it is important that there is a strong encouragement for manufacturers to work towards this aim.

Background

On 17th December 2003, Directive 2003/102/EC relating to the protection of pedestrians and other vulnerable road users before, and in the event of, a collision was introduced to amend Directive 70/156/EEC.

Its aim was to increase the protection of pedestrians by implementing phase 1 of a set of tests based upon those specified by EEVC WG10 & 17, although with lessened performance criterion. All new vehicles will have to pass phase 1 of these pedestrian tests by 1st October 2005 and all new registrations of existing models by 2012.

As part of this Directive, a feasibility test was also conducted to evaluate to what length manufacturers would be able to comply with the full test criterion defined by the EEVC. If a strong argument were put forward proving that manufacturers would not be able to design vehicles to comply, then active safety systems would be evaluated to assess whether they would be able to make up the difference in estimated casualty savings as a result of relaxing the tests recommended by EEVC WG 17. TRL conducted the feasibility study and suggested a relaxed set of testing standards that were judged to be feasible for the industry.

After negotiation with industry, the EU proposed a regulation which would incorporate all the present requirements of phase 1 and revised requirements for phase II based on the feasibility study. The main proposals of the draft Regulation are summarised as:

a) a first phase set of test requirements (phase I) will apply to all new types of vehicles as from 1st October 2005 and to all new vehicles placed on the market after 31 December 2012
b) a second phase of tests (phase II), based on the results of the comprehensive study carried out into the feasibility of the original requirements, will apply to all new types of vehicles from 1st September 2010 and to all new vehicles by 2015
c) the active safety system, brake assist, will be required in all new vehicles as from 1 July 2008
d) the use of new systems, such as collision avoidance, will be recognised as alternatives.

The two ways to encourage manufacturers to dedicate more resources towards the protection are through consumer demand and setting high crash test standards that are relevant to the real world.

The setting of relevant crash test standards is important, and it is disappointing that a negotiated agreement will involve a level of active safety, which reflects a level of assumed accident avoidance rather injury mitigation.

RoSPA's detailed comments throughout the EU consultation on pedestrian protection can be found at:
http://www.rospa.com/roadsafety/consultations/2005/pedestrian_protection.pdf
http://www.rospa.com/roadsafety/consultations/2004/pedestrian_protection.pdf
http://www.rospa.com/roadsafety/consultations/2001/pedestrian_protection.pdf

The setting of active safety standards to specify an actual figure of casualty reduction is an interesting precedent, since the figure will be affected in future by external forces, such as any reduction in accident rates due to other road safety initiatives. This is especially true in countries where there is much road safety improvement to be had in order to achieve the same safety records of Sweden, The UK, and The Netherlands.

With the draft Regulation in its current state, further work now needs to look at the effectiveness of the pedestrian protection Regulation in the future, as it has raised as many issues as it has addressed.

a) How will it be confirmed that the relaxed protection offered by the bonnet will attain the casualty reductions predicted?

   HIC is not a linear scale, and testing to a HIC of 1700 (A HIC of 1000 and above is generally assumed to be unsurvivable in other tests) may not result in any significant predictable casualty reductions.

b) Of the tests that were omitted from legislation, what monitoring will take place?

   How will the results of these tests be evaluated? What will be done to ensure that the results of these tests will not, and do not, progressively worsen?

c) Can the results of the monitoring be made public or made available for scrutiny by an independent research organisation?

   Is there further scope for developing and expanding upon the amount of consumer feedback to help drive forward the technology, in lieu of high test standards?

d) How will the effectiveness of the different manufacturers braking systems be ensured?

   A vehicle's overall braking deceleration also depends upon the vehicle design. Simply by having an active safety system, it does not necessarily mean that the vehicle will be able to stop in a certain distance from a certain speed. This is a dangerous assumption to make in legislation designed to save lives.

Improving the consumer knowledge of the pedestrian protection scores is an important issue, and ways of spreading consumer knowledge is discussed in the section 5.2. Pedestrian protection is important and it is hoped that manufacturers will start to make more reference to it in advertising literature now that some have achieved the maximum EuroNCAP rating of four stars.

4.2 Compatibility

Vehicle to vehicle compatibility will be a larger area to address in the future. The main thrust of vehicle crash testing currently has been to show the cars that meet best practice and there are situations in the real world where the car may not perform as well in protecting the occupant.

In crash testing, the collision partner is known during the design of the vehicle (e.g. an offset barrier). In the real world, collision partners will vary dramatically in width, height of impact, mass, and stiffness.

Compatibility is a way of addressing some of these differences by ensuring that in vehicle-to-vehicle collision, cars can prevent occupant injury from a range of collision partners.

Compatibility is highlighted as an issue here to ensure a holistic overview of the future of passive safety, although it is an issue to be addressed by mainly engineering methods.

4.3 Head Restraints & Whiplash

Whiplash describes the motion by which a neck injury can be caused, the quick movement of the head relative to the shoulders puts the neck under strain that it would not usually encounter. Although the mechanism by which injury occurs is known, the exact nature of the injury is not.

Injuries caused by whiplash (hereafter collectively referred to as Whiplash Associated Disorders – or WADs) is only coded a 'slight' injury in STATS 19 due to the relatively small amount of damage to the neck which is physically caused, this does not fully describe the impact that it can have on someone's quality of life.

The insurance industry state that over 80% of personal injury claims arising from motor vehicle accidents are WADs, and report that this totals around 250000 injuries per year. The vast majority of these injuries are not long term and do not result in an undue period of suffering, however, some cases have also been know to last permanently.

The majority of WADs occur when a vehicle has been struck from the rear, and this means that head restraints can be used as a counter measure in order to reduce both the likelihood and severity of an injury. A well-adjusted and well-designed head restraint can limit the movement of the neck and support the head for a longer period in an accident.

There is consumer information about how to adjust a head restraint, and how to find a well designed head restraint on the RoSPA website.

http://www.rospa.com/roadsafety/advice/motorvehicles/adjust_head_restraint.htm
http://www.rospa.com/roadsafety/advice/motorvehicles/safer_head_restraints.htm

Thatcham have been conducting tests on vehicle seats in the UK to see how well they are designed to prevent WADs, and claims evidence has shown that several types of seat design and an improvement in head restraints will reduce the risk of whiplash.

Once an appropriate injury criterion and dummy are decided on then it is imperative that minimum standards of seat performance to reduce WAD should be set in European Directives or Regulations. Ideally, the tests will occur at a range of speed to prevent designs which are only optimised for the test speed, and also mitigate chance that changes to seat backs to prevent WAD will create an injury risk to another section of the spine.

Although WAD occurs in rear impacts, they also are caused by impacts from other angles and these are also issues that need to be addressed in future.

Resources may help those who have suffered a WAD and prevent the longevity of such injuries. A good example is The Whiplash Book[xvi], which is published by The Stationary Office.

4.4 Child Car Seats

Child car seats are a large concern for the section of the road safety community who work in ETP, although a child seat itself is essentially an engineering measure designed to decrease the risk of injury to children in vehicles. This is an area that is a very good example in which ETP and Engineering have worked together – the engineering measure provides a potential improvement in safety and ETP ensures that the correct use and usage rates are improved.

There is clear concern from the public and from experts that inappropriate restraint use and misfitted restraints would lead to a preventable injury, which is why we have seen this integrated approach.

It is important that this work continues in the future, although the mandatory use of child restraints is now legislated, there is still a need to ensure that parents purchase a seat suitable for the vehicle and know how to fit it correctly. RoSPA remains concerned that the vast number of child restraints in use are incorrectly fitted.

4.4.1 Child Car Seat Testing

Currently, there is a European standard for child car seats, which approves child seats for use in forward and rearward facing vehicle seats. The standard is ECE R44, and the current revisions are ECE R44.03 and ECE R44.04. It is illegal to sell child restraints that do not meet this standard, and from March 2008, it will be illegal to use child car seats that do not also meet this standard.

The standard covers many areas but generally relates to the crashworthiness of the seat and the testing methodology. Other issues are also covered, such as the quality of the instructions that the seat is supplied with.

ECE R44 goes some way to controlling aspects of usability between different seats – for example by standardising things such as the harness release button. The standard does not cover the ease of a seats use.

EuroNCAP also release star ratings for in car child safety. These ratings are a measure of the combined performance of both the vehicle and the restraint recommended by the car manufacturers. A good star rating in this could be neither used to prove that every child restraint is safe in the back of that vehicle, nor that the child restraint is safe in every vehicle.

What the EuroNCAP ratings do achieve is they put emphasis on the vehicle manufacturer to design cars that can provide child safety in the rear. How best to design the vehicle to offer protection in the tests can then be considered in the design phase.

Research has shown that booster seats with side wings can reduce the risk of injury to children in a side impact, as they help to contain the head and prevent it from hitting an intruding vehicle of the interior of the car.

None of the standards systematically cover is the protection that a child seat offers in side impact, although occasional consumer testing has rightly raised the issue. It is important that child seats are designed to protect children in real world crashes, which can result in serious or fatal injury.

RoSPA are frequently contacted by parents who wish to find out which child seats offer the most protection for their children in a crash. The main point is that the safest seat is one which is fitted to the manufacturers instructions, meaning that it will be safe and secure in the vehicle – with very little or no movement forward and side to side – and will also be designed for the child's weight and height. This is the most important point.

However, parents may have many options available to them or need guidance about which child seats they should try to fit into their car first, the assumption that expense equals safety is not one which should be made.

There are many different consumer ratings systems available for parents to refer too. Many consumer groups carry out tests that have been good for giving guidance and raising specific issues to parents, for example, tests by Which? have previously highlighted the dangers of carrycots for younger children. However, the assessment methods used differ, and this can lead to the same restraint having different ratings in different programmes.

A comprehensive European wide testing regime similar to EuroNCAP, which consists of a scientific based procedure whereby seats were rated for usability and dynamic performance to give a rating would be highly beneficial for consumers and encourage people towards buying safer seats.

4.4.2 Future Child Seat Design

There are several issues which need to be examined in future to improve the safety of children in cars.

More attention needs to be paid to the potential dangers of interaction between child car seats and side airbags. Laboratory tests have shown that there may be cause for concern, although this has never been backed up by real world data.

Systems such as ISOFix will almost certainly lead to a reduction in the number of misfitted child seats, as their method of attachment is much more intuitive. The fact that all new vehicles now have ISOFix points will increase the number of ISOFix seats being used.

Work needs to be done towards standardising the ISOFix system, as it is still the case that not every ISOFix seat will work in different cars.

There are also two main ways of preventing rotation around the point where the seat clips in – either by a top tether or foot at the base of the seat – and it is important that parents know how to use both of these devices and which one is needed for the seat that they are using.

It is also important that vehicle manufacturers themselves start to think about how to offer more protection to children in a 'family' car. Although it is accepted that it may be virtually impossible to provide a suitable integrated restraint for children under 3, due to the large anthropometrical and physiological differences between small children and adults, there is much more which can be achieved.

There are now one or two models of vehicle available that combine integrated booster systems into the back seats of the car.

It is important that any system in a vehicle that is intended for children is tested to and has passed the appropriate UN ECE standard to ensure that it can offer a known and appropriately safe level of protection.

4.5 Other Future Passive Safety Issues

Passive safety is a relatively mature field although as in all sciences, today's state of the art model is tomorrows sweeping assumption.

A better understanding of the mechanisms of how human injury occurs can be used to improve and crash testing program and passive safety systems, and also to further review and quantify their effectiveness. This understanding can also be used to refine and develop the injury criterion, which are used to set the experimentally measurable targets that dummies pass or fail in tests.

Improved dummy bio-fidelity will also help testing become more comparable to the real world.

A report was conducted by Loughborough University entitled 'Review of Secondary Safety Priorities - Looking at where best to direct future resources'. This looked at not only the injuries that occurred most frequently, but also how costly they were. By focussing on these two areas, key areas for action that would bring the most benefit could be determined.

More work is also needed to protect older car occupants, who are more prone to injury in crashes. The reason behind this is that as people get older, the structure of the bone changes and the trabeculae that give it strength start to thin out, and the bone becomes less resistant to impact.

Not only is this a concern when an elderly occupant would be unfortunate enough to hit the inside of a car, but the magnitude and way that the forces from a restraint system (such as a seatbelt or airbag) are distributed over an occupant.

In future we may see vehicles designed and marketed for elderly drivers, with the restraint systems optimised for the elderly consumer.

Adaptive restraints will also have a role to play here, and occupant vulnerability and brittleness of the bones are variables that can be taken into account before deciding how to best to restrain an occupant. Early efforts have been made towards designing techniques that measure occupants bone strength.

Most legislative and crash test procedures test vehicles with a 50th percentile male dummy; in future legislative or consumer tests could deal with the 5th percentile female dummy and 95th percentile male dummy so that restraint systems are optimised for a range of occupants.

Computerised simulations and virtual testing may be a cost effective way of seeing how a restraint system would protect a range of occupants, although it would be almost impossible to use computerised simulations as a basis for legislation.

5 Tertiary Safety: The Post Crash Car

A future e-Safety concept looks at what role the vehicle and its technology can play post crash to reduce the number of deaths on the road, the first positive involvement that vehicle technology will play in tertiary safety.

Before, during, and after the crash, information is recorded using technology within the vehicle. Systems such as in car-cameras, biomedical sensors, and radar and camera units equipped the exterior of the vehicle would all record information which could be used by the emergency services. This data would be stored aboard a black box, and is a positive argument for them to be fitted to vehicles in future.

If information about the crash and nature of injuries sustained can be fed back quickly to the emergency services pre-arrival at the scene of the crash, then it is likely that the consequences of the injuries suffered can be reduced.

The first way that a system will prove to be a boon is by automatically contacting the emergency services post crash, alerting them in a quicker time frame than current ad hoc methods.

This could be especially useful in cases where there are multiple occupants in the vehicle and would give the emergency services quantifiable information about which occupants are in greater need of medical attention.

Emergency services could be informed of the make and model of vehicles before arriving at the scene of a collision. If they also had access to a database of a vehicles safety features, and best methods of extracting an occupant (which differs between vehicle and accident depending on which airbags have deployed and high strength structural reinforcement – such as boron rods) then the speed at which emergency services could assess the scene would be improved.

It is high priority that the cataloguing of safety technologies on different vehicles for the use of emergency services should take place.

The system would also raise the possibility of creating a verbal link between the emergency services and the occupants of the crashed vehicle, creating an earlier interaction between the vehicle occupants and the emergency services that could be a useful way of delivering primary first aid, or at least psychological support.

5.1 Event Data Recorders

Event Data Recorders (EDR) is the description given to any device that records vehicle and occupant details over a period of time. In a road safety context, they have potential to increase the knowledge and understanding about the period of events leading up to, and during a crash.

This gives great potential to gather consistent and accurate data for analysis in many areas of road and vehicle safety.

- Factors that contributed and caused an accident can be studied in order to help prioritise education, training, and publicity focus.
- Data about the vehicle dynamics can help manufacturers identify situations in which vehicles are not performing as well as expected or where a minor improvement in, say stability or braking, might bring a large accident reduction.
- The data may also help road engineers determine what environmental circumstances contributed to the accident.
- Provide data in situations where there has not been a collision, but where the circumstances could have caused one. This will aid the study of future active safety systems.
- The data could also be used to bring improvements in occupant protection systems, and give greater understanding of injury mechanisms and tolerances in order to develop injury criterion further.
- Validate the effectiveness of crash test programs, and help to influence their future direction based on the nature and severity of commonplace real world crashes.
- Post accident the data can be used to help emergency services understand the nature of the crash and therefore help them plan before they arrive on the scene, and the data will also be able to feed into accident reconstruction.

Clearly every discipline within road safety will benefit from a more accurate and comprehensive dataset, however, there are some issues that will have to be resolved before data is put to wider use – for example with privacy and ownership of the data.

In order for the data to be useful and improve analysis, there will need to be a consensus achieved over the variables that are collected, and the frequency at which they are recorded.

There is potential for EDR to be used to collect information on the frequency of near misses; these are an important indicator of a driver's risk of being involved in an actual collision. Health and safety has used reporting of near misses in order to demonstrate potential hazards in absence of injury accidents over the last few decades, and the analysis technique developed is known as Heinrich's triangle.

There may be ways in which employers, for example, would be able to assess the risks to their drivers by monitoring near misses, and help the employers reduce that risk by providing suitable training.

If parameters could be defined for near misses so that their frequency can be recorded on an EDR, then this may give a good tool for identifying high-risk drivers.

As well as recording driver's behaviours and making this information available for analysis post crash, EDR may have an influence on reducing the number of accidents that occur in the first instance. Drivers who are aware that they are observed may want to avoid the risk of negative feedback about their performance and modify their behaviour to perform safer over a short period after EDR are introduced.

Event data recorders have a good deal of potential to improve safety in the future, and it is important that legal issues of data ownership, possible ways to use the data effectively, and standards for data collected are set. The privacy of the individual also needs to be considered as part of the debate about data ownership.

Potentially, the widespread use of EDR will result in a large amount of data, which would need handling and storing.

Early consideration and debate of these issues will help the introduction of a beneficial and standardised system in the future.

6 Consumer Information

As more and more safety systems become present on vehicles, it becomes more and more important that consumers are helped to purchase safer vehicles. In order to do this, informed choices need to be supported and a culture of vehicle aware buyers needs to be fostered.

The current spread and consumer take up of active safety is similar to the early days of passive safety, where manufacturers would advertise individual safety technologies but with no holistic presentation of the field as a whole. Passive safety disseminated through the market place quicker once a benchmark was set to identify good practice.

It could therefore be argued that passive safety didn't take off as a consumer issue until a system was developed that defined its absence rather than its presence.

The best way to encourage the spread of Active Safety systems is to set benchmark tests and protocols, much like the protocols which have been developed as part of the PNCAP program – as many areas of a vehicles dynamic performance can be compared and rated.

EuroNCAP has already made points available for Seat Belt Reminder (SBR) systems and it seems logical to continue to do this for active safety systems with a proven benefit.

It is also important to develop protocols that develop good practice in other quantifiable areas of vehicle technology, for example, in order to develop guidelines for safer In Vehicle Information Systems (IVIS). Ratings can then be introduced to influence consumers purchasing choices and remove the number of IVIS and ADAS systems that have a higher risk of distracting the driver.

Information about vehicles systems is of course something that shouldn't just be made available for the purchasers of new cars. There is a clear and urgent need to ensure that purchasers of second hand vehicles also receive the correct information about the safety systems on board a vehicle, this could be a difficult risk to manage – especially in cases where a car is sold privately.

Drivers purchasing second hand vehicles need to reduce their accident risk when using them, and the only practical way of doing this is to encourage drivers to receive refresher training in the vehicle, or on a vehicle with the same systems, as soon as possible. Training will help drivers deal with new technology in a safer way and learn the appropriate skills required quicker.

The issue of a driver not being familiar with a vehicle also arises when hiring cars for occasional use.

6.1 Consumer Information in 2006

There are several sources of information available to the consumer currently, although each concentrates on a specific area of vehicle safety and uses different processes to feed back the information, this may of course be confusing and time consuming to a buyer who wants to take safety into account.

A more holistic overview could be presented to the consumer, with information and advice about what the ratings actually mean in real terms. This will also help consumers prioritise between different technologies and purchase cars based upon what the vehicle will be used for.

The most notable source of consumer information in recent years has been The European New Car Assessment Programme. Under the programme, cars are crash tested to see how well they offer occupant protection at speeds higher than vehicles are required to provide for legally. The better the protection the more points they are awarded. This ultimately leads to a vehicle being awarded a separate star rating for adult occupant protection, child occupant protection, and the protection that a vehicle could potentially offer to a struck pedestrian.

The EuroNCAP results are readily available at http://www.euroncap.com.

The protection that a vehicle offers against whiplash is not tested as part of the EuroNCAP program. Internationally, the insurance industry has developed protocols to comparatively assess seats and consumers can find information about how well vehicles perform at http://www.thatcham.org/ncwr/

Child car seats are an important item and it is important that a holistic ratings system is developed and publicised. Currently there are several schemes that are produced on a yearly or occasional basis and reports are available from Which? and the AA Trust.

EuroNCAP also looks at child safety although this puts the impetus on the car manufacturer to design a safe child restraint and vehicle combined system rather than rating individual restraints, and it should not be assumed that a child restraint that performs well in one vehicle would perform well in another.

There is currently a need for better promoted and balanced consumer information in all areas of active safety.

6.2 What More Can Help the Car Buyer In The Future?

Fundamentally, no matter what safety systems manufacturers' offer, consumers need to be told about their availability and exactly how effective a system could be in order to save their lives.

Consumer knowledge is hindered by the scattered approach to the introduction of safety systems. A prime example is the introduction of ESC, which, as previously discussed, has at least 9 different acronyms for what is essentially the same system. This seems highly counter productive to the issue of consumer education.

With the number of ADAS set to increase into the future, RoSPA can envisage this problem escalating, leaving consumers confused by what vehicles have and haven't got. Consumer knowledge is key to the purchasing rates, and the safe use of active safety systems.

It would be highly useful for all manufacturers to work together to specify standard names for ADAS. The enhanced public knowledge would commercially be more advantageous for a manufacturer than having a separate name for a system in order to market it as a unique selling point.

It would also help drivers understand what equipment is fitted to a hire car, or pool car that is infrequently driven, preventing mistakes and accidents that are down to the driver not understanding what is fitted to the car.

As an initial attempt to help consumers in this area, RoSPA has produced and will maintain an A-Z list of vehicle safety Jargon, which can be found on line at http://www.rospa.com/roadsafety/vehiclesafety/index.htm. This will be added to when more systems become available.

More can be done to push safety up the car buyer's concerns. Interestingly, a recent study by EuroNCAP looked at how consumers believe that safety is important when buying a vehicle. Work such as this is key to understanding how consumers make car buying choices and what can influence these choices.

In the survey, 83% of respondents thought that the protection of drivers and front seat occupants was important. The percentage of respondents who felt that the protection of rear seat passengers and child occupants was important was slightly lower, at 71% and 70% respectively. Finally 61% of respondents thought that the protection of child pedestrians was important, and 56% said the same for adult pedestrians.

The comparison between the percentages of people who think that safety is important, and the percentage of people who actually look for safety information is interesting and concerning. Only 47% of people look for safety information when they are buying a new car. This seems to indicate a group of consumers who are either, concerned about safety but do not know where to find this information, or who post rationalise their buying decision based on information discovered at a later date.

The best way to influence this group, may be to present them with the necessary information about vehicle safety at the point of sale, and a recent survey by Bosch found that 100% of British consumers thought that the dealer/manufacturer should supply information about safety systems.

It is true that the only time when the majority of the population have interaction with vehicle safety messages is when they are buying a new vehicle. The salesman, whom the consumer sees as a representative of the vehicle manufacturer, will deliver those safety messages. It is therefore important to ensure that these safety messages are both useful and correct.

Another method of ensuring that consumers receive safety information would be to increase the amount of printed safety information at the point of sale. A similar scheme already runs in the UK to inform consumers about the fuel economy and CO_2 emissions[xvii] of cars, at the point of purchase. This is a voluntary agreement by car manufacturers following discussion with environmental groups.

Some car manufacturers already do focus on safety within advertising, however, it could be argued that consistency across all car manufacturers would raise consumer awareness and help to highlight manufacturers who are behind the industry average, as well as those who are ahead of it.

The requirement to label passenger cars with their NCAP star ratings has been introduced in the United States, and from September 2007, vehicles will have to display this information on the price sticker[xviii].

Further consumer support could also be gleamed from analysis of real world data. Folksam, who are a large insurance company in Sweden, runs such a scheme. Consumers can download a brochure entitled “How Safe Is Your Car”[xix] which gives the relative safety of each vehicle in a crash.

The Department for Transport has also published it’s own studies entitled Cars: make and model: the risk of driver injury. There are two available, the first one published gave information about vehicles between 1996-2000[xx], the second one looked at 2000-2004[xxi]. These evaluate the risk of driver injury if the vehicle is involved in an accident, it does not give any indication of the risk of being involved in an accident in the first place.

There could be some interesting conclusions that can be drawn from comparing safety of the vehicles in the reports with the predicted safety of the vehicles in the EuroNCAP star ratings. A further detailed study could be conducted in this area.

The data used in the DfT reports are old, as it does take time to collect enough information to be statistically significant, and many newer, and safer models of vehicles become available before it is published. Whilst it is a useful tool in comparing the safety of vehicles between 1996 and 2000, it cannot be used to compare vehicles from this period with modern vehicles.

It can take time to collect enough data to be statistically significant. If data was gathered from across Europe then this time scale could be dramatically reduced, and this could be a superb use for the PENDANT[xxii] which is looking at combining and standardising accident collection procedures across Europe and will finally create a single European accident database that could be analysed.

It could be also argued that two vehicle safety ratings may confuse a car buyer, no matter how much the two correlate and support each other.

However, real life accident studies could be a useful support to the EuroNCAP crash tests that provide a benchmark, and point towards which manufacturers lead the way in good practice, rather than how a vehicle will respond in all real world accidents.

An updated version of Cars: make and model: the risk of driver injury could provide further consumer information.

Research should be conducted which evaluates schemes such as EuroNCAP, to find out how consumers are receiving the messages and how the results of vehicle testing can be better promoted. EuroNCAP is essentially as much of an ETP project as much as it is an engineering project, and there are many lessons to be learnt for the future from this side of the program.

There is little doubt that EuroNCAP has been instrumental in rapidly driving forward safety, but this has been through the two processes. Firstly through increasing the competitiveness between car manufacturers to provide a better level of safety; and secondly through an increased consumer pressure on manufacturers. The significance of, and interaction between, the two effects needs to be studied

7 Conclusions

Vehicle technology can improve the transport system in many ways, but specifically in the context of this paper, it has the potential to reduce the number of accidents on the roads.

There are a vast number of new technologies available on new vehicles or top of the range vehicles that will become more common in future, there are also many more technologies being researched. All of which are designed to alert, assist, or take control from, the driver, and all respond to different dangers at different intervals before an accident occurs.

It is important that the most beneficial of these technologies are identified at an early stage and emphasis is put on introducing them as early as possible. This emphasis must consist of; ensuring that resources are dedicated towards developing the technology and validating it's safety effects, promoting the safety benefits of the technology to the public in the wider context of road safety, and ensuring early take up of the technology where possible.

The success of this emphasis is dependant upon developing vehicle safety policy as much as it is the engineering aspects of vehicle safety. A policy framework that identifies how and to what extent technology will play a part in meeting targets in the larger road safety strategy – and indeed national transport strategy – needs to be in place.

All stakeholders need to take a proactive approach to the inclusion of vehicle technology in road safety, and indeed health and safety, policies. It is important that road safety policies and strategies develop with technology.

We have recently seen an example of how early versions of 'priority' technology can support road safety enforcement and education activities. The Road Safety Act allows courts to use alcholocks as part of the sentence following a drink-drive conviction.

Pro-active fleet managers who are looking to reduce the risk to their employees as part of a strategy to manage occupational road risk within an organisations health and safety arrangements are also well placed to advocate emerging technology.

Another main point that this policy should highlight is that the safe use of vehicle technology is dependant on the one key interaction – that between the human and the technology.

It is important that this is addressed from both sides – by ensuring that the controls are intuitive for drivers, and that the drivers are properly trained in the use of new vehicle technology.

The issue of making sure that drivers receive appropriate training for the use on in-vehicle equipment is crucial, as the use of some of the new equipment will require fundamentally different skills to the ones currently learnt by drivers during the driving test. It is important that drivers are encouraged to attend refresher courses and courses suitably designed to help prepare a driver for the new ways of interacting with vehicles, and that businesses address this requirement for their employees to learn new skills.

In the long term, there must be an emphasis on how to use these new technologies safely within the driving test. Ensuring that the driver has the appropriate training for the equipment will also be important when hiring cars, and indeed when cars are bought and sold second hand.

In future, these training issues will be more fundamental to the usability, and indeed benefits of vehicle technology. Up until recently, vehicle safety technology has required no great amount of interaction from the driver. Passive safety where the greatest benefit has been gained works to prevent driver injury, with only the requirement that a driver buckles the seat belt. Braking and stability systems assist driver's actions and limit the consequences of driver error by magnifying the effectiveness of the drivers manoeuvre, a driver in a vehicle with ESC should still respond to a hazard in the same way whether it is fitted or not.

Cars are changing, and in order to get the best out of any new technology, we all need to understand how.

8. Recommendations

From the policy document, a number of key recommendations have been made.

8.1 Implementation

1. It is also highly important in vehicle safety policy to prioritise systems depending on their proven potential to reduce the number of accidents and injury.

2. If a system could have a potential impact on vehicle safety (whether it is termed a safety system or a comfort system) then this needs to be assessed before it is introduced widely into the vehicle fleet.

3. Emphasis is firmly on the manufacturers to ensure that adequate warnings are given about potential misuse to the detriment of safety of any product they supply.

4. A policy framework that identifies how and to what extent technology will play a part in meeting targets in the larger road safety strategy – and indeed national transport strategy – needs to be in place.

8.2 Education/Training/Publicity

5. Education and training issues need to be addressed when introducing new active safety, driver assist, and driver comfort systems, to ensure that safety benefits are not lost due to drivers adapting their behaviour.

6. Where the benefits of a safety system are proven, publicity may help increase its take up.

7. The importance of consumer information should be stressed and evaluated so that a consensus on the best way of getting the information to the consumer is achieved.

8. Ensuring that drivers understand how to use ADAS when the technology reaches the second hand market is an important step towards ensuring that the equipment is properly used.

9. The education and publicity side of EuroNCAP should not be overlooked, as evaluations and research of it's effectiveness may help disseminate the information better in future, and also aid similar consumer organisations who wish to inform the public about comparative tests.

10. Similarly, any future changes to the testing star ratings released by EuroNCAP need to be carefully considered from the consumer's point of view, to ensure that confidence in the program is not undermined.

11. Consumer information ratings need to extend to, areas of active safety such as IVIS, and other areas of passive safety such as child car seats.

12. Further education of safety systems to traders and vehicle sales staff will help to improve the amount and quality of safety information that people consider when buying new vehicles. This will also help shift the emphasis of car buyers to the most salient points when purchasing new vehicles.

8.3 Engineering

13. The issue of HMI is overarching to the whole issue of active safety and ensuring that technology is designed so as not to overload the driver with information.

14. Standards need to be reached about how in-vehicle technology interacts with the driver. Without standards then similar signals could be used in different vehicles to indicate different risks. Standards need to be augmented with driver training.

15. The dangers of driver underloading need to be considered, and is a vital part for any road map which considers the future implementation of active safety.

16. Passive Safety needs to remain high on the agenda, there is still much to be done to improve current understanding of biomechanics and crash test protocols.

17. A test to help reduce the number of injuries resulting from whiplash needs to be introduced when there is expert consensus.

18. The maintenance of in vehicle technology needs to be considered, and the MOT test is the most appropriate point to ensure that systems do not fail throughout the vehicles life span.

8.4 Specific Technologies

19. The potential benefits of ESC have been proven and encouragement needs to ensure that the public are aware of it, and how to get the best out of it.

20. Event Data Recorders (EDR) could play a vital part in helping set future vehicle engineering and vehicle safety policy agendas. It would be highly beneficial to have them fitted as original equipment on all vehicles as soon as possible.

21. Day Time Running Lights (DRL) may have a positive safety impact but there is very little scientifically derived evidence in this country, this needs to be conducted before the issues explored in depth. Any potential increased risk to vulnerable road users needs to be taken into account.

22. Pedestrian Protection must be stressed as an area issue for future improvements to vehicle design.

23. The Regulation for Pedestrian Protection needs to be clarified and rapidly implemented.

8.5 ISA

24. The potential casualty savings for ISA are great and this technology should be supported.

25. One of the largest tasks that need to be completed before ISA is introduced is the completion of a digital roadmap of the UK with speed limit information.

26. The potential of ISA as a tool to help businesses manage occupational road risk needs to be stressed. Organisations who wish to control the risk to their employees using the roads should ensure that their vehicle fleet is equipped with ISA when it becomes available.

27. The insurance industry needs to discuss the implications that ISA will have on group ratings and insurance premiums, along side other stakeholders such as road safety and research organisations. The results of real world trials will hopefully underpin and provide the evidence base upon which these discussions occur.

28. The road safety focus needs to remain on the problem of speed to help change drivers attitudes. This will help increase the acceptance of ISA.

29. The options of introducing ISA need to be explored, as well as the roles of each stakeholder in encouraging its take up. The benefits of a Market Driven or Authority Driven implementation scenario for the UK should be reviewed to find the best route forward.

30. How ISA can be implemented and what steps can be made towards it need to be considered when road user charging schemes are introduced in the UK. The two technologies are similar and both use satellites to monitor the position of the car and the road it is travelling on.

8.6 Emergency and Rescue

31. Emergency services should be helped in rescuing occupants from the vehicle by having access to information about the nature of the crash, and the safety systems of the specific vehicle involved to help with the efficient rescue of occupants, prior to arrival on the scene.

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